2009

Formalizing Theory Development in IS Design Science Research: Learning from Qualitative Research

Bill Kuechler
University of Nevada, kuechler@unr.edu

Eun Hee Park
Georgia State University, epark@cis.gsu.edu

Vijay Vaishnavi
Georgia State University, vvaishnavi@cis.gsu.edu

Formalizing Theory Development in IS Design Science Research: Learning from Qualitative Research

Bill Kuechler
Accounting and Information Systems
University of Nevada
kuechler@unr.edu

Eun Hee Park
Computer Information Systems
Georgia State University
epark@cis.gsu.edu

Vijay Vaishnavi
Computer Information Systems
Georgia State University
vvaishnavi@cis.gsu.edu

ABSTRACT

The parallels between design science research and various types of qualitative research as well as the synergies between the two research paradigms have been pointed out in many recent design science research in IS (DSRIS) papers. Commonly, for example, a qualitative research method, action research, has been used or proposed for validation of a DSRIS artifact. Building on insights into the similarities of the two methodologies, we have surveyed the qualitative research literature in search of techniques from that area that could be applicable to theory construction and refinement in DSRIS. We have found four techniques widely used in theory construction in qualitative research that are immediately applicable to DSRIS, thus leveraging the work in an older discipline for the benefit of DSRIS. In addition we explicate the similarity between qualitative research and DSRIS in a more detailed manner than has been done previously.

Keywords

Design science research, theory construction and refinement, qualitative research, research model, interdisciplinary research.

INTRODUCTION

While interest in and the practice of Design Science Research in Information Systems (DSRIS) has grown to the point where it is considered "an equal companion to behavioral research in the Information Systems field," (March and Storey 2008) it is still a relatively young research paradigm. The relationship of DSRIS to *theory* continues to evolve as it matures. Kuechler and Vaishnavi (2008) make a strong case for the capability of DSRIS to develop and refine a broad spectrum of theory – fundamental or "kernel" theory and mid-range theory as well as design theory. We agree with this position and in this paper we explore theory development techniques applicable to all levels of theory from an older field, qualitative research, and develop their applicability to DSRIS.

Areas of commonality between DSRIS and qualitative research (QR) techniques have been suggested in a number of recent DSRIS papers (Goldkuhl 2004; Jarvinen 2007). Frequently action research or other qualitative methods are proposed as means of validating the artifacts produced by DSRIS. However, qualitative research in general has deeper similarities to DSRIS including: seeking situated understanding, ongoing developmental analysis of data *throughout* the research effort, and an emphasis on inductive, iterative discovery. It was these similarities, especially the epistemological and axiological similarities between DSRIS and many QR methods and the interest of both investigative areas in mid-range theory (Merton 1957; Merton 1968) [1] that led us to suspect that the techniques used for theory development in QR might be applicable to theory development in DSRIS.

[1] Merton (1957) coined the term 'middle-range theory', and defined as it as follows (1968): "Middle-range theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory. . ."

A Brief Overview of Theory Development in DSRIS

The most basic purpose of design science research is to create a novel and useful artifact and an accompanying descriptive design theory (Hevner et al. 2004). However, much information of substantial value to both practitioners and future researchers is lost if not codified in additional theoretical formulations (Gregor 2006). In design science research, the theory development process could start with a kernel theory which could guide the direction of the subsequent theory development process and which could be iteratively refined through mid-range theorizing. Alternatively, the process could begin with an open-ended research design (no kernel theory) and then proceed to collection of data, analysis of the data, shaping hypotheses and preliminary mid-range theories based on gathered data, and later testing those against literature. Figure 1 illustrates the General Design Cycle frequently used to illustrate the most general structure of DSRIS. As shown, theory building can take place in or across any of the phases in the cycle.

Research Questions

In this study we have tried to identify the qualitative research theory development techniques which are most readily applicable to theory development in IS design science research. Our specific research questions are:

- What kinds of theory development techniques from qualitative research could support rigorous mid-range theory development process in design science research?
- Exactly how would such techniques map to the normative process of design science research?

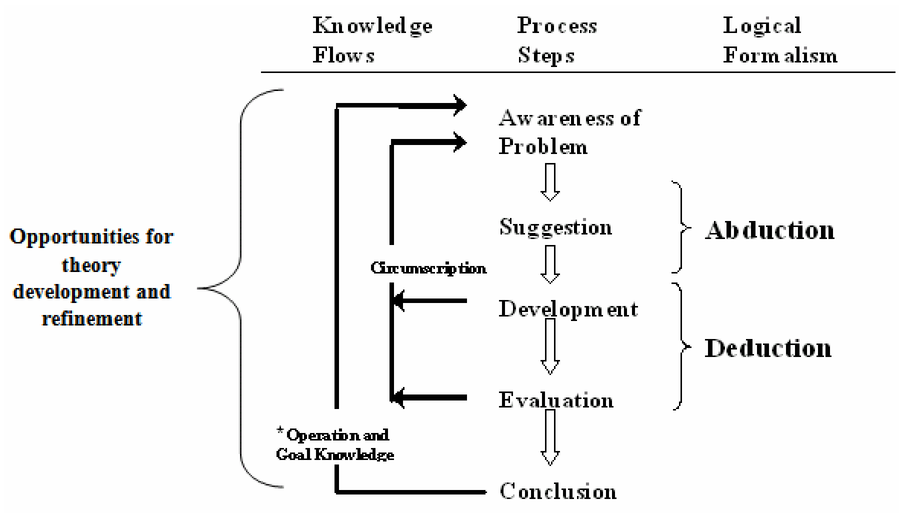

Figure 1. Reasoning in the Design Research Cycle
(from Kuechler and Kuechler, 2008 as adapted from Takeda, et al., 1990)

*An operational principle can be defined as "any technique or frame of reference about a class of artifacts or its characteristics that facilitates creation, manipulation and modification of artifactual forms." (Purao, 2002; Dasgupta, 1996).

Research Method and Structure of the Paper

After identifying a set of theory generation techniques from a survey of the qualitative research literature concerned specifically with theory development, we expand the usage and relevance of each technique to design science research. Next, the study demonstrates through a usage model how the techniques identified can improve theory development and refinement for future design science research endeavors. To partially evaluate the model, a published design science research exemplar is parsed to demonstrate the implicit use of the QR derived theory development techniques.

LITERATURE REVIEW

Theory in Qualitative and Design Research

Qualitative research and design science research have many similarities, which motivate the current research.

- Both identify the importance of substantive theory and formal theory (mid-range theories), but still seek to be generalizable to cross-settings (Glaser and Strauss 1967; Willis 2007; Kuechler and Vaishnavi 2008).
- Both have an interest in inductively discovering significant regularity emerging from data (Patton 2002).
- Both focus on understanding a given setting, rather than just relying on speculation on the setting (Denzin and Lincoln 1994).
- Both require that researchers shape a model or hypotheses about what is happening in the given setting (Denzin and Lincoln 1994).
- Both designs need ongoing and developmental analyses of data (Denzin and Lincoln 1994).
- Both can adopt a flexible research design (Patton 2002; Ritchie and Lewis 2003).

Historically, many qualitative research studies are descriptive and exploratory. Thus, they investigate complex circumstances that are unexplored in the literature and explicitly show relationships between events and the meaning these relationships have. Another trend of qualitative research studies has been more driven by goal, action, advocacy or empowerment (Patton 1990). Theories generated from such studies could represent an attempt to develop 'explanation' about reality, or an attempt to build 'prescription' about issues. Either of these theory development motivations from qualitative research resonates with design science research which is also concerned with goal driven (sometimes atheoretical) exploration.

In the theory development process in qualitative research, theories can either guide the entire research process or may emerge from it. Thus, theory development in qualitative research could be carried by two research approaches (see Figures 2a and 2b): the inductive approach, and the mixed approach. In the *inductive approach*, inductive analysis starts with open-ended observations (Patton 1990) and builds categories, themes and patterns from data (Denzin and Lincoln 1994). It is also called the 'research-before-theory model' (Bruce 2000).

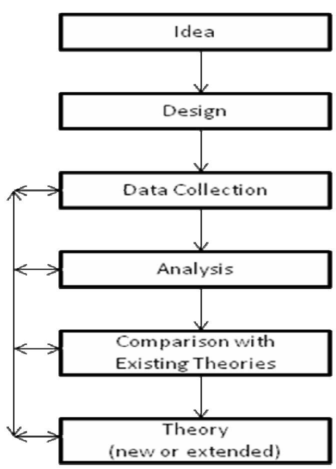

Figure 2a. Inductive Approach

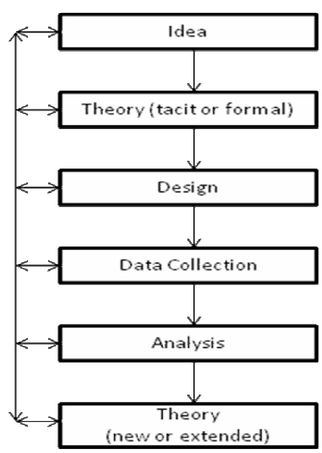

Figure 2b. Mixed Approach (Deductive and Inductive)

In the *mixed approach*, according to Marshall and Rossman (1995), tacit theory (one's personal understanding) and formal theory (from a literature review) guide hypotheses and subsequent data collection and analysis process. The mixed approach integrates both the research-before-theory and theory-before-research models (Bruce 2000). It begins by setting up hypotheses from a literature review in deductive way, but later inductively reexamines theoretical assumptions and iteratively refines those until reaching a saturation[2] point.

[2] Qualitative research literature frequently refers to the 'saturation' of data analysis – a somewhat subjective notion that indicates that the data has been thoroughly considered through all the lenses known to the researcher and analysis has reached the point of diminishing returns.

Since the theory development process in design science research can start with or without kernel theories, both approaches in qualitative research (see Figures 2a and 2b) could prove useful for design science research. Moreover, it is apparent from a comparison of the QR theory building research approaches illustrated in Figures 2a and 2b with the general DSRIS cycle of Figure 1 that the *process* of design research is compatible with either approach. Not only are both the DSRIS cycle and the QR approaches inherently iterative, but also the activities and their sequencing are very similar. In the following section, four widely accepted theory development techniques from qualitative research which can be employed for both inductive and mixed theory development approaches in DSRIS are presented.

Four QR Theory Development Techniques

The formal statement of how research findings generalize to broader populations is one of several functional definitions of theory construction. In the consideration of generalization, 'validity' is a critical element and can support the quality or sustainability of research findings (Ritchie and Lewis 2003). Some writers believe the notion of validity in qualitative research is on a different epistemological basis than for natural science research. Validity in qualitative research can be broadly interpreted: for example, as 'truth,' - "is the explanation credible? (Denzin and Lincoln 1994)," or as 'well-grounded (Ritchie and Lewis 2003),' - "the extent to which an account accurately represents the social phenomena to which it refers (Silverman 2000, p174)." The artifacts developed in DSRIS share with social research a strong emphasis on situatedness – applicability in a specific environment. Further, DSRIS generates relatively small sample sets (frequently 1) for assessment and thus its notions of validity are more similar to QR with its in-depth explorations of a limited number of situations than to much positivist research with its reliance on statistical techniques to assess the meaning of far larger samples of data.

According to Ritchie and Lewis (2003), *comparative analysis* across two or more cases could increase the internal validation (checking accuracy of fit internally) on findings. For external validation (verifying findings externally), the technique of *triangulation* – the use of multiple methods of assessment – can improve the clarity of research findings even though the findings have limitations with respect to representing the full population (Silverman 2000). Denzin (1970, p472) also mentions that "the greater triangulation, the greater the confidence in the observed findings." *Analytic induction* – the in-depth analysis of data, frequently without statistical or other mathematical analysis, in search of potentially general patterns – is yet a third method by which qualitative researchers or ethnographers try to formulate generalizations (external validation) that hold across all their data (Silverman 1985).

In Table 1 potential theory development techniques from QR and their specific uses in the theory building process are summarized.

In the following section, we provide a more extensive description of each of the techniques shown in Table 1 preparatory to indicating specifically how these techniques can enhance theory construction and refinement in the specific context of DSRIS.

Triangulation

Denzin extended the original concept of convergent validation in a multi-method context (Campbell 1956; Campbell and Fiske 1959) to include multiple dimensions of triangulation (Denzin 1978, p295).

- *Data triangulation*: the use of a variety of data sources in a study with multiple sampling strategies. There are three subtypes of data triangulation: time, space, and person. Person analysis is related to three elements: aggregation, interactivity, and collectivity. Data triangulation provides multiple ways to test a theory and thus increases the possibility to detect negative cases (Denzin 1970).
- *Investigator triangulation*: the use of several different researchers or evaluators. Through investigator triangulation, researchers can test the reliability quickly and judge observation bias.
- *Theoretical triangulation*: the use of multiple perspectives to interpret a single set of data.
- *Methodological triangulation*: the use of multiple methods to study a single problem. Within-method (e.g. an investigator employs varieties of the same method) and between-method can be used.
- *Interdisciplinary triangulation*: Janesick (1994) adds the fifth type to the list. It promotes "out of the box" thinking to reach beyond the dominant assumptions of a single discipline.

The qualitative research literature has multiple successful examples of research employing multiple triangulation combinations with multiple data types, observers, theories, methods, and disciplines in the same investigation (Patton 2002).

Theory Development Techniques	Description	Used For	References
Triangulation	- Data triangulation: the use of a variety of data sources - Investigator triangulation: the use of several different researchers or evaluators - Theoretical triangulation: the use of multiple theoretical perspectives - Methodological triangulation: the use of multiple methods - Interdisciplinary triangulation: the use of multiple outside disciplines.	External Validation	Denzin 1970, 1978; Janesick 1994; Burns 1999; Silverman 2000; Patton 2002; Ritchie & Lewis 2003
Comparative Analysis	It uses theoretical sampling, explicit coding and analytic procedures. The process involves with comparing incidents applicable to each category, integrating categories and their properties, delimiting a theory, and finally writing a theory.	Internal Validation	Glaser & Strauss 1967; Silverman 1985; Strauss & Corbin 1990; Ritchie & Lewis 2003
Analytic Induction	It involves with exhaustive examination of cases to find regularities in real world. The process starts with setting up an explanatory hypotheses and a provisional definition. Then the hypothesis is compared with facts and is modified by iterative procedure.	External Validation	Znaniecki 1934; Robinson 1951; Glaser & Strauss 1967; Denzin 1970; Ritchie & Lewis 2003
Developmental Process	It indicates iterative research cycle for data collection, data analysis, and hypothesis testing until reaching a saturation point. It can provide a procedural ground, in which the other three techniques can function to develop a theory.	Procedural Grounding	Susman & Evered 1978; Miles & Huberman 1994; Patton 2002

Table 1. QR Theory Development Techniques with Potential for DSRIS

Comparative Analysis

The concept of 'comparative analysis' originates from the general method, 'the logic of comparison,' developed by sociologists (e.g. Weber, Durkheim, Mannheim) (Glaser and Strauss 1967). Generally comparative analysis involves theory-based sampling, explicit coding of the samples and analytic procedures. Glaser and Strauss describe the four steps of the comparative method (p.105): first, comparing incidents applicable to each category; second, integrating categories and their properties; third, delimiting the theory; fourth, writing the theory. This process is continuously conducted until the analysis reaches a saturation point. Glaser and Strauss also demonstrate the use of comparative analysis for assuring accurate evidence, empirical generalization, specifying a concept, verifying theory, generating theory, and testing theory.

Comparative analysis is closely related to triangulation and iterative developmental process in the generation of theory because the analysis is associated with developing hypotheses and evaluating them by constant comparison across multiple times, spaces, and persons (Ritchie and Lewis 2003).

Analytic Induction

According to Znaniecki (1934), analytic induction involves finding regularities in physical and social worlds. It is a method of "exhaustive examination of cases in order to prove universal, causal generalizations (Patton 2002, p493)." Denzin (1970) called the process 'the development of processual theories'. The analytic induction process starts with an explanatory hypothesis and a provisional definition of something to be explained. The hypothesis is then compared with facts, and it is modified by an iterative procedure. Through this process, fact, observation, concept, and proposition are interwoven together and a theory is formulated and modified until no negative cases appear (Robinson 1951).

The clear difference between analytic induction and comparative analysis is that analytic induction focuses on provisional testing of hypotheses against all data or negative cases, but comparative analysis focuses on generating and suggesting categories, properties, and hypotheses about the general problems and is completed at the saturation of data, rather than by proof of inclusion within the provisional theory of all available data. The methods are complementary to each other (Glaser and Strauss 1967).

Developmental Process

According to Miles and Huberman (1994), "unlike survey and experimental research, qualitative studies tend to have a peculiar life cycle, one that spreads collection and analysis through out a study… (p. 431)" and thus "the more one investigates, the more layers of the setting one discovers." Under the iterative research process, the analytic induction approach "corresponds to the 'grounded theory' approach, which itself shares important features with other approaches to interim analysis (generative analysis, constructive analysis, 'illuminative' analysis) (p. 431)." Practitioners of DSRIS will immediately recognize the similarity between the above description of QR and the iterative discovery process of DSRIS.

In addition, during the iterative process, constant comparative analysis leads to the creation of 'developmental' theory. "Whether the theory itself is static or developmental, its generation, by this method and by theoretical sampling, is continually in process (Glaser and Strauss 1967, p114)." Once again, a discussion originating in the QR literature is immediately applicable to DSRIS.

Mapping Qualitative Research Theory Development Techniques to IS Design Science Research

In this section we use DSRIS literature to show that the qualitative research theory building techniques detailed above logically accord with the practice of design science research. In some instances foundational DSRIS papers allude to these techniques but call them by different names or only implicate their use. Other papers describe DSRIS projects that have used the techniques either explicitly or by other names as part of the specific DSRIS process used in that project. Both types of paper demonstrate the conceptual and practical utility of QR theory building techniques in DSRIS.

A number of published IS research efforts have included a rigorous theory development process even though they did not explicitly use theory development terminology from QR (e.g., Nunamaker et al. 1991; Baskerville and Wood-Harper 1996; Goldkuhl 2004). More specifically, design science literature has implicitly or explicitly highlighted the importance of the theory development techniques identified in the current study (see Figure 3): triangulation, comparative analysis, analytic induction, and developmental process. The compatibility of these techniques with the philosophy and process of DSRIS is indicated below.

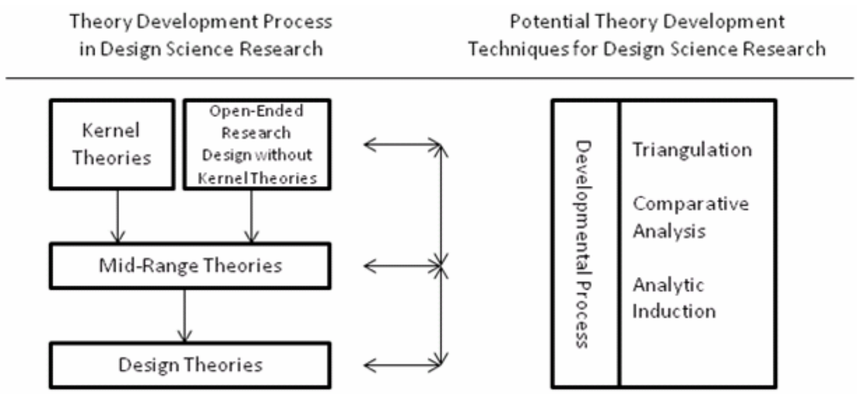

Figure 3. Potential Theory Development Techniques in Design Science Research

Triangulation

Nunamaker et al. (1991), in a seminal DSRIS paper, presented an integrated multi-dimensional and multi-methodological approach composed of theory building, system development, observation, and experimentation for generating useful and relevant IS research results. Thus, the authors implicitly indicate the significance of both theory and the use of triangulation in theory building.

Developmental Process

Figure 4 represents the outputs of design science research. As advised by the QR theory building literature Figure 4 illustrates the potential for both mid-range and higher level theorizing during each iteration of research within a single case study (Vaishnavi and Kuechler 2008). From Merton's discussion (1968) on mid-range theory development, the outcome in the bottom oval of Figure 4 is close enough to the observed data gathered from a situated context to allow possible mid-range theory development, and the outcomes in the upper ovals are more abstract and amenable to generation or refinement of higher level of "grand" theories. The developmental process in design science research has the potential to generate or refine theory at multiple levels of abstraction through multiple iterations of the design cycle (Figure 1).

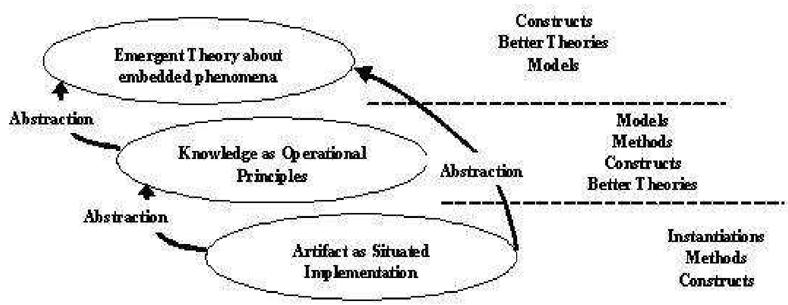

Figure 4. Outputs of Design Science (from Vaishnavi and Kuechler 2008)

Analytic Induction

In analytic induction, formulating a hypothetical explanation of the phenomenon is critical to the direction of the research (e.g., Robinson 1951). Developing hypotheses can be done by either the inductive approach or the mixed approach (Patton 2002). In the mixed approach, a researcher starts to shape literature-derived hypotheses, test them, and then inductively revises them to fit to specific contexts (Marshall and Rossman 1995; Bruce 2000). This approach can be applied to design science research procedure in which kernel theories provide explanations and theoretical grounding for artifact and thus guide design theory development.

The inductive approach could also support the design theory development process when, for example, finding theoretical support from the existing literature is difficult, or researchers want to focus on novelty emerging from data and thus begin with specific observations and build testable hypotheses later – the purely inductive approach.

Comparative Analysis

Comparative analysis can provide a rigorous theory development procedure in design science research in conjunction with qualitative research methodologies such as action research and grounded theory. The grounded theory approach can bring rigorous comparative analysis into theory development process (Glaser and Strauss 1967; Strauss and Corbin 1990). Action research could provide a developmental, procedural ground on which the comparative analysis can be conducted (Susman and Evered 1978). Many recent DSRIS papers indicate that action research can have a good fit with design science research (e.g., Jarvinen 2007; Johnstone and Venable 2008) by providing deep understanding of a complicated context. Moreover, it can support the development of models and theories since action research can provide a cyclical process linking theory and practice (Baskerville and Wood-Harper 1996).

A Model for Theory Development in DSRIS

In the prior section of the paper we have explicated four specific techniques that are widely used in QR for theory development and refinement and have shown that they are procedurally, logically and epistemologically congruent with DSRIS. The following discussion integrates these findings into a usage model for the techniques within DSRIS. Figure 5 illustrates the model which is integrally related to Figure 1, an illustration of the process and logic flows in DSRIS. Holding both figures in mind (it may be helpful to visualize Figure 1 'overlaying' either of the 'Iterative Development Process' arrows of Figure 5) we point out first the inherently iterative nature of triangulation, comparative analysis and analytic induction as used in QR and DSRIS. In both forms of research the same techniques are repeatedly applied during different iterations through the discovery (QR) or design (DSRIS) cycle. Note that 'iterative developmental process' as explicated in the QR literature, is itself an integral part of many forms of both QR and DSRIS. It can now be seen as a technique for theory development and refinement as well as for artifact development in DSRIS.

We next propose that three other techniques, triangulation, comparative analysis and analytic induction, are applicable to multiple *individual* phases of the DSRIS cycle of Figure 1. Note that not all techniques are required; the techniques are applicable both individually and in combination. Theoretical triangulation and comparative analysis can readily be seen as applicable to the **Awareness of Problem** and **Suggestion** phases during which different approaches to a problem, both atheoretical and theoretical, are surveyed; in **Awareness of Problem** the survey yields different aspects of a large problem; in

Suggestion different approaches to a partial solution or approaches to analogous problems are synthesized into a novel, possible approach. Moreover, the same three techniques can be seen as useful – and in the DSRIS literature can be observed as being actually *used* – in the **Evaluation** phase.

Finally, we propose that the same three techniques are also applicable to *complete individual passes* through the DSRIS cycle. This is illustrated by the 'Between-Cases' section of Figure 5. Especially in the case of an open-ended (intuitively or practice guided) DSRIS effort, the results of each pass through the design cycle serve as the analogue of a 'case' in some types of QR. In ISDR the iterative method can generate new data and insights on each pass, against which triangulation, comparative analysis and analytic induction can be used to excellent effect.

The demonstration of precisely which techniques might be useful at exactly which points in the DSRIS cycle of Figure 1 has not been exhaustively developed; the research described in this paper is still in its preliminary stages. What is novel and immediately useful in this presentation is the identification these techniques, commonly used in the QR literature, as *means of theory development and refinement in DSRIS*.

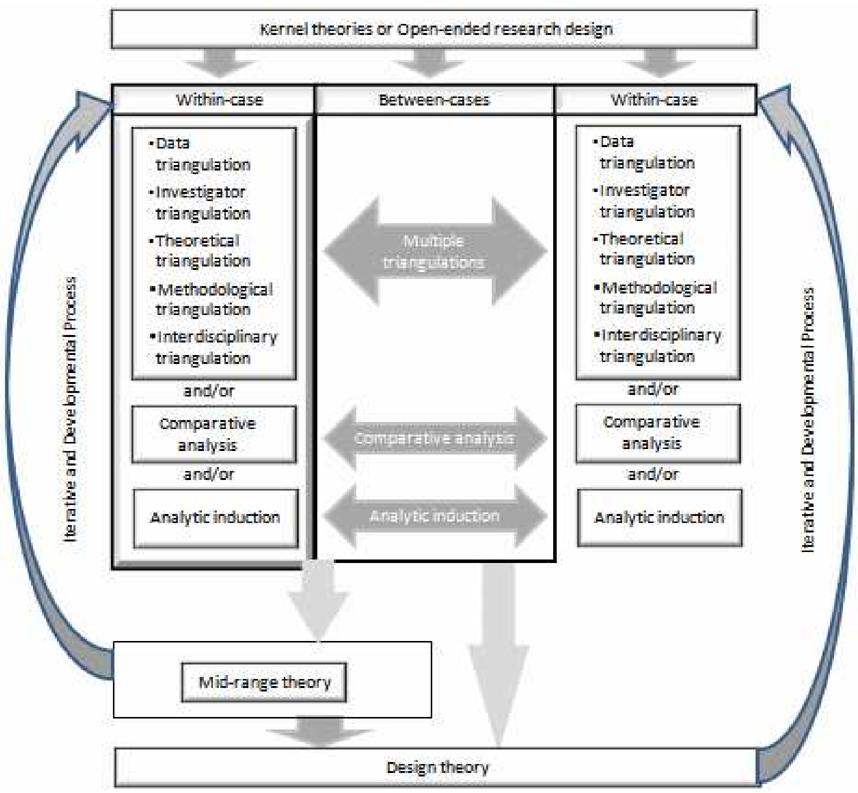

Figure 5. A Model of Theory Development in DSRIS

EVALUATION

In this section, we demonstrate how the QR theory techniques discussed in the prior section have actually been implicitly or explicitly applied in a published example of a DSRIS research project, partially validating our usage model. Although the capacity of those techniques for theory development and refinement was not always fully utilized in this research project, we point out how this could easily have been done. Note that the paper chosen uses or proposes for future work all of the techniques described previously.

An Example of QR Theory Development Techniques in DSRIS

The research problem identified in the Adomavicius et al. (2008) study is that firms often fail to conduct IT landscape analysis to inform information technology investment decisions due to the numerous available technologies and the complex set of relationships. To address the issue, the study developed an IT ecosystem model by defining a new set of constructs and methodologies which can reduce the complexity of the IT landscape for practitioners and thereby support IT investment decision. The authors brought theoretical backgrounds from technology evaluation and IT innovation theories and developed a proposed model through a process theory approach.

Triangulation: The study used multiple triangulation strategies to provide trustworthiness to the proposed model. The authors developed a proposed model based on their observation and *theoretical triangulation* (e.g., drawing from the IT innovation and technology evaluation literature). Also they used *methodological triangulation* to evaluate the proposed artifacts by conducting both a qualitative case study on digital music technologies and a quantitative case study on wireless networking technologies. Moreover, they employed a *data triangulation* strategy by interviewing multiple participants from four different populations.

Comparative Analysis: The authors used a rigorous comparative analysis method for providing improved 'empirical generalization' by coding technologies into roles and constantly comparing the codes to determine patterns of technology evolution change given roles and paths of influence. Also the authors sought 'accurate evidence' through a comparison of the qualitative example of digital music with the quantitative example of wireless networking technologies. In so doing, the authors found that "different patterns of technological change can occur in different ecosystems (p. 796)." Finally, in order to verify the proposed model, the authors compared other common technology forecasting techniques with their model by reviewing the literature and thus illustrated how their approach compliments such techniques (p. 802).

Analytic Induction: The study specified a propositional model based on kernel theories. Analytic induction was conducted through a mixed theory development approach (see Figure 2b) which began by setting up a hypothetical model and then inductively evaluating the model. The analytic induction procedure in the study is as follows:

1. The authors identified the research problems and the definition of the problem was formulated.
2. Based on kernel theories and their observations, the authors built a hypothetical model.
3. To evaluate the feasibility of the model, the author used multiple means: first, they conducted both qualitative and quantitative research; second, they conducted interview with four sets of participants; third, they carried out comparative analysis between both other technology forecasting techniques and their approach.
4. The outcome of the multiple evaluations showed that the proposed model approach could make a contribution in the targeted setting. Also new implications appeared from the interviews.
5. The research stopped at this point. However, the authors plan future research based on new implications: a combined action research and design science research effort to refine and to extend their IT ecosystem model through iterative problem-solving process.

In this study, the analytic induction technique is nicely fused with multiple triangulations, and comparative analysis theory development techniques, providing external validation to strengthen generalizations of the study.

Developmental Process: Even though the authors did not conduct iterative developmental research in the current study, they identified the significance of continuous refinement and extension through the iterative developmental process. In the study, the authors found significant potential and applicability for the suggested IT ecosystem model. Also they generated additional implications from the interviewing process that they planned to research in future using a developmental process.

In summary, the authors validated their model externally and achieved increased clarity of the proposed model through multiple *triangulations*. *Comparative analysis* helped the authors to find the different patterns of technological change and to check the accuracy of their model. *Analytic induction* enabled the authors to test their hypothesized model and thus formulate a generalizable model.

CONCLUSION

This research has presented a set of mid-range theory development techniques taken from qualitative research, *triangulation*, *analytic induction*, *iterative developmental process*, and *comparative analysis* that are readily applicable to DSRIS. We explained these techniques as presented in the QR literature in detail and demonstrated that they are compatible with the process and core concepts of DSRIS. To partially validate the usage model a published example of a DSRIS research project was parsed. It was demonstrated that the techniques used in the project included the theory development techniques of the usage model although described using a different terminology.

The implications of our research, especially at this preliminary stage, are primarily *for* research. First, we note that several of the DSRIS papers we considered for this study used an implicit form of one or more of the QR techniques detailed in this paper (cf. our analysis of Adomavicius et al., 2008). Our familiarity with the literature leads us to believe that QR techniques in some form are familiar (though possibly not by name) to many DSRIS researchers. Thus, as DSRIS matures and the call for mid-range theory development becomes more common, our research shows one path to such theory development would be: 1. a more formal understanding of and practice of these techniques as refined in QR and 2. the application of the techniques at the appropriate point(s) in the research project (see Figure 1).

A second observation for DSRIS is that many of the QR techniques discussed permit an *open ended research design*; that is, they permit research and theory development to proceed from an intuition or observation driven atheoretic base. The ability of DSRIS to produce useful knowledge (i.e. design theory or methods) absent a formal theoretical basis has been discussed in the DSRIS literature (Vaishnavi and Kuechler, 2008); our research extends the capabilities of DSRIS to produce in addition grounded mid-range theories, of use to both design practice and research, without the requirement of kernel theories. In planned extensions of our research we plan to more fully develop and proceduralize these two implications.

REFERENCES

1. Adomavicius, G., Bockstedt, J.C., Gupta, A., and Kauffman, R.J. (2008) Making sense of technology trends in the information technology landscape: A design science approach, *MIS Quarterly*, 32, 4, 779-809.
2. Baskerville, R.L., and Wood-Harper, A.T. (1996) A critical perspective on action research as a method for information systems research, *Journal of Information Technology*, 11, 3, 235-246.
3. Bruce, L.B. (2000) Qualitative research methods for the social sciences (4th ed.), Allyn and Bacon, Boston.
4. Campbell, D.T. (1956) Leadership and its effects upon the group, Ohio State University Press, Columbus.
5. Campbell, D.T., and Fiske, D.W. (1959) Convergent and discriminant validation by the multitrait-multimethod matrix, *Psychological Bulletin*, 56, 2, 81-105.
6. Denzin, N.K. (1970) Sociological methods: A sourcebook, Aldine, Chicago.
7. Denzin, N.K. (1978) The research act: A theoretical introduction to sociological methods (2nd ed.), McGraw-Hill, New York.
8. Denzin, N.K., and Lincoln, Y.S. (1994) Handbook of qualitative research, Sage Publications, Thousand Oaks.
9. Glaser, B.G., and Strauss, A., L. (1967) The discovery of grounded theory: Strategies for qualitative research, Aldine De Gruyter, New York.
10. Goldkuhl, G. (2004) Design theories in information systems - a need for multi-grounding, *Journal of information Technology Theory and Application*, 6, 2, 59-72.
11. Gregor, S. (2006) The nature of theory in information systems, *MIS Quarterly*, 30, 3, 611-642.
12. Hevner, A.R., March, S.T., Jinsoo, P., and Ram, S. (2004) Design Science in Information Systems Research, *MIS Quarterly*, 28, 1, 75-105.
13. Janesick, V.J. (1994) The dance of qualitative research design, in: *Handbook of qualitative research,* N.K. Denzin and Y.S. Lincoln (eds.), Sage Publications, Thousand Oaks.209-219.
14. Jarvinen, P. (2007) Action research is similar to design science, *Quality & Quantity*, 41, 37-54.
15. Johnstone, M., and Venable, J. (2008) Enacting design science with action research: An illustrative case study in methodology development, *Proc 3rd International Conference on Design Science Research in Information Systems and Technology (DESRIST)*, Atlanta, GA, 2008.
16. Kuechler, B., and Vaishnavi, V. (2008) On theory development in design science research: anatomy of a research project, *European Journal of Information Systems*, 17, 5, 489-504.
17. March, S.T., and Storey, V.C. (2008) Design science in the information systems discipline: An introduction to the special issue on design science research, *MIS Quarterly*, 32, 4, 725-730.
18. Marshall, C., and Rossman, G.B. (1995) Designing qualitative research (2nd ed.), Sage Publications, Thousand Oaks.
19. Merton, R.K. (1957) Social theory and social structure, The Free Press, Glencoe.
20. Merton, R.K. (1968) Social theory and social structure, The Free Press, New York.
21. Miles, M.B., and Huberman, A.M. (1994) Data management and analysis methods, in: *Handbook of Qualitative Research,* N.K. Denzin and Y.S. Lincoln (eds.), Sage Publications, Thousand Oaks.428-444.
22. Nunamaker, J., Chen, M., and Purdin, T. (1991) Systems development in information systems research, *Journal of Management Information Systems*, 7, 3, 89-106.
23. Patton, M.Q. (1990) Qualitative evaluation and research methods (2nd ed.), Sage Publications, Newbury Park.

24. Patton, M.Q. (2002) Qualitative research and evaluation methods (3rd ed.), Sage Publications, Thousand Oaks.
25. Ritchie, J., and Lewis, J. (2003) Qualitative research practice: A guide for social science students and researchers, Sage Publications, London.
26. Robinson, W.S. (1951) The logical structure of analytic induction, *American Sociological Review*, 16, 6, 812-818.
27. Silverman, D. (1985) Qualitative methodology and sociology: Describing the social world, Gower, Brookfield.
28. Silverman, D. (2000) Doing qualitative research: A practical handbook, Sage Publications, London.
29. Strauss, A., and Corbin, J. (1990) Basics of qualitative research, Sage Publications, Thousand Oaks.
30. Susman, G.I., and Evered, R.D. (1978) An assessment of the scientific merits of action research, *Administrative Science Quarterly*, 23, 4, 582-603.
31. Vaishnavi, V., and Kuechler, W. (2008) Design science research methods and patterns: Innovating information and communication technology, Auerbach Publications, New York.
32. Willis, J.W. (2007) Foundations of qualitative research: Interpretive and critical approaches, Sage Publications, Thousand Oaks.
33. Znaniecki, R. (1934) The method of sociology, Farrar & Rinehart, New York.