EXPLORING QUALITATIVE COMPARATIVE ANALYSIS IN IS RESEARCH

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Abstract

Qualitative Comparative Analysis (QCA) has been proposed as a promising qualitative data analysis strategy to study complex problems. QCA provides multiple conjunctural causation that can address generalizability concerns associated with case study research within the IS and other social science disciplines. However, there are not many studies that offer guidelines on how to effectively apply this methodology to IS research. This paper outlines a set of methodological principles for using QCA. An illustrative example of case studies of collaborative networks is discussed to demonstrate the application of QCA.

Keywords: Case study, generalizability, qualitative comparative analysis.

1 INTRODUCTION

In the information system (IS) field of research, the interplay between information technology (IT) use and organizations has been considered one of the core IS research areas (Sidorova et al., 2008). Given an increasingly complex relationship between technological issues and organizational situations, an increasing number of IS research has employed a multiple case study design to offer rich insight. The attractiveness of a multiple case study design is that research findings have broader generalizability through theoretical replication (Yin, 2003).

Dube and Pare (2003) suggest that a small number of IS publications provide principles and guidelines with respect to data analysis methods for a multiple case study design. The motivation of this paper is to introduce IS researchers to Qualitative Comparative Analysis (QCA) as a useful data analysis method that has the potential to explain diverse interactions of factors associated similar outcomes in IS research (Van de Ven and Poole, 1995). The paper is structured as follows. The next section discusses the role of case study in IS research. Then, the overview of QCA is presented along with a discussion of how to apply the methodological principles of QCA to develop insights in multiple case study research. Next, we demonstrate the use of QCA in case study research to examine sustainability in collaborative networks. The final section draws some conclusions and considers opportunities for further exploration of QCA in IS research.

2 CASE STUDY IN IS RESEARCH

Over the years, the case study method has been prevalently used by IS researchers to inductively build theory around IS in organizations. An inductive approach begins with a detailed observation of the phenomenon of interest. Subsequently, relevant theory, propositions and concepts are developed to theorize the phenomenon of interest. For a qualitative study, the data is collected in the form of text from documents, interviews, focus groups and observations. Qualitative data analysis involves identification, coding and categorizing the raw data into themes and subthemes to develop a better understanding of the phenomenon of interest (Cavana et al., 2001). Then, the researcher compares the themes emerged from the first case with other cases to construct theoretical constructs and their relationships. In effect, the resulting theory emerges from the within-case and cross-case analyses (Eisenhardt and Graebner, 2007).

Case study methodology is sometimes criticized for its lack of reliability and validity (Johnson and Onwuegbuzie, 2004; Orlikowski and Baroudi, 1991; Yin, 2003). Reliability is concerned with the consistency in the study's findings. Validity focuses on the generalization from a sample to a larger population or from one setting to another (Yin, 2003). Qualitative data analysis can be somewhat challenging because researchers need to collect a large amount of raw data from a small number of organizations through in-depth interviews. Miles and Huberman (1984, p. 35) commented on this issue: "One cannot ordinarily follow how a researcher got from 3600 pages of field notes to the final conclusions, sprinkled with vivid quotes though they may be." Similarly, Eisenhardt (1989, p. 616) contended that "analyzing data is the most difficult and the least codified part of the process". The lack of clear data analysis guideline has raised four major methodological problems with a case study approach: (1) lack of controlled observations, (2) lack of controlled deductions, (3) lack of replicability and (4) lack of generalizability (Lee, 1989). Among these, generalizability has been argued as a major challenge in qualitative IS research (Lee and Baskerville, 2003; Walsham, 1995).

However, generalizability plays an important role in evaluating the quality of theory in IS research (Gregor, 2006). Lee (1989, p.41) defined generalizability as a "quality describing a theory that has been tested and confirmed in a variety of situations, whether such testing is conducted through case research, laboratory experiments, statistical experiments, or natural experiments". Further, Lee and Baskerville (2003, p.221) asserted that "the generalizability of an IS theory to different settings is important not only for purposes of basic research, but also for purposes of managing and solving problems that corporations and other organizations experience in society". As such, several qualitative IS researchers have proposed various approaches to generalization (see Table 1). This paper adopts Yin's (2003) approach of generalization that emphasizes the use of replication logic with multiple cases. The primary purpose of using multiple cases is analogous to a series of laboratory experiments. In other words, multiple cases serve as replications and extensions to help understand the complex inter-relationships that exist among key themes across different cases (Eisenhardt and Graebner, 2007). The use of multiple cases is an important element in QCA as this method aims to examine a range of variables across different cases in order to establish generalizability.

Types of Generalization	
Eisenhardt (1989)	• Theoretical sampling to replicate or extend the emergent theory
Walsham (1995)	• Development of concepts • Generation of theory • Drawing of specific implications • Contribution of rich insight
Lee & Baskerville (2003)	• Generalizing from data to description • Generalizing from description to theory • Generalizing from theory to description • Generalizing from concept to theory
Yin (2003)	• Statistical generalization: generalizing the findings from the sample to the population • Analytical generalization: generalizing the findings from a single case or multiple case studies.

Table 1. Approaches to Generalization.

3 QUALITATIVE COMPARATIVE ANALYSIS: AN OVERVIEW

Originating in comparative sociology, QCA has been used in a variety of disciplines including political science, management, and government policy (Fiss, 2007; Grofman and Schneider, 2009; Kitchener et al., 2002; Loane et al., 2007; Ragin, 1999; Rizova, 2007; Skaaning, 2011). QCA is a comparative case-oriented research technique developed by Charles C. Ragin in the 1980's and 1990's (Ragin 1987, 1994). QCA offers rigorous and systematic analytics to identify causal conditions among independent variables that relate to an outcome while preserving rich contextual details of the case studies. The case-oriented data analysis methodology is based on Boolean algebra for studying a small-to-moderate number of cases. Particularly, QCA explores similarities and differences across cases by comparing and observing patterns derived from the empirical findings that are grounded in the case study. QCA treats "cases as whole entities" (Ragin, 1987, p. x). QCA is grounded on the notions of "heterogeneity" and "causal complexity" underlying most social phenomena, including those in IS. The method is especially applicable to research contexts where complex interactions among conditions are observed. Heterogeneity recognizes that more than one causal condition is likely to relate to the same outcome. In QCA, causation is viewed conjuncturally. In other words, outcomes "are analyzed in terms of intersections of conditions, and it is usually assumed that any of several combinations of conditions might produce a certain outcome" (Ragin, 1987, p. x). QCA aims to seek different types of necessary but not sufficient causal conditions (those important in some but not all cases) to produce the same outcome. Causal complexity suggests that a relevant causal condition constitutes several variables instead of a single variable. This characteristic is appealing to IS research in which complex logic is often observed in explaining outcomes of interest to IS researchers.

QCA can be used to study different pathways or causal combinations that can affect the same outcome across a small number of cases. The researcher uses an induction approach to begin the research. An induction approach starts with detailed observation of the phenomenon of interest to develop subsequently relevant theory. Propositions and concepts are generated to generalize the phenomenon of interest. Generally, QCA adopts a case study method, a qualitative approach, entailing an iterative process of data collection that provides "a rich dialogue between ideas and evidence" (Ragin, 1987, p.52). For example, Rizova (2007) used QCA to study six technology projects and identified factors that engender positive project outcomes. The study posited that successful project implementation was determined by formal and informal structural project factors. QCA was used to assess all logically possible combinations that based on the presence/absence of each factor to study successful project implementation. After eliminating unnecessary factors for the presence of successful outcome across the six case studies, only four critical project success factors were identified.

Using Boolean algebra, QCA offers a systematic approach to identifying complex interactions among factors that explain an outcome of interest (Ragin, 1987). There are four basic steps for using QCA (Ragin, 1987). First, the researcher has to identify the phenomenon of interest. Second, the researcher analyzes each case study through a combination of deduction and induction logic to seek "underlying similarities among members of a set displaying some common outcome' (Ragin, 1989, p.45). Third, the researcher codes these similarities as dichotomous values: "1" (membership in the set) or "0" (non-membership in the set). Subsequently, the researcher constructs a "truth table" that depicts all possible combinations of membership and non-membership of the similarities. This phase is deemed deductive as "initial theoretical notions serve as guides in the examination of causally relevant similarities and differences (Ragin, 1989, p.45). Fourth, the researcher matches the empirical cases against the logical combinations. This phase is deemed inductive as "the researcher determines which of the theoretically relevant similarities and differences are operative by examining empirical cases" (Ragin, 1989, p.45). In effect, QCA provides generalization because different patterns of similarities and differences may produce the same outcome. More significantly, QCA allows multiple conjunctural causation (Ragin, 1987).

The concept of multiple conjunctural causation plays an important role in analyzing multiple case studies. Specifically, multiple conjunctural causation "contains the notion of equifinality, which simply means that different paths can lead to the same outcome'' (Berg-Schlosser et al., 2008). The term 'multiple' refers to the number of paths, while the term 'conjunctural' conveys the notion that each path consists of a combination of conditions. QCA analyzes each case study with respect to its unique causal path, and considers these different paths as configurations of empirical patterns. The analysis of various causal combinations of conditions across different number of paths allows clarification of multiple conjunctural causation thus enabling a holistic view of the studied phenomena (Ragin, 1999). The identification of causal patterns enables a replication with similar results (a literal replication) or a replication with contrasting results (a theoretical replication) (Yin, 2003). For instance, Fiss (2007) followed literal replication logic across cases and empirically identified that configurations of strategy, structure, and environment were crucial for technology firms to achieve high organizational performance. Loane et al. (2007) emphasized a theoretical replication through different cross-national findings. Their study found that the role of teams and team dynamics in the internationalization process of new ventures was important to the development of new firms. In summary, QCA enables researchers to gather in-depth insight within and across cases by simultaneously capturing the complexity of the cases and maintaining a certain level of generalization (Ragin, 1987).

4 APPLYING QCA TO IS RESEARCH

QCA is relatively new to IS researchers, with only a few studies having used QCA to understand IT innovations (Fichman, 2004; Rizova, 2007) and quality of life (Techatassanasoontorn and Tanvisuth, 2010). In this section we provide an example to illustrate QCA as a useful approach to multiple-case study research.

4.1 Research context: Collaborative networks

Forming a collaborative network is a strategic approach to enhance an organization's competitive advantages by co-specializing one's existing resources with complementary resources and skills that are accessible through the collaboration. Engaging in collaborative networks is particularly critical for firms operating in complex and turbulent business environments (Hoffman and Schlosser, 2001; Pavlovich and Akoorie, 2003). Despite the strategic and operational benefits attributed to collaborative networks, limited success has been observed (Kale and Singh, 2009), suggesting the need for research to examine how collaborative relationships can be sustained over time (Kale et al., 2009; Reuer and Zollo, 2010; Taylor, 2005; Turrini et al., 2010). In this study, we are interested in two outcomes; sustainable and non-sustainable collaborative networks.

We conducted a comparative study of four cases to explore the sustainability of a collaborative network. These four networks in the healthcare setting have deployed various types of information and communication technologies (ICT), such as the Internet, knowledge portals, group decision support systems and electronic meeting systems, to facilitate and support their collaborative networks. Two networks are involved with health IT development while the other two are involved with healthcare service delivery. Because of space limitation, we cannot go into full details of the four collaborative networks. As such, a short description of each case is provided below:

Case 1: The network comprised of eight organizations that sought to develop a national Patient Health Portal. Importantly, this case provided an example of one of the extreme outcome – the network was not sustained over time.

Case 2: This was a contrasting case study to Case 1. This network was sustained over time. The network involved three organizations collaborating to develop a mobile Electronic Health Record.

Case 3: This was selected as a contrasting case study to Case 2. This collaborative network comprised six organizations and, similar to Case 2, was sustained over time. This network was formed to deliver a medical healthcare service.

Case 4: Similar to Case 3, this was a sustained collaborative network. It comprised seven organizations and was formed to deliver a surgical healthcare service.

Selecting causal conditions

While there is a vast of literature that has theorized the role of resources and capabilities in achieving or sustaining competitive advantage, studies that explore the role of capabilities in sustaining collaborative networks are scarce in the literature. We propose that sustaining a collaborative network requires technological, organizational, and governance resources and capabilities. However, this analysis focuses on technological resources and capability are influential to the sustainability of an ICT-enabled collaborative network. Resources are defined as tangible and intangible factors that an organization possesses or controls and are available to be utilized to gain competitive advantage or increase organizational performance (Amit and Schoemaker, 1993; Araya et al., 2007). Capabilities are defined as the "capacity to deploy resources, usually in combination, using organizational process to effect a desired end" (Amit and Schoemaker, 1993, p. 35). Capabilities are regarded as higher-level resources that are needed to execute lower-level type of resources to perform their functions (Araya et al., 2007). For example, technological resources are needed to facilitate communication within the network and co-ordinate collaborative activities. In addition, a network-wide technological capability has to be developed to combine and utilize the necessary technological resources to provide the basis for network communication and information processing and to support and facilitate effective co-operation between the collaborative partners (Bharadwaj et al., 1999; Bhatt and Grover, 2005).

During data collection in case study research, we conducted interviews with people who involved in the development and operation of each collaborative network. Based on the recommendations of the contact people for each network and information gathered during the interviews, a list of additional potential interviewees was generated. These people were then invited to participate in the research. Relevant documentation about each network was also gathered either from the Internet or from individuals associated with each network. Interviews were semi-structured, based on a pre-defined interview guide. Where possible, face-to-face interviews were held at a mutually convenient location, usually at the organizational premises of the interviewee. Otherwise, a telephone interview was conducted,. The average length of each interview was approximately 1 hour. Interviews were audio-taped (with the interviewee's permission) and transcribed in full. Detailed notes were also made during each interview. A total of 32 interviews were conducted, spanning 29 hours of interview time.

We began the data analysis process with a deduction approach. We used the concepts suggested in the literature to identify different types of technological resources. Subsequently, we compared the proposed types of technological resources with the data collected from Case 1. We found that the original set of technological resources proposed was insufficient to explain the negative outcome of the case study. The initial list of technological resources focused on technological infrastructure, technological skills, and technological training. However, the analysis of Case 1 suggested that management of the technological infrastructure and other resources was important to sustain the relationships in a collaborative network. Thus, technological skills and training were combined into a single resource, technological competence. Also, technological management skills was created as a new technological resource based on the case study data with support from the extant literature in this area. The validity of these new and re-defined technological resources was then verified in the analysis of the other three cases. In the end, we have coded four conditions that influence the sustainability of a collaborative network:

1. *Technological infrastructure*: This consists of the technologies, systems, applications and services shared between network members and used to support communication and the exchange of information across time and space in a collaborative network (Bharadwaj et al., 1999; Bhatt and Grover, 2005; Melville et al., 2004). A strong infrastructure will enhance network stability as it can support an efficient flow of communication and information among organizations to support a collaborative network's operations (Barua et al., 2004; Chi and Holsapple, 2005).
2. *Technological competence*: Technological competence reflects the abilities of the members of a collaborative network to understand, use and exploit the infrastructure available within the network (Ritter and Gemünden, 2004). It includes both technical skills and the training needed to acquire them.
3. *Technological management skills*: Technological competence is not sufficient for the effective use of infrastructure and applications. Firms need technological management skills to conceive, deploy and exploit IT to support and enhance organizational and, by extension, network activities (Bharadwaj, 2000; Bharadwaj et al, 1999; Mata et al., 1995). Important management skills include the ability to understand and anticipate the communication and co-ordination needs of the various members of a collaborative network, the ability to source and deploy appropriate IT applications, and the ability to co-ordinate activities using applications in a supportive way (Mata et al., 1995; see also Gulati et al., 2012).
4. *Technological capability*: Technological capability serves as a co-ordinating mechanism in which technological resources are synchronized through a process of planning, deploying and managing to support and facilitate effective communication and co-operation between the collaborative partners. Technological infrastructure, competence and management skills are

co-specialised resources (Tippins and Sohi, 2003) that, together, enable a collaborative network to function effectively. A technological infrastructure yields limited benefits as a stand-alone resource. It needs to be deployed by technologically competent users and managers. The combination of these three resources needs to be implemented through appropriate communication and co-ordination processes to support and maintain the collaborative network. The value of these resources is dependent on the learning and experience involved in developing the relevant network-wide technological capability.

4.2 Creating the truth table

There are three types of QCA: crisp-set QCA, fuzzy-set QCA and multi-value QCA (refer to Table 2). We selected csQCA for this research because the collected qualitative data can be coded to strictly dichotomous values, in which each condition and outcome was assigned a value of 1 (present) or 0 (absent).

Types of QCA	Name	Variable range	Application
csQCA	Crisp-Set	Dichotomous	When variables can be defined or approximated into binary categories of present (1) or absent (0)
mvQCA	Multi-Value	Multichotomous	When attribute values under study can reasonably be summarized into a small number of discrete options
fsQCA	Fuzzy-Set	Continuous	When finer gradations in the dataset are significant and each variable can be assigned a value along a continuous range

Table 2. Types of QCA (adapted from Jordan et al., 2011).

Collaborative networks with the presence of conditions (i.e., technological infrastructure, technological competence, technological management skills and technological capability) were coded 1, whereas those in absence of the conditions were coded 0. Similarly, a sustained collaborative network was coded 1 while an unsustained one was coded 0. The coding results are summarized in a truth table (see Table 3.

Cases	Technological Infrastructure	Technological Competence	Technological Management Skills	Technological Capability	Outcome
Case 1	1	1	0	0	0
Case 2	1	0	1	1	1
Case 3	1	1	1	1	1
Case 4	1	0	1	1	1

Table 3. Truth Table.

4.3 Results

We conducted two separate analyses for this study, both of which used network sustainability as an outcome. First, we analyzed the conditions that lead to a sustained collaborative network. Second, we analyzed conditions that lead to an unsustained collaborative network. We provide evidence in support of our analysis in Table 4.

Resources/Capability	Data Segment
Technological infrastructure	*For some of us, we actually make full use of Collab particular for documents sharing. It was communicated to the key players that this was the tool for document sharing*. (Project Consultant, ITConsult, Case 1) *MediSoft and MediSolutions had utilized a Database Dictionary, an inter-organizational information system, which stored technical documents and information that was needed to build the database structure.* (Director, MediSolutions, Case 2). *We use e-mails and phone calls to co-ordinate. E-mails weren't that effective because surgeons don't do e-mails ... Whereas you see the MOH and DHBs are strongly e-mail underpinned organisations; everything relies on written words and documents. Whereas consultant medical staff typically use cell phones. And that's how referrals get discussed, cases reviewed.* (Network Co-ordinator, Case 4)
Technological competence	*MediNet provided ICT training to the partners in order to enhance their understanding of how to deploy the website to assimilate and dissimilate information. The website manager met the administrator and health professional of southern unit for a face-to-face training. The training entailed an explanation of what were the technical aspects of the website and how to create the website's anchor points followed by a demonstration of how to upload the documents.* (Administrator, Case 3)
Technological management skills	*Our administrator is the key person for a lot of things. She knows the telephone number and fax number for all the units. Although that sounds minor but it can be really very important because people can end up on a phone ringing for ages to find out who shall I ring. It has actually streamlined things in a great deal*. (Sub-specialist A, Northern unit, Case 3) *The leader is reporting every week on how things are. The data is coming through, a constancy of data. Like you don't want to be waiting three or six months for the next data; you really want to see what happening week on week is. That's an important point.*(Medical Director, NGO, Case 4)
Technological Capability	*The technology platform like Collab was good but the developers were using it for technical communication. The wider project and important stuffs were never got communicated. Mainly when I looked at Collab it was not used too much for communication it was used to share documents around. It took away the need to email everybody around time. There was no communication in that sense.* (CEO, Systems Provider A, Case 1) *The leader's been very, very good at communicating via e-mails and keeping everybody informed. The number of face-to-face meetings is only probably about two or three a year, but again the various issues or work streams that have been developed by the network have someone who has responsibility for carrying them through. But again, he does a good job of coordinating all that.* (Clinical Leader, Southern Region, Case 4)

Table 4. Selected Evidence from Case Studies.

Outcome 1: Sustained Collaborative Network

This analysis resulted in two main pathways which are sufficient for a sustained collaborative network, shown in Figure 1. Both pathways include common conditions of technological infrastructure, technological management skills and technological capability. The first pathway is a combination of all four conditions. The second pathway is a combination of technological infrastructure, technological management skills and technological capability. This suggests illustrates that technological competence is not a necessary condition for a sustainable collaborative network.

Outcome 2: Unsustained Collaborative Network

This outcome was observed in Case 1. Despite the presence of technological infrastructure and technological competence, the lack of technological management skills and capability prove to be important to the success of a collaborative network. The other three collaborative networks identified a focal leader who had the know-how skills to deploy technological infrastructure to foster an effective communication process. In the other three cases, the leaders applied their managerial skills to exploit both synchronous and asynchronous channels to facilitate an open communication process that was crucial for an efficient co-ordination of collaborative activities. Consistent with the literature (Legler and Reischl, 2003; Midwinter and Sheppard, 2000), a communication process has to entail both synchronous and asynchronous communication channels, enabling collaborative partners to work co-operatively. The network in Case 1 failed to develop network-wide technological capability to foster the collaboration. Though this network possessed technological infrastructure and technological competence, it lacked the ability to deploy and combine the two technological resources to facilitate communication among the members and co-ordinate the collaborative activities. Therefore, both technological management skills and technological capability should be areas of focus for practitioners seeking to improve the sustainability of collaborative networks.

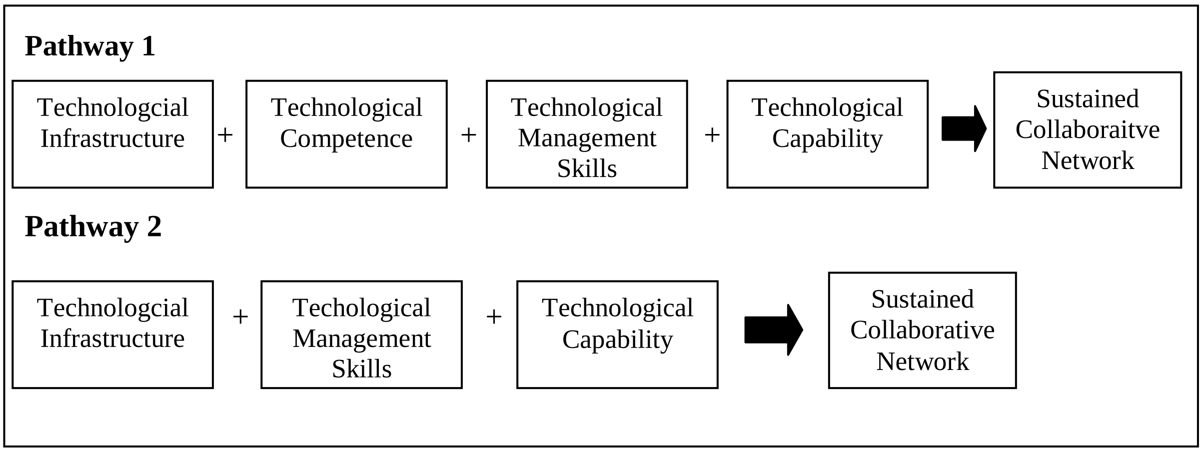

Figure 1. Pathways to a Sustained Collaborative Network

5 CONCLUSION

Generalizability has been one of the concerns for qualitative IS research. In this paper, we propose QCA as an analytical approach to conduct systematic cross-case comparisons while preserving the richness of each case. In particular, QCA focuses on identifying multiple and conjunctural conditions that can affect an outcome of interest across a small number of cases. This paper makes two contributions to IS research. First, it provides guidelines with respect to QCA as a useful data analysis method for a multiple case study research. Second, it demonstrates how QCA can be applied to an IS context. It is hoped that this paper will entice other IS researchers to explore the value of QCA in their studies.

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