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HOW TO RIGOROUSLY DEVELOP PROCESS THEORY USING CASE RESEARCH

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Abstract

Dynamic phenomena are key concerns of IS researchers. However, the methodological approaches usually selected to investigate IS phenomena often rely on variance theory. Underlying factor models represent a rather static approach to the phenomenon by focusing on independent and dependent variables and explaining the degree of the relationships between them. Process theory has been suggested to overcome this problem. Process theory provides a complementary, dynamic perspective on IS phenomena by explaining how independent and dependent variables are linked in terms of event sequences. Although applying both approaches provides more complete pictures of IS phenomena, a lack of research methods focusing on process theories may hinder this goal. This article seeks to help closing this gap by examining how case research can be applied to develop process theory. We analyzed IS case research as well as process research literature and consolidated inputs from both sources toward a single methodology. The results highlight that the development of process theory benefits from a consistent methodology and quality measures that have been suggested in general case research. However, we also found that each step requires specific consideration of process theory characteristics in order to develop rigorous process theory.

Keywords: process theory, case study research, research methodology, process model, variance theory

1 INTRODUCTION

Dynamic phenomena such as information systems development, technology-supported group processes, IS staffing, and technology adoption (cf. Shaw & Jarvenpaa 1997) are key concerns of information systems (IS) researchers. However, variance research and underlying factor models – which dominate IS research – are rather unsuitable for examining the dynamic aspects of these phenomena. These models focus on the static aspects in the form of variances in independent and dependent variables and based thereon explain the degree of the relationships between the variables. However, these models largely omit any sequential or temporal details of this relationship (Ramiller & Pentland 2009, Shaw & Jarvenpaa 1997). This lack of a dynamic component limits the explanation of *how* variance in one factor leads to variance in a dependent factor. According to Sabherwal & Robey (1995), "[this] is analogous to cooking with a list of ingredients but without the recipe" (p. 549).

It has been suggested that process theory (cf. e.g., Mohr 1982, Markus & Robey 1988, van de Ven & Huber 1990) overcomes these limitations, as it is based on process models, which emphasize a dynamic view of phenomena. Process theory seeks to explain how independent variables (e.g., the context) shape the evolution of the process and, in turn, how the process influences dependent variables (e.g., outcomes). Gregor (2006) suggests that process research might examine the content, context and settings in which information systems are introduced, thus isolating conditions and events that lead to outcomes. Variance research could further investigate the degree of the relationships between events, conditions, and outcomes. Thus, applying variance *and* process theory to IS phenomena can lead to pictures that are more complete.

However, compared to methods suggested for addressing variance research, methodological considerations in the context of process research lack common analysis methods and tests (cf. Pentland 1999). In this paper, our goal is to contribute to closing this gap by examining how case research can be employed in developing process theory. Case research has been suggested (e.g., Eisenhardt 1989) and is widely used and accepted as theory development tool in the IS field. In the context of process research, case research is frequently employed to address process theory. The multifaceted data collection methods as well as the collection of qualitative and quantitative evidence are ideal for addressing the vivid and dynamic phenomena necessary to develop complete process models (cf. e.g., Creswell 1994, Newman & Robey 1992). The qualitative orientation of case research suggests eligibility for examining the qualitative relationships between independent and dependent variables as emphasized by the dynamic character of process theories. Nevertheless, existing case research methodologies that have received widespread attention in the IS field (e.g., Benbasat et al. 1987, Lee 1989, Eisenhardt 1989, Yin 2003, Dubé & Paré 2003, Paré 2004) are either too general or focus on variance theory specifics (cf. also the "better stories vs. better constructs" discussion by Dyer & Wilkins (1991) and Eisenhardt (1991)). In both cases, the characteristics of process theory – that is, the underlying components of process models – are largely ignored. This, in turn, affects research design, data collection and data analysis, and thus the resulting process theory. Nonetheless, we believe that process research can benefit from methodological suggestions raised in the area of general case research. Suggestions from the process research field may help to refine these ideas towards a more rigorous methodology to specifically develop process theory. In order to address this objective, we seek to answer the following research question: *How can process theory be developed using explorative case research?*

We proceed as follows: In the following foundations section, we briefly summarize the evolution of process theory to date. We then suggest a general process model, which is used to conceptualize process theory and underlies our examination. Following we outline the research methodology that we employed to address the research question. In this paper's results section, we delineate the case research methodology focusing on developing process theory derived from our examination. We discuss research steps along with respective quality measures in more detail. We conclude with a brief summary and discussion of our results.

2 FOUNDATIONS

2.1 Evolution of process theory

Due to their logical structure, theories can be classified as taking either a *variance* theoretical perspective or a *process* theoretical perspective on the phenomena under investigation (Markus & Robey 1988, Mohr 1982). Mohr (1982) distinguishes between them by referring to the former as *variance theory* and the latter as *process theory*: Variance theory is based on a factor model that causally links variables with one another. Variance research seeks to examine the extent of these links between variables and thus to explain variation in dependent variables by the variations of one or more independent variables. Variance research often relies on cross-sectional studies. Conversely, process theory seeks to explain by identifying sequences of actions that lead to outcomes if specific antecedent conditions are fulfilled. Therefore, process research often relies on longitudinal studies.

It cannot be argued that the one type of theory is superior to the other (Markus & Robey 1988). Rather, each theory type provides a different view of the same social reality. Mohr (1982) states that these theories can be mutually informative but should not be merged into one theoretical approach. The distinguishing features, as noted by Mohr, must be kept in mind when dealing with process *and* variance theories as they constitute the strengths of both approaches. However, the exclusion of variables from process theories – as favored by Mohr – has subsequently been questioned by researchers (cf. e.g., van de Ven & Huber 1990, Abbott 1990, Sabherwal & Robey 1995, Pentland 1999, Shaw & Jarvenpaa 1997). It has been suggested to incorporate variables in order to conceptualize events' causes and consequences. Langley (1999) maintains that the variety of theories constructed is otherwise unnecessarily limited. It may be important to understand events' impact on a variable (i.e. the outcome) and contextual variables' effect on the evolution of events (Langley 1999, p. 693). Van de Ven and Huber (1990) suggest seeing events that constitute a process as dichotomous variables that are explained by other independent variables. In this article, we build on this development in process research, which emphasizes sequences of events as process theory's distinguishing features, but also incorporates variables, as process studies are "either meaningless or irrelevant" (van de Ven & Huber 1990, p. 215) if they do not focus on what causes these events or what their consequences are.

2.2 Conceptualization of process phenomena

Variance theory's core construct is a factor model linking independent and dependent variables via causal relationships (cf. e.g., Lee & Hubona 2009 for a formal representation). Accordingly, process models are used to conceptualize process theory. However, compared to variance research, there is at present no consensus on a common process model in process research. Since such an underlying process model is essential for conceptualizing process phenomena and, thus, for guiding the process of theory development, we suggest a general process model that will underlie this paper's subsequent sections.

Process researchers highlight three main components of process models (e.g., Abbott 1990, van de Ven & Huber 1990, Sabherwal & Robey 1995, Pentland 1999, Lyytinen & Newman 2008): (1) the *process* itself, (2) *causal factors*, such as contextual or antecedent conditions that shape the evolution of the process, and (3) *consequential* factors, such as impacts or outcomes that are caused by the process. These elements are represented in our suggested general process model (cf. Figure 1).

Theorizing the typical sequences of events lies the core of process theories (Abbott 1990, Pentland 1999). The suggested general process model thus contains a sequence of events, which is the core component of the *process* under investigation. In this context, Sabherwal and Robey define events as "instances of social action that occur during the process being studied" (1995, p. 306). A second component of process models is antecedent or contextual conditions that influence the occurrence of

events, thus shaping the process. Lyytinen and Newman define antecedents as elements "that preceded the event and could be viewed instrumental (i.e. necessary) in producing it" (2008, p.599). We summarize all factors, be they antecedent conditions, contextual factors or external constraints that somehow shape the process as *causal factors*. A third component of process models is outcomes, effects or impacts, which are caused or influenced by the process. We summarize these elements as *consequential factors*.

Causal factors refer to the *independent variables* part of a factor model, whereas consequences reflect *dependent variables* (cf. Abbott 1990). The process is a critical component as it connects causes and consequences (Pentland 1999) and thus significantly contributes to explanation within a process theory. A process model that excludes causes and effects would be limited to a rather descriptive generalization (Pentland 1999). This suggests that causal and consequential factors should be related to the respective events during the course of theory development, as indicated by the arrows in Figure 1, in order to facilitate the explanatory power of the resulting theory.

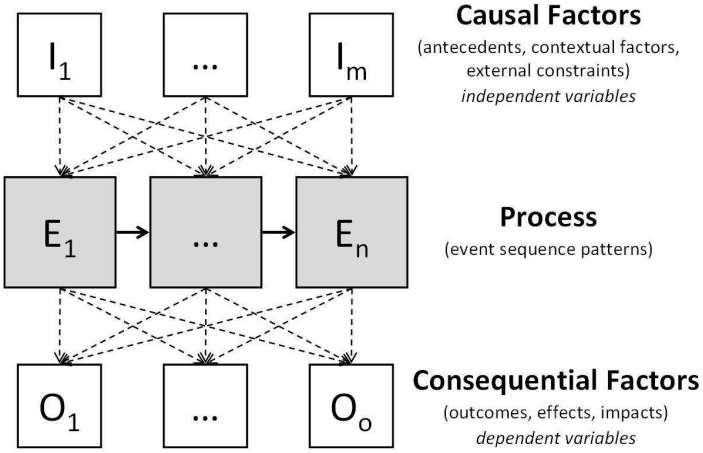

Figure 1: Suggestion for a general process model

3 RESEARCH FOCUS AND METHODOLOGY

We focused our research with respect to two aspects. The first is the approach to theory development that we took and the second is the philosophical orientation that we assumed.

Similarly to variance theory, process theory can be addressed in a *inductive theory developing* way or in a *deductive theory testing* way (cf. e.g., Eisenhardt & Graebner 2007, Becker & Niehaves 2007, Shaw & Jarvenpaa 1997). The inductive approach seeks to extract process theory from the ground up whereas within the deductive approach, a priori process theories are formulated and tested in the field (Langley 1999). Although we acknowledge the deductive theory testing approach (cf. Sarker & Lee 1998 for an example) to addressing process theory, we limit our examination to inductive explorative development of process theory, which most process researchers employ (Langley 1999).

Two major philosophical orientations have received widespread attention from researchers in the IS field: positivism and interpretivism (cf. e.g., Orlikowski & Baroudi 1991, Lee & Baskerville 2003, Weber 2004). Positivism emphasizes an independent objective reality that exists independently of the researcher and that can be observed and measured with a structured set of instruments. Interpretivism holds that people create and associate their own intersubjective meanings as they interact. Subjective and objective reality are thus inseparable. Researchers attempt to understand phenomena by accessing meanings that participants assign to them. Case study research can be conducted following either a positivistic (cf. Benbasat et al. 1987, Lee 1989, Eisenhardt 1989, Yin 2003, Dubé & Paré 2003, Paré 2004) or an interpretive (cf. Walsham 1995, Klein & Myers 1999) orientation. The chosen perspective

has to be stated clearly, since differing epistemological assumptions may hinder mutual understanding, for example, with regard to positivistic criteria, such as validity and reliability, which are inappropriate for interpretive case studies (Klein & Myers 1999). In order to avoid such misunderstandings, we limit our focus to one philosophical orientation and take a positivistic position in the following sections.[1]

In order to address our research question, we followed a three-step research methodology. (1) In a first step, we examined the current state of positivistic explorative case study research. Thereby, we focused on publications that have received widespread attention in the IS field: Benbasat et al. 1987, Lee 1989, Eisenhardt 1989, Yin 2003, Dubé & Paré 2003, and Paré 2004. There are three main phases when conducting case research: research design, case study conduction, and data analysis. This study's results were structured according to these phases. (2) In a second step, we reviewed methodological papers that address process theory as well as papers from authors who develop process theory and assigned the methodological steps to one of the three phases identified in the first step. (3) In a last step, we consolidated the methodological steps identified in either the first or the second step to establish a case research methodology for developing process theory. We considered input from the IS case research literature if the suggested steps were also applicable and reasonably addressed process theory (i.e. did not address any variance theory specifics). Input from the process theory literature was used to either replace variance theory specific steps suggested in IS case research, or to refine and add steps or reorder the existing steps.

4 RESULTS

Table 1 forestalls the results of our examination in terms of the overall methodology in order to guide the reader during the following discussion. We will discuss the basic steps for each of the three main phases, highlight the process theory specifics in these steps along with the accompanying quality measures. We will refer to the corresponding process and case research literature that motivates this methodology, and will illustrate each phase with three consecutive examples from the IS field.

phase	steps	process theory specifics	quality measures
research design	*(1) define research question* *(2) define unit and level of analysis* *(3) specify a priori process constructs*	research design that • defines **process phenomena** of interest • predefines **causal and consequential factors**	• explication of research design
case study conduction	*(4) select sites and data sources* *(5) conduct pilot case* *(6) collect process data*	selection of data collection means that ensures • a **longitudinal perspective** collection of raw process data that captures • **event sequences** as complete as possible • **factors and their relationships** to events	• explication of data collection procedure • case study database • triangulation
data analysis	*(7) within-case analysis* *(8) cross-case analysis* *(9) compare with extant literature*	• within case analysis results in **case-specific process story** • cross-case analysis results in **preliminary process theory** • comparison with extant literature leads to **process theory**	• explication of data analysis procedure • maintain link between data and theory • presentation of evidence

Table 1. Overall methodology

[1] Please note that a detailed discussion of the philosophical foundation of process theory is beyond the scope of this paper.

4.1 Research design

Our examination suggests three steps in this phase: the definition of the research question, the definition of the unit and level of analysis, and the specification of a priori constructs (cf. Table 1).

Definition of research question: As in any research endeavor, defining the research question is considered the most important step (Yin 2003). It expresses the essence of a study and links it to its practical and theoretical contributions (Dubé & Paré 2003). Process theories can focus on description, explanation and prediction (cf. Gregor (2006) for a discussion of theory types in the IS field). *Description* is closely linked to the underlying process model's main components by asking: Is there a typical sequence pattern or are there typical families of sequences? Are there external constraints that shape the event sequence or generally influence which (of several) sequence patterns can be observed? What is the effect of the process? (cf. Abbott 1990, Pentland 1999). Process research also takes an *explanatory* perspective by "understanding *how* things evolve over time and *why* they evolve this way" [emphasis added] (Langley 1999, p. 694). The process pattern is a critical component for explanation as it links causes and consequences. Process research may also take a *predictive* perspective by associating specific outcomes with corresponding process patterns (cf. Langley 1999, Shaw & Jarvenpaa 1997).

Definition of unit and level of analysis: Dube and Paré argue that, in "an exploratory case study, a clear definition of the unit of analysis helps define the boundaries of a theory which in turn set the limitations in applying the theory" (2003, p. 611). However, this task is not trivial as process data can refer to multiple units and levels of analysis (Langley 1999). Process stories can be about individuals, groups, projects or whole organizations. These actors thus determine the level and unit of analysis (Pentland 1999). Abbott (1990) recommends sticking to a single level of analysis. Furthermore, it must be taken into account that the time for collecting process data increases significantly as the level of analysis increases (Shaw & Jarvenpaa 1997, Leonard-Barton 1990).

Specification of a priori constructs: Whereas a priori constructs may, on the one hand, be helpful in guiding theory building research, researchers should acknowledge that such constructs are tentative, and researchers should start off "as close as possible to the ideal of no theory under consideration" (Eisenhardt 1989, p. 536). A priori constructs in process theory can refer to the process, causal or consequential factors. Questions may focus on specific process phenomena, the influence of specific causal factors, or the impact on specific consequences based on prior (variance) research. These considerations significantly simplify subsequent data collection and analysis. However, "[a]lthough the early identification of the research question and constructs is helpful, it is equally important to recognize that both are tentative in this type of research" (Eisenhardt 1989, p. 536). Sabherwal & Robey (1995), for example, focus on the influence of actor participation as one causal factor on the ISD processes as process phenomenon of interest (cf. Table 2).

Analogous to general case research, process researchers should carefully set out the research design choices in order to increase the reliability of the study (Dubé & Paré 2003). Table 2 outlines exemplary research design choices in this phase.

example	research question	unit (U) and level (L) of analysis	a priori constructs
Newman & Sabherwal 1996	investigate how level of commitment is influenced during the course of ISD projects	U: ISD process L: decision	derived determinants of commitment from literature
Sabherwal & Robey 1995, 1993	explain level of actor participation's influence on ISD projects	U: ISD process L: project	focused on actions and actors of ISD process
Currie 2008	observe how institutionalized processes undergo change over time caused by societal, organizational and individual pressures	U: institutionali-zation process L: organization	focused on factors and processes motivated by institutional theory

Table 2. Exemplary research design choices

4.2 Case study conduction

Our examination highlighted five substeps of the case study conduction phase: Before entering the field, cases and data sources must be selected. A pilot case should precede the data collection, which should be concluded with the preparation of field notes (cf. Table 1).

Site selection: The number of cases in the context of process case research differs. Whereas, for example, Newman & Sabherwal (1996) base their process theory on one detailed 17-year IS project, Sabherwal & Robey (1995) analyze 50 ISD projects (cf. Table 3). However, these two examples differ in terms of the level of analysis (cf. Table 2). This decision is furthermore a trade-off between accuracy *and* simplicity and the intended process theory's generality (Langley 1999, Glick et al. 1990). Furthermore, this decision influences the applicability of analysis techniques in the later stages. Multiple cases allow for more general and stable theories (Eisenhardt 1989) and are necessary to establish process patterns (Ramiller & Pentland 2009). In this context, *random* sampling of cases is neither necessary nor preferable (Eisenhardt 1989, Eisenhardt & Graebner 2007). Instead, the selection should maximize what can be learned from the study (Paré 2004). Pettigrew (1990) discusses a set of decision rules that may guide site selection in longitudinal field research.

Selection of data sources and *collection of data:* Dubé and Paré highlight that "a major strength of case study data collection is the opportunity to use many different sources of evidence to provide a richer picture of the events and/or issues than would any single method" (2003, p. 615). Data triangulation, which is made possible by multiple data collection methods, provides stronger substantiation of theory constructs (Eisenhardt 1989, Paré 2004, Pettigrew 1990). In the context of process research, data collection must focus on collecting data referring to the process models' main components: event sequence data as well as causal and consequential factors, and the identification of relationships among these components. The selection of data sources especially has to consider the longitudinal character of process research. In general, one can distinguish between collection of real time and historical data in this context (cf. Langley 1999, Leonard-Barton 1990). Real-time process data can be obtained through participant observation, for example, whereas historical data can be retrieved via retrospective interviews, document analyses and archival data (cf. e.g., Pettigrew 1990). The latter methods are especially appropriate when it comes to macro-level processes (Langley 1999). However, process case research should not only rely on retrospective data as it is difficult to determine cause and effect from reconstructed events (Leonard-Barton 1990). Although case researchers generally recommend collecting qualitative and quantitative data (cf. Eisenhardt 1989, p. 538), process research *should* be built on both data types (cf. Langley 1999, Pentland 1999, Shaw & Jarvenpaa 1997) as quantitative information is especially useful in the context of collecting data on causal and consequential factors. The collection of quantitative data often relies on questionnaires (e.g., Glick et al. 1990). However, this requires a priori specification of possible relevant factors, for example, through a literature review (Glick et al. 1990, cf. Table 2). Multiple investigators are recommended for process research (Pentland 1999). This enhances the study's creative potential, while the convergence of observations from multiple investigators can improve confidence in the findings (Eisenhardt 1989, Glick et al. 1990).

Conducting a pilot case and *preparation of field notes:* It is suggested that a *pilot case* should be conducted as a final preparation for data collection (Yin 2003, Dubé & Paré 2003, Paré 2004). Specifically in highly explorative process research, a pilot case may help researchers to determine the appropriate unit of analysis, refine the data collection instruments, and familiarize the researchers with the phenomenon itself (Dubé & Paré 2003) as well as specifying preliminary and tentative ideas concerning causal and consequential factors of interest. The preparation of field notes (Eisenhardt 1989, Paré 2004) concludes the data collection and leads to the data analysis. Such field notes summarize important impressions gained during data collection and may be helpful in later phases of theory development by highlighting the first ideas of process patterns, important causal or consequential factors, and their interrelationships.

Besides the triangulation of data sources and investigators, general case research highlights two additional quality measures in this phase that can be applied in process research: the explication of the data collection procedure and the creation of a case study database. A case study database contains all the case material, such as the raw data (e.g., recordings, transcripts and documents) and derived reports. A case study database seeks to make the data available for independent inspection and, thus, enhance its reliability (Yin 2003). Another important quality measure in the data collection phase is the *explication of the data collection procedure*. For this purpose, Yin (2003) suggests the development of a case study protocol. A case study protocol document guides the investigator in carrying out the data collection by providing the procedures as well as general rules to be followed. Furthermore, it enhances reliability by documenting the study procedures. Compared to variance research, both measures are especially useful in process research as there are few standards to follow and expectations are less clear when it comes to the reporting of the results. Nonetheless, one must be just as rigorous as in variance research (cf. Shaw & Jarvenpaa 1997). Table 3 outlines exemplary case study conduction choices.

example	cases	selection of data sources and data collection	quality measures
Newman & Sabherwal 1996	1 ISD project	• multiple interviews with multiple interviewees on 5 occasions during the entire project duration (17 years) • documents and observation concerning organizational circumstances	• multiple data sources • participant review
Sabherwal & Robey 1995, 1993	50 ISD projects	• retrospective interviews were used to derive the event histories of ISD projects	• multiple interviewers
Currie 2008	4 clients	• interviews, observations during all implementation phases, collection of internal and external documents	• multiple data sources

Table 3. Exemplary case study conduction choices

4.3 Data analysis

A striking feature of explorative case research is the overlap of data collection and data analysis. This allows for a head start in data analysis and for making use of flexible data collection (Eisenhardt 1989). The amount of process data usually collected in the prior phase is beyond the information processing capabilities of even the trained human mind, which further complicates process case research (van de Ven & Huber 1990, Pettigrew 1990). Handling this amount of data requires iteratively summarizing and reducing it to the core artifacts of the desired theory. Because process data can "take both qualitative and quantitative forms, it follows that the data analysis methods can also" (Shaw & Jarvenpaa 1997, p. 84). In general, explorative case study research analysis takes place by first analyzing the data on a single case basis (within-case analysis). The output of this step is used for the iterative development of theory across cases (cross-case analysis) (cf. Yin 2003, Paré 2004, Dubé & Paré 2003, Eisenhardt 1989). We found this separation especially useful in the context of process research (cf. Table 1). *Within-case analysis* can identify events, causes and consequences on a single case basis and results in case-specific process stories. These can be used as input for various *cross-case analysis* methods that have been suggested in process research. The resulting preliminary process theory should be *compared to extant literature* (Eisenhardt 1989) in order to derive the final process theory.

Within-case analysis: This step comprises identifying and analyzing the data referring to events, causes and consequences on a single case basis. Therefore, the raw data should be abstracted into events, causes and consequences, and these elements should be linked with one another. Common decision rules should guide this abstraction (cf. e.g., van de Ven & Poole 1990, Sabherwal & Robey 1995, Lyytinen & Newman 2008). Two analysis strategies suggested by Langley (1999) can complement this step. Langley (1999) suggests that, within the *visual mapping strategy,* the event sequences, causes, and consequences should be graphically and comprehensively represented. This could be especially useful to depict the dependencies between these elements (Lyytinen & Newman

2008). Displaying data has also been promoted in general case research as a means of (1) reducing data, (2) obtaining a bird's eye view of the data, (3) enhancing the reader's understanding of the case study, and (4) increasing the chances of arriving at and verifying valid conclusions (Miles & Huberman 1994). The *narrative strategy* can be used to construct a detailed story from the raw data, which includes identified event sequences, causes and consequences. This strategy avoids excessive data reduction and thus preserves the variety and richness of the qualitative data. This strategy corresponds with the concept of case write-ups proposed by Eisenhardt (1989) to cope with the volume of data, to become familiar with each case as a stand-alone entity, to allow each case's unique patterns to emerge, and to accelerate cross-case comparison within the next step.

Cross-case analysis: In the context of process research, cross-case analysis seeks to identify process patterns across all the cases, the causes that shape these patterns, and the consequences caused by these patterns. However, in order to identify similarities between cases, event sequences observed on a single case basis and described in a *case-specific* vocabulary, have to be transformed into sequences containing events from a common universe of events above all the cases. This can be achieved through *coding*. For example, Sabherwal and Robey (1995) classify all events observed in the event sequences of 50 cases into a set of 15 exclusive and cumulatively exhaustive event categories (cf. Table 4). A similar analysis should be conducted for the consequences and causes. Consequently, all cases can be described by using events, causes and consequences from a common universe. This significantly eases comparison between cases and identifying patterns in the next step.

Various methods have been suggested for identifying common process patterns across cases. These can be distinguished in methods following a *quantification approach* and those following a *qualification approach*. Within the quantification approach, Abbott (1990) distinguishes between methods that identify patterns based on similarities between sequences and similarities among events. For example, the resemblance can be calculated using the number of transformations necessary to transform one sequence into another or based on temporal distances among events. Subsequently, these resemblance measures can be used as inputs for standard classification techniques, such as cluster analysis. Sabherwal and Robey (1995) apply this technique and identified five clusters of information system development processes (cf. Table 4). An advantage of these methods is the objectified identification of sequence patterns. However, these methods usually require a relatively large number of cases. Pentland (1999) criticizes this approach as a "sequence only" approach that merely ignores the causes and consequences of these patterns. Furthermore, rich qualitative information is lost and, with it, a benefit of qualitative research. Therefore, in the class of qualification approaches, relying on visual inspection may help researchers to cope with small numbers of cases and a loss of qualitative information. Once again, researchers could employ visual displays as suggested by Langley (1999) and Miles and Huberman (1994). Graphical representations of standardized event sequences, causes and consequences may be compared between cases in order to identify typical patterns. An important question in this phase is whether the resulting process theory will comprise a single pattern, families of patterns, or different process phenomena. Characteristics of causal and consequential factors can provide useful hints (cf. McPhee 1990, Langley's (1999) "synthetic strategy"). If all cases share the same kinds of causal and consequential factors, which only vary in degree, this may indicate the same underlying process pattern. Different causal factors but the same consequential factors may indicate families of underlying process patterns. Different causal and consequential factors may indicate different process phenomena that underlie the sets of cases. Finally, the identification of deep structures (Pentland 1999) that underlie the process phenomena, as for instance suggested by Van De Ven & Poole (1995) in the context of organizational change, provides further justification for the resulting process theory.

The identification of process patterns, related causes and consequences provides the basis for explanation. The identification of event sequences is especially critical, since "unless a sequence of events can be identified, any theoretical explanation will be suspect" (Pentland 1999, p. 718). The identified process patterns explain the connection between causes and consequences. This explanation should also comprise how and why causal factors shape the identified process patterns and how the

process influences the identified consequences. Langley's (1999) "temporal bracketing strategy" can support explanation purposes. It suggests dividing the process into phases and examining how actions in one period lead to changes in the context, which affects actions in subsequent periods.

Comparison with extant literature: The cross-case analysis step results in a preliminary process theory. Researchers emphasize the comparison of the emergent theory with extant literature (e.g., Eisenhardt 1989, Dubé & Paré 2003, Pettigrew 1997). Similar findings lead to stronger internal validity, wider generalizability, and a higher conceptual level. Conflicting findings indicate the limits of the theory (Eisenhardt 1989).

Since process research requires a wide range of methods and since these methods are less established, one should be able to *set them out* (Shaw & Jarvenpaa 1997). Furthermore, data analysis must remain the *logical link* between data and theory (Miles & Huberman 1994). In addition, qualitative and quantitative *evidence* should be presented to substantiate the results (Dubé & Paré 2003). Table 4 outlines exemplary data analysis choices.

example	within-case analysis	cross-case analysis	derived process theory
Newman & Sabherwal 1996	• preparation of detailed case study description from transcripts • identification of commitment types from case description • joint iterative theory development by authors		• dynamic process model of commitment in IS projects • includes determinants influencing and being influenced by commitment events
Sabherwal & Robey 1995, 1993	• joint preparation of event listing for each case by authors	• coding of events (and actors) into 15 action types • level of actor participation was used to identify classes of ISD processes • calculation of "ideal" pattern for each class	• five ISD process patterns characterized by different levels of actor participation
Currie 2008	• development of case drawings according to implementation life cycle for each case	• phase-wise summary of activities per case and highlighting of factors motivated by institutional theory • analysis of case drawings based on institutional theory to understand process of institutionalization of compliance	• found at macro-level that especially regulative factors release a non-linear institutional change process that resulted in compliance as institutionalized activity

Table 4. Exemplary data analysis choices

5 DISCUSSION AND CONCLUSION

In this paper, we examined how process theory can be addressed with explorative case research. Therefore, we reviewed literature on general explorative case research and on process research. Our analysis resulted in an overall methodology, discussed in the previous section. The methodology consists of three main phases, several substeps, and accompanying quality measures, as summarized in Table 1.

Although we found that the development of process theory can rely on similar basic steps, as suggested in the area of general case research, our examination also showed that it is necessary to refine these steps in order to consider the specifics of process theory. This is primarily the result of different underlying theoretical models within process and variance theory. Consequently, research design should consider different aspects of IS phenomena that can be addressed by process theory and derive tentative factors that help to guide further investigation. Data collection must focus on the process model components and consider the longitudinal perspective of process research. Finally, data analysis ought to focus on identifying and explaining process patterns, causes and the consequences of these patterns. Our analysis shows that process research suggestions can be incorporated in the basic overall steps put forward by general case research in order to refine them toward a methodology specifically for developing process theory by considering process theories' distinguishing features.

Process researchers as well as IS researchers can benefit from these results. Process researchers can rely on a more codified methodology, motivated by a methodology that relies on steps commonly employed in general case research. Quality measures applied in general case research can also be employed in process case research (cf. e.g., Gibbert et al. 2008, Dubé & Paré 2003 for a discussion of quality measures in case research). If process research were to deliberately rely on codified steps and quality measures, this may help develop it more rigorously. Furthermore, providing a methodology for developing process theory via case research may encourage IS researchers to take a process perspective on IS phenomena and thus to obtain a more complete picture of IS phenomena in general. Future research should deepen this discussion by (1) focusing on specific instruments to observe and measure process phenomena, (2) further elaborating on the philosophical foundation, (3) extending this discussion to a deductive theory-testing perspective, and (4) further investigating the incorporation of quality measures by showing how these measures influence quality criteria such as validity and reliability.

References

Abbott, A. (1990). A PRIMER ON SEQUENCE METHODS. Organization Science, 1 (4), 375-392.

Becker, J. and Niehaves, B. (2007). Epistemological perspectives on IS research: a framework for analysing and systemizing epistemological assumptions. Information Systems Journal, (17), 197-214.

Benbasat, I., Goldstein, D. K. and Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. MIS Quarterly, 11 (3), 369-386.

Creswell, J. W. (1994). Research Design: Qualitative and Quantitative Approaches. Sage Publications, Inc.

Currie, W. (2008). Institutionalization of IT Compliance: A Longitudinal Study. In Proceedings of the International Conference on Information Systems (ICIS 2008), December 14 - 17, 2008, Paris, France.

Dubé, L. and Paré, G. (2003). Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations. MIS Quarterly, 27 (4), 597-635.

Dyer, W. G. and Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: a rejoinder to Eisenhardt. Academy Of Management Review, 613-619.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. Academy Of Management Review, 14 (4), 532-550.

Eisenhardt, K. M. (1991). BETTER STORIES AND BETTER CONSTRUCTS: THE CASE FOR RIGOR AND COMPARATIVE LOGIC. Academy Of Management Review, 16 (3), 620-627.

Eisenhardt, K. M. and Graebner, M. E. (2007). Theory Building from Cases: Opportunities and Challenges. Academy of Management Journal, 50 (1), 25-32.

Gibbert, M., Ruigrok, W. and Wicki, B. (2008). What passes as a rigorous case study? Strategic Management Journal, 29 (13), 1465-1474.

Glick, W. H., Huber, G. P., Miller, C. C., Doty, D. H. and Sutcliffe, K. M. (1990). STUDYING CHANGES IN ORGANIZATIONAL DESIGN AND EFFECTIVENESS: RETROSPECTIVE EVENT HISTORIES AND PERIODIC ASSESSMENTS. Organization Science, 1 (3), 293-312.

Gregor, S. (2006). THE NATURE OF THEORY IN INFORMATION SYSTEMS. MIS Quarterly, 30 (3), 611-642.

Klein, H. K. and Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. MIS Quarterly, 23 (1), 67-94.

Langley, A. (1999). STRATEGIES FOR THEORIZING FROM PROCESS DATA. Academy Of Management Review, 24 (4), 691-710.

Lee, A. S. (1989). A Scientific Methodology for MIS Case Studies. MIS Quarterly, 32-50.

Lee, A. S. and Baskerville, R. L. (2003). Generalizing Generalizability in Information Systems Research. Information Systems Research, 14 (3), 221-243.

Lee, A. S. and Hubona, G. S. (2009). A SCIENTIFIC BASIS FOR RIGOR IN INFORMATION SYSTEMS RESEARCH. MIS Quarterly, 33 (2), 237-262.

Leonard-Barton, D. (1990). A DUAL METHODOLOGY FOR CASE STUDIES: SYNERGISTIC USE OF A LONGITUDINAL SINGLE SITE WITH REPLICATED MULTIPLE SITES. Organization Science, 1 (3), 248-266.

Lyytinen, K. and Newman, M. (2008). Explaining information systems change: a punctuated socio-technical change model. European Journal of Information Systems, 17, 589-613.

Markus, M. L. and Robey, D. (1988). Information Technology and Organizational Change: Causal Structure in Theory and Research. Management Science, 34 (5).

McPhee, R. D. (1990). ALTERNATE APPROACHES TO INTEGRATING LONGITUDINAL CASE STUDIES. Organization Science, 1 (4), 393-405.

Miles, M. B. and Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook. Sage Publications.

Mohr, L. B. (1982). Explaining organizational behavior. Jossey-Bass, San Francisco.

Newman, M. and Robey, D. (1992). A Social Process Model of User--Analyst Relationships. MIS Quarterly, 16 (2), 249-266.

Newman, M. and Sabherwal, R. (1996). Determinants of Commitment to Information Systems Development: A Longitudinal Investigation. MIS Quarterly, 20 (1), 23-54.

Orlikowski, W. J. and Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. Information Systems Research, 2 (1), 1-28.

Paré, G. (2004). Investigating Information Systems with Positivist Case Study Research. Communications of the AIS, 13, 233-264.

Pentland, B. T. (1999). BUILDING PROCESS THEORY WITH NARRATIVE: FROM DESCRIPTION TO EXPLANATION. Academy Of Management Review, 24 (4), 711-724.

Pettigrew, A. M. (1990). LONGITUDINAL FIELD RESEARCH ON CHANGE: THEORY AND PRACTICE. Organization Science, 1 (3), 267-292.

Pettigrew, A. M. (1997). What is a processual analysis? Scandinavian Journal of Management, 13 (4), 337-348.

Ramiller, N. C. and Pentland, B. T. (2009). Management Implications in Information Systems Research: The Untold Story. Journal of the Association for Information Systems, 10 (6), 474-494.

Sabherwal, R. and Robey, D. (1993). AN EMPIRICAL TAXONOMY OF IMPLEMENTATION PROCESSES BASED ON SEQUENCES OF EVENTS IN INFORMATION SYSTEM DEVELOPMENT. Organization Science, 4 (4), 548-576.

Sabherwal, R. and Robey, D. (1995). Reconciling Variance and Process Strategies for Studying Information Systems Development. Information Systems Research, 6 (4), 26.

Sarker, S. and Lee, A., S. (1998). Using a positivist case research methodology to test a theory about IT-enabled business process redesign. In Proceedings of the International Conference on Informations Systems (ICIS1998), Helsinki, Finland.

Shaw, T. and Jarvenpaa, S. (1997). Process models in information systems. In Proceedings of the Proceedings of the IFIP TC8 WG 8.2 International Conference on Information Systems and Qualitative Research, Philadelphia, Pennsylvania, United States.

van de Ven, A. H. and Huber, G. P. (1990). LONGITUDINAL FIELD RESEARCH METHODS FOR STUDYING PROCESSES OF ORGANIZATIONAL CHANGE. Organization Science, 1 (3), 213-219.

van de Ven, A. H. and Poole, M. S. (1990). METHODS FOR STUDYING INNOVATION DEVELOPMENT IN THE MINNESOTA INNOVATION RESEARCH PROGRAM. Organization Science, 1 (3), 313-335.

Van De Ven, A. H. and Poole, M. S. (1995). EXPLAINING DEVELOPMENT AND CHANGE IN ORGANIZATIONS. Academy Of Management Review, 20 (3), 510-540.

Walsham, G. (1995). Interpretive case studies in IS research: nature and method. European Journal of Information Systems, 4 (2), 74-81.

Weber, R. (2004). The Rhetoric of Positivism Versus Interpretivism: A Personal View. MIS Quarterly, iii-xii.

Yin, R. K. (2003). Case Study Research - Design and Methods. SAGE Publications.