Exploring Process Theory in Information Systems Research

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Abstract

While variance theories are common in information systems (IS) research, process theories are relatively scarce, and often not as well defined. Process theories are well suited to longitudinal case study research, and highlight the relevant events that unfold over time. Process theories can also be of significant value to the stakeholders involved in information systems, as they provide more guidance for action than variance theories. There are a number of different and inconsistent characterisations of process theory. In this paper we adopt a realist perspective, use Weber's (2012) ontology driven framework for evaluating and developing theories, and explore its utility in representing process theory. We discuss the constructs that may be used in developing a process theory, and provide an example process theory based on dynamic capabilities, that describes how business analytics innovations are introduced within organisations. We conclude the paper with some critical observations about process theory and some suggestions for future work.

1. Introduction

Theory is fundamental to research in IS and the development of rigorous and relevant theory is a significant goal of researchers (Weber 2012). Theory has been characterised in many different ways based on philosophical paradigm, level of abstraction and its focus on variance, process or systems (Burton-Jones et al. 2011; Gregor 2006; Weber 2012). Theory frames how we make sense of the world and enables us to understand, explain and predict phenomena. Theory development and refinement contributes to knowledge about a domain and is of value to other researchers. Development of good theory is important (DiMaggio 1995; Sutton and Staw 1995; Weick 1995) and a challenging task in IS due to the rapid evolution of technology (Weber 2003) and the complex interactions between technical and social systems within organisational contexts (Lee 2001). Theory may also benefit practitioners by providing systematic means of understanding and improving practice in their domain (Gregor 2006; Weber 2012) and provides guidelines for management (Ramiller and

Pentland 2009). "*Nothing is as practical as a good theory*" (Lewin 1945: p 129 from Weber 2012).

We adopt a realist position and define theory as "a particular kind of model that is intended to account for some subset of phenomena in the real world" (Weber 2012, p 4). Theories may vary depending on their purpose and level of abstraction. Theories may be used to describe, explain and predict (Whetten 1989). Theories may be defined at various levels of abstraction including macro, mid-range and micro theories. Macro theories operate with larger aggregates (societies, social processes, structures) and very abstract concepts, such as Giddens's structuration theory (Jones and Karsten 2008). Mid-range theory is less abstract, has narrower scope and can lead to testable hypotheses (Gregor 2006). It may be used to study organisations, groups and communities (Neuman 2000). Mid-range theories may be used as sensemaking devices (Lychnell 2011), and are particularly useful when theorising about process data in IS research (e.g., Newman and Robey 1992; Lyytinen and Newman 2008). Micro theories use very precise constructs, such as the technology acceptance model (Davis 1989) and are well suited to experimental studies.

Theories may be defined as comprising three elements: a set of concepts, associations between the concepts and a boundary (Dubin 1976; Neuman 2000). The concepts should be well-defined and independent and have attributes that are measured. Associations may be of different types, representing simple relationships, sequences and causal relationships (Dubin 1978). Boundaries represent the scope of the theory and need to be clearly defined (Dubin 1978; Weber 2012). Theory may be defined as variance or process depending on the nature of the associations. Variance theories focus on the relationship between the values of attributes of constructs, analysing correlations between the attribute values. Many variance studies examine causal relationships. Process theories examine dynamic phenomena (Mohr 1982) and focus on event chains that show how the history of values of attributes depends on the history of values of other attributes over time (Weber 2012). Burton-Jones et al. (2011) also define a systems type of theory emphasising systems, subsystems and emergent properties.

We focus on process theory. There have been many characterisations of process theory (Markus and Robey 1988; Radeke 2010; Ramiller and Pentland 2009; Recker et al. 2009; Soh and Markus 1995; Weber 2012; Van de Ven and Poole 1995). These vary in emphasis from event sequences where focal actors generate the events (Radeke 2010; Ramiller and Pentland 2009), to associations between concepts that are "necessary" rather than "necessary and sufficient" involving changes of state (Markus and Robey 1988), and sequences of activities or capabilities connected by data flows (Wheeler 2002). Some process theories are complex, involving a large number of concepts at a detailed level of abstraction (Lyytinen and Newman 2008) while other are quite abstract and involve few concepts (Soh and Markus 1995). We seek to understand and clarify this position, and define a framework for process theory that is useful in empirical case study research in IS.

There are three motivations for this paper. First, there is a need to develop a clear framework for process theory in IS at an appropriate level of abstraction. Process research as a distinct approach is not clearly defined and various studies use process theory representations that are inconsistent with each other. Second, because of its emphasis on event chains, process theory provides an ideal means for analysing longitudinal data especially from case study research. This is particularly important and relevant in a practice-oriented domain such as IS research. Third, because process theory attempts to isolate events, which lead to important changes in phenomena, it provides insights into potential points of leverage for management action. It is therefore potentially highly relevant and useful to practitioners (Ramiller and Pentland 2009).

In this paper, we examine process theory within IS research and discuss how it has been used. We identify a strong need for a clear framework for process theory that is suitable for both theory building and theory testing in longitudinal case study research. This is an area that has been largely ignored in the literature (Radeke 2010). We also investigate the potential of Weber's (2012) framework for theory in representing process theory within the context of socio-technical information systems. The research question we address is:

How can process theory be represented and used in IS case study research?

The structure of the paper is as follows. First, we discuss previous work on process theory in IS, including work that discusses process theory specifically and other work that uses process theory in empirical studies. Next we identify the concepts from Weber's (2012) framework for theory that are relevant for a realist framework for process theory. We define the framework and present generic models to illustrate how the framework elements may be used to represent a process. We then use the elements in the framework to describe the Business Analytics Innovation Process Theory, a process theory grounded in dynamic capabilities theory that explains how business analytics innovations are introduced within organisations. Finally, we conclude the paper with some critical observations about process theory and some suggestions for future work.

2. Process Theory in Information Systems Research

This section first discusses how process theory has been defined within IS research, describes different types of process theory and highlights some important empirical IS research undertaken using process theory. Process theory focuses on dynamic phenomena, and comprises three elements: process, change and development (Poole et al. 2000). The *process* element explains how phenomena change over time using cause and effect logic. The *change* element examines differences in form and state of a phenomenon over time. The *development* element focuses on the sequence of change events over time (Poole et al. 2000). Process theories need all three elements in order to adequately explain dynamic phenomena.

2.1. Approaches to Process Theory

Three broad approaches to process theory may be found in the literature: "necessary" causal associations between concepts (Markus and Robey 1988; Soh and Markus 1995), event chains (Lyytinen and Newman 2008; Radeke 2010) and sequences of activities or capabilities (e.g., Wheeler 2002).

Markus and Robey (1988) argue that while variance theories include "necessary and sufficient" associations between concepts, process theories include only "necessary" conditions. This means that the antecedent concept must be true for the consequent concept to be true, but it does not ensure that it will always be true. The logic flow in the theory is therefore non-deterministic, and other more powerful forces may influence the outcome. Another characteristic of this type of process theory is that the outcome is a discrete occurrence representing a "state" of the concept (Soh and Markus 1995). Use of this type of process theory is illustrated by Soh and Markus (1995), although the theory they develop is at a high level of abstraction and would be difficult to use in empirical research.

Event chains have been proposed as a key characteristic of process theories (Lyytinen and Newman 2008; McLeod and Doolin 2012; Sabherwal and Robey 1995; Van de Ven and Poole 1995). In this type of process theory event chains are the prominent concept. Each event has an antecedent (originating condition) and consequent (outcome of the event). Event chain process studies have frequently involved large and complicated sequences of events (Lyytinen and Newman 2008) and are able to capture rich details about longitudinal IS phenomena. These studies do not provide a rigorous definition of precisely what an event is or how events relate to other constructs in the theories.

The third approach to process theory defines process as a sequence of activities or capabilities, connected by information flows (Crowston 2000; Wheeler 2002). In the Net-Enabled Business Innovation Cycle (NEBIC), Wheeler (2002) defined a series of four capabilities that occur in a sequence. Wheeler argues that his NEBIC theory is suitable for both variance and process research, and suggests unfolding event chains as a means of empirical process research, but does not explain how events relate to the capabilities in his theory.

2.2. Types of Process Theory

Van de Ven and Poole (1995) define four types of organisational change process theory, by mapping the mode of change (prescribed or constructive) with the unit of analysis (single or multiple entities). The types of theory are lifecycle (single entity and prescribed), evolutionary (multiple entities and prescribed), teleological (single entity and constructive), and dialectic (multiple entities and constructive).

Life-cycle process theories are characterised by a sequence of events following a deterministic and predictable path, culminating the formation of a final product. Examples include innovation models and group decision-making phases (Van de Ven and Poole 1995).

Evolutionary process theories are characterised by a sequence of events shaped by competitive survival among entities due to scarce resources. The sequence of events follows a probabilistic path of variation, selection, and retention. Examples include punctuated equilibrium theories (Arnott 2004), which have been used in studies of the alignment of IS and organisational strategy and structure (Sabherwal et al. 2001).

Teleological process theories are characterised by the purposeful action of a group of individuals who act together to reach a goal state. There is no prescribed sequence of events: rather, a set of possible (equally effective) paths to achieve a goal that is defined. An example is theories related to strategic planning (Van de Ven and Poole 1995).

Dialectic process theories are characterised by the conflict of opposing entities (thesis and antithesis) that compete with each other for power and control. A sequence of events describes the process of confrontation of opposing forces and the resolutions that may occur intermittently over time. An example is models of negotiation in strategy (Van de Ven and Poole 1995).

2.3. Weak and Strong Process Theory

More recently, Van de Ven and Poole (2005) defined two further types of process theory, by mapping epistemology (variance or process narratives) with ontology (as primarily things or processes). The two types of process theory relevant for this paper are weak process theory (process narrative involving things) and strong process theory (process narrative involving processes).

Weak process theories adopt a transactional perspective of the temporal occurrence of key events. The world comprises things, whose state is changed by sequences of events. This is a traditional view of process theory that has been used widely in organisational change research (Van de Ven and Poole 2005). An advantage of this approach to process research is the ability to observe and empirically investigate processes. However, the focus on changes to things rather than on the processes themselves and the characterisation of time as a series of intervals has been criticised as a weak definition of process (Van de Ven and Poole 2005).

Strong process theories view the world as comprising processes as emergent organising activities and things as “reifications of processes”. In this type of process theory, time is socially constructed by people and intertwined within organisations and cultures. This type of process theory leads to rich and complex descriptions of process and is undertaken using interpretivist research approaches (McLeod and Doolin 2012; Van de Ven and Poole 2005).

2.4. The Need for an Improved Definition of Process Theory

There are many varied approaches to defining process theory and to undertaking process research in IS. Many empirical process studies involve complex and detailed narratives of emergent process (e.g., Lyytinen and Newman 2008; McLeod and Doolin 2012). These studies typically involve analysis of complex event chains and cover a wide range of concepts. Other process studies are at a high level of abstraction and would be difficult to use in empirical research (e.g., Soh and Markus 1995; Wheeler 2002). There is a strong need for process theory that is mid-level and can be readily used in empirical case study research in IS (Radeke 2010).

Our aim is to explore the potential of Weber's (2012) framework for theory to develop a framework for process theory that is rigorously defined and suitable for process theory building and evaluation. The framework will be mid-range (Neuman 2000), of the "weak" process theory type (Van de Ven and Poole 1995) and based on realist ontology (Weber 2012). We follow the approach of Milton et al. (2010) and provide a detailed description within each of the key states, of the activities that lead to the changes of state. The definition of key states and state transitions provides a basis for defining propositions. The framework is described in the next section.

3. A Framework for Process Theory in IS

We base the framework for process theory on Weber's insight that a theory provides "a representation of how a subset of real world phenomena should be described" (Weber 2012, p 3). According to Weber, theories are essentially 'specialised ontologies' that should be rigorously defined rather than based on ideas that are vague and imprecise. In this section we provide brief definitions of the fundamental constructs that we use in our framework for process theory. These include things, classes (of things), attributes, states and events.

The parts of any theory are its constructs (attributes in general), associations, states and events. Variance theories include constructs, associations and states. They describe associations between the constructs of one of more classes and relate the values of one construct with the values of another construct. Process theories include all four elements and time. An association in a process theory relates the history of values of instances of one construct within the history of values of instances of another construct. Process theories describe the changes of state and hence the events over time. The boundary of a theory is defined as the set of parts of the theory (Weber 2012).

The fundamental construct in the ontology described in Weber (2012) is the *thing*. The world is made of substantial and conceptual *things* that have *properties*. We use this fundamental construct in our framework for process theory.

Class

A *class* comprises things that have at least one property in common. Class is an important construct in our framework as it enables us to clearly define the classes included in a particular process theory. Furthermore, these same classes may be used in related variance theories, thus enabling process and variance theories to be defined using shared constructs.

Attribute

Attributes are our perceptions of the properties of things. *Attributes in general* belong to classes, and *attributes in particular* belong to specific things or instances in classes. *Attributes in particular* represent the value of a property of a particular instance. Both attributes in general and attributes in particular can be intrinsic or mutual. *Intrinsic attributes* represent properties of individual things or classes of individual things. *Mutual attributes* represent properties of two or more particular things or classes of things.

State

A *state* of a thing is defined as a “vector of attributes in particular” (Weber 2012, p 4), that is, a set of values at a point in time. A change in state occurs when at least one attribute changes value. State is a key construct in process theories and may be defined at various levels of abstraction. Identification and representation of the important states is an important skill in designing process theories. Note that a high-level state may comprise a number of finer-grained states that we do not model in our abstraction. We document high-level states as a description of the events that lead to the changes of state (Milton et al. 2010). The level at which to model key states is a choice made by the researcher (Simsion et al. 2012). The *history* of a thing is a sequence of its states.

Event

An *event* is the change of a thing from one state to another state, in other words a change in the values of one or more attributes in particular. One event might create the conditions where a new event becomes possible (lawful). As we focus on modelling key states, each of which may have finer-grained states, it is possible to have finer-grained events that we do not model in our abstraction. However, we do describe each as a collection of activities that lead to the changes of state (Milton et al. 2010).

3.1. Elements of Process Theory

We define the elements of process theory at two levels. At the first level we define the classes, attributes and associations that comprise the theory. This partly clarifies the boundary of the theory, but also enables process and variance theories to be defined using the same classes and attributes. For process theory we then focus on the history of events that change the state of things. For variance theory we focus on the covariance between attributes (constructs in the theory). This enables a clear understanding of the relationship between process and variance theories involving the same system of things (Sabherwal and Robey 1995). In this generic process theory, the associations represent the dependency of the history of events in one thing on the history of events in another thing (or in the same thing). For example, the class model may depict the generic process of the SAP ERP implementation method in an organisation (a single class of the phenomenon) and may contain attributes such as cost of ownership analysis, SAP implementation project plan, change management and training, data center, solution stack and test plan, etc. (Anderson 2003; Francalanci 2001). A generic first level process theory is shown below in Figure 1.

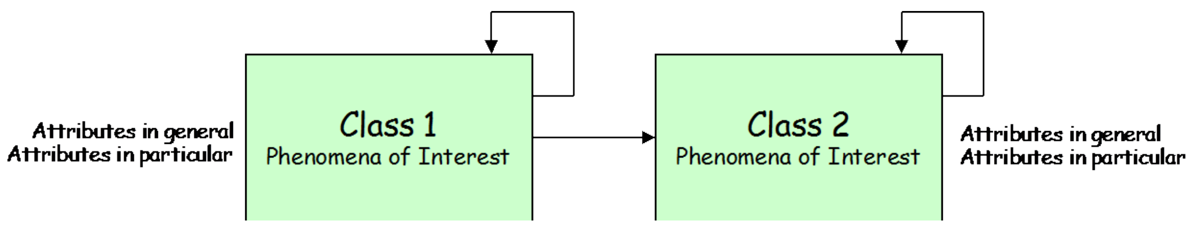

Figure 1: **Class Model for “Generic” Process Theory**

For process theory we define the second level of theory as a state transition model using states and events. The states represent a particular set of values of attributes in particular of things. As the possible state space can be very large, we focus on the key states that are required to represent and understand the process and include the key events that cause transitions between these. Using our example, the SAP ERP implementation will consist of a sequence of the key states, i.e. project preparation, sizing and blueprinting, functional development, final preparation, and ‘go live’ state (Anderson 2003; Francalanci 2001), where each subsequent state is te result of the completion of a preceding state. A generic state model for process theory is shown in Figure 2.

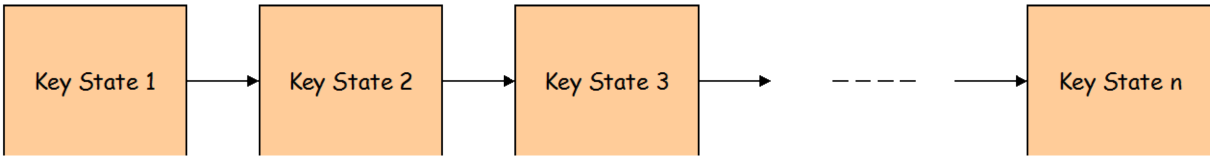

Figure 2: **State Model for "Generic" Process Theory**

The state model may be used to generate propositions for testing of the form:

> Completion of detailed events in the Key State 1 *is necessary for* transitioning to Key State 2.

Each of the key state transitions may be used to generate a proposition. Empirical data from case studies may be analysed using pattern matching to check that the detailed events within a key state have been completed.

4. The Business Analytics Innovation Process Theory

In this section we present an example of a process theory developed using the principles described in the previous section. The Business Analytics Innovation Process (BAIP) theory explains how business analytics innovations are introduced into organisations, and change operational capabilities leading to value (Shanks and Bekmamedova 2012). Business analytics systems, including data warehouses, reporting, analytics processing, data mining and data visualisation, enable managers and other decision-makers to interpret organisational data to improve decision-making and optimise business processes (Watson and Wixom 2007).

To develop the BAIP theory we synthesised and adapted concepts from our previous evolutionary process model (Shanks and Bekmamedova 2012), the net-enabled business innovation cycle (NEBIC) (Wheeler 2002), the resource-based based view (Wade and Hulland 2004) and dynamic capabilities theory (Baretto 2011; Teece et al. 1997). We first present a brief discussion of the underlying theoretical background and then describe our Business Analytics Innovation Process (BAIP) theory.

4.1. Underlying Theory

The resource-based view argues that organisational resources are the basis for improved firm performance (Wade and Hulland 2004). Organisational resources that are valuable, rare, inimitable and non-substitutable provide value and competitive advantage (Barney 1991). Capabilities are organisational routines and processes that combine tangible human and technical resources with intangible resources including knowledge assets and culture to enable value creation. The resource-based view has been criticised as too static in turbulent environments and dynamic capabilities are proposed as a means of renewing and reconfiguring organisational resources to respond to rapidly changing environments (Teece et al. 1997).

Dynamic capabilities are "the capacity of an organisation to purposefully create, extend or modify its resource base" (Helfat et al. 2007, p 4). They may be conceptualised as comprising several simpler capabilities, for example *search* for new opportunities, *select* opportunities that are most likely to be of value, and *orchestrate assets* to develop new resources and reconfigure resource configurations (Baretto 2011). Wheeler (2002) developed a similar conceptualization of dynamic capabilities in his NEBIC process model that explains how organisations create business value through net-enabled innovations. Wheeler's simpler capabilities include *choosing* enabling/emerging technologies, *matching* with economic opportunities, *executing* business innovation for growth and *assessing* customer value.

4.2. Defining the Business Analytics Innovation Process Theory

The first level of the BAIP theory is shown in Figure 3 below. The class, business analytics innovation, represents the focal phenomenon. Each business analytics innovation changes state as it is being developed, until it is fully developed and put into production. Over time, there will be many instances of new innovations that each lead to changes to the BA capabilities, which in turn leading to value and competitive advantage.

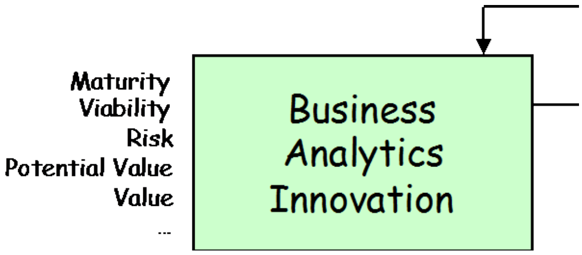

Figure 3: **Class Model for Business Analytics Innovation Process Theory**

A *business analytics innovation* involves the identification, justification, implementation and measurement definition for a business analytics initiative (Wheeler 2002). Previous empirical research has shown that business analytics innovations are distributed throughout organisations, are evolutionary in nature and rely on entrepreneurial managerial actions (Shanks and Sharma 2011). Consequently, our unit of analysis is a business analytics innovation, with each innovation corresponding to a discrete information systems project. An important attribute of a business analytics innovation is its value, measured using financial, behavioural and perceptual indictors (Wheeler 2002).

The second level of the BAIP theory is shown in Figure 4, where state sequences are defined. The Business Analytics Innovation class has been defined using a *life cycle* process theory, as it is follows a predictable path (Van de Ven and Poole 1995). The BA Option State involves identifying, assessing, deciding about the timing and viability of innovations (Wheeler 2002). Some BA innovations progress beyond this state to the BA Innovation Business Case State. Here, BA innovations are subjected to careful scrutiny including fit with business strategy, shifts in customer and business trends, risk assessment and cost-benefits analysis. Some BA innovations progress beyond this state to the BA Innovation Implementation State. Within this state, the innovation is implemented, including technology development and integration, reconfiguration of business processes, training, and possibly recruitment. After the innovation is ready for use within the business, measures are developed to assess the value of the innovation (Wheeler 2002). After the measures are developed, the BA innovation is ready for use in the organization and is transitioned to the BA Innovation In production State. Detailed descriptions of the activities within each state follow.

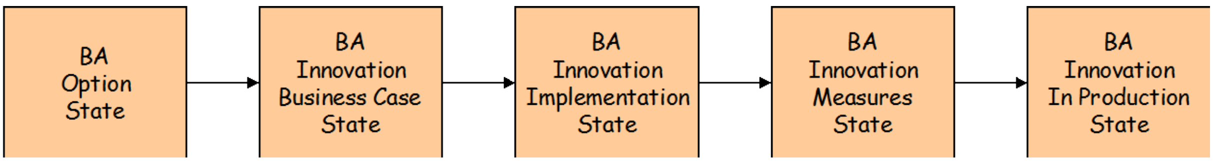

Figure 4: **State Transition Model for Business Analytics Innovation Class**

4.2.1 BA Option State

A BA Option is an innovative use of data and BA technology to generate insight that may be of use to the organization. Various stakeholders including BA specialists, business users, or managers may suggest BA options. Innovations may come from new developments in business analytics technology, vendor marketing, insights generated by business analytics experts analyzing organizational data or users with experience using business analytics systems (Wheeler 2002). New BA opportunities may be identified from sources including BA specialists analysing organizational data, BA software vendors, competitor activities, and creative ideas from business users and managers. The maturity of the BA technology and its fit within the organization's business processes and current IT infrastructure needs to be assessed. The viability of the BA innovation and its alignment with the organisation's business strategy needs to be determined (Shanks and Bekmamedova 2012, Wheeler 2002). When these events are completed, some BA options are ready for further analysis and a transition to the BA Innovation Business Case State occurs.

4.2.2 BA Innovation Business Case State

The BA Innovation Business Case State involves matching economic opportunities with the selected BA option by developing a business case (Wheeler 2002). This includes assessing each BA option in terms of capital commitment required, shifting customer or business trends, risk to the organisation, and allocation of resources including time, people and management attention (Wheeler 2002; Shanks and Bekmamedova 2012). Also, it includes alignment with organisational goals and strategic priorities (Davenport et al. 2010; Seddon and Constantinidis 2012; Wheeler 2002). Many data-driven insights remain hidden until entrepreneurial actions bring them into focus and to the attention of management (Wixom and Watson 2001). After a BA innovation has been subjected to the rigorous development of a business case, some are selected for implementation and a transition to the BA Innovation Implementation State occurs.

4.2.3 BA Innovation Implementation State

The BA Innovation Implementation State includes organisational routines for project management, change management including user training, clear communication channels and a culture that embraces change (Wheeler 2002). Potential obstacles to implementation include political resistance within user groups and power-based issues between functional areas. The implementation includes the reconfiguration, integration, acquisition and divestment of resources to align with the new BA innovation (Wheeler, 2002). Governance mechanisms are important in allocating decision rights and identifying stakeholder responsibilities within the implementation process (Shanks et al. 2011). After a BA innovation has been successfully implemented, a transition to the BA Innovation Measures State occurs.

4.2.4 BA Innovation Measures State

Defining measures for BA innovations enables an organisation to assess the impact of the implemented BAI solution. Typically the measures involve financial (e.g. revenue, costs), perceptual (e.g. customer satisfaction) and behavioural measures (e.g. rate of usage of BA insights). Each of these measures has a time lag from the initial implementation of the BAI solution. For example, some financial indicators will not be apparent for some time, and some perceptual measures are forward looking indicators (Wheeler 2002). The impact of BA innovations will also evolve over time due to cognitive factors including system familiarity, analyst and peer interaction, and training (Shanks and Bekmamedova 2012). Consequently a time series analysis of measures for BAI innovations may be useful. After BA innovation measures have been defined, a transition to the BA Innovation In Production State occurs.

4.2.5 BA Innovation In Production State

The BA innovation is now used in production and its impact is monitored. Measures are used to determine the effectiveness of the BA innovation and provide feedback to the activities within the BA innovation process (Wheeler 2002).

4.3. Propositions from the Business Analytics Innovation Process Theory

Four propositions may be defined from the BA Innovation Process Theory. These are each based on the key events or key state transitions that are defined in the theory.

P1 Completion of detailed events in the BA Options State *is necessary for* transitioning to BA Innovation Business Case State.

P2 Completion of detailed events in the BA Innovation Business Case State *is necessary for* transitioning to BA Innovation Implementation State.

P3 Completion of detailed events in the BA Innovation Implementation State *is necessary for* transitioning to BA Innovation Measures State.

P4 Completion of detailed events in the BA Innovation Measures State *is necessary for* transitioning to BA Innovation In Production State.

5. Discussion

We offer some critical observations about using Weber's (2012) framework for developing and evaluating process theory in information systems. Weber has clearly articulated a detailed, rigorous and soundly based definition of the key concepts used in theory within the realist tradition. His framework has provided a sound base on which to define the elements of a process theory. The example provided within Weber (2012) is a variance theory: this paper has used his framework to define an example of a process theory, the BAIP theory. While there is insufficient space to provide full details about the BAIP, we argue that there is sufficient detail to understand some of the issues that arise.

1. A significant benefit of using Weber's framework is the ability to define both variance and process theories from the class model. Weber highlights the importance of carefully defining constructs in theories as attributes in general of classes and ensuring that they are not "proxies for the same underlying property in general" (Weber 2012, p 8). Associations within a well-defined class model form the basis for variance research studies. Similarly, the same class model can be used in process research by focusing on states and events over time. This enables both the variance and process approaches to be used to better understand the focal phenomena. Process models can be used to explain the 'why' of variance models.
2. The issue of human agency needs further attention. Although a process theory may be defined using the constructs class, attribute, state and event, many events are caused by human agency. We have included what people do in our descriptions of key states, following the approach used by Milton et al. (2010) who described 'cognitive processes' in this way. However, agents have been acknowledged as the antecedents of many important events that occur in process models. Agents "provide a thread that ties the events…together" (Van de Ven and Poole 1995, p 1386). More research is required to better understand how to include intentional agency and human actions into process models represented with the constructs provided in Weber (2012).

3. The process theory we define is a mid-level theory, based on Weber's (2012) criteria for theory evaluation. This is an appropriate level for case study research as it is neither too narrow and precise, nor too broad to be well-defined (Weber 2012). Concepts in the theory were developed from a synthesis of previous theoretical and empirical research (Baretto 2011, Shanks and Bekmamedova 2012, Wheeler 2002).
4. The framework for process theory that we describe can be used for both theory building and theory testing in longitudinal case study research. In its present form, the BAIP theory can readily be used in theory testing, following Yin's (2009) guidelines for conducting hypothetico-deductive case study research. We have defined four propositions based on the BAIP process theory that may be tested. Data collected from longitudinal case study research can be organised into event sequences and state sequences and then pattern matching can be used in data analysis to evaluate the process theory. Detailed event sequences may be matched with activities defined within state descriptions, following the approach used by Milton et al. (2010). Similarly, data collected from longitudinal case study research can be organised into event sequences, and clustered into key states and transitions (events) (Radeke 2010) to build process theory based on the framework proposed in this paper.
5. The approach we have used has been labelled *weak* process research as we adopt a transactional perspective of the sequence of key events with a focus on things and their states (Van de Ven and Poole 2005). We argue that this approach has great value as it facilitates the use of both variance and process approaches to research using the same well-defined set of classes. This is appropriate within a realist world perspective. *Strong* process theories, with their emphasis on the emergent organising activities where time is socially constructed by people, are valuable for interpretivist research approaches (Van de Ven and Poole 2005). Such approaches give fuller recognition to human agency as a motor of processes. Design decisions regarding the level of abstraction at which to model the phenomena of interest, as classes are very important. There is a trade-off between precision, clarity and parsimony.
6. The BAIP theory is novel and provides a sound theoretical base for building and testing explanations of how BA-enabled innovations can be introduced into organisations to bring benefits. It provides a strong starting point for future empirical research.

6. Conclusion

There is a strong need for process theory in information systems research. We have explored the utility of Weber's (2012) framework for evaluating and developing process theory in the information systems discipline, and identified a number of issues that need further consideration. We have proposed a framework for process theory, and provided an example of how we might use the framework in developing a process theory for innovation with BA systems. Further work is planned to refine and enhance the BAIP theory ready for longitudinal case study research.

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8. References

Anderson, G.W., (2003), SAP Planning: Best Practices in Implementation, Sams Publishing.

Arnott, D., (2004), "Decision Support Systems Evolution: Framework, Case Study and Research Agenda", European Journal of Information Systems, Vol. 13, No. 4, 247-259.

Barney, J., (1991), "Firm Resources and Sustained Competitive Advantage", Journal of Management, Vol. 17, No.1, 99-120.

Barreto, I. (2011), "Dynamic Capabilities: A Review of Past Research and an Agenda for the Future", Journal of Management, Vol. 36, 256-280.

Burton-Jones, A., McLean, E., Monod, E., (2011), "On Approaches to Building Theories: Process, Variance and Theories", Working paper, Sauder School of Business, University of British Columbia.

Crowston, K., (2000), "Process as Theory in Information Systems Research", Proc. IFIP WG 8.2 International Conference: The Social and Organizational Perspective on Research and Practice in Information Technology, Aalborg, Denmark, 149-166.

Davis, F. D., (1989), "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly, Vol. 13, No. 3, 319–340.

DiMaggio, P.J., (1995), "Comments on 'What Theory is Not", Administrative Science Quarterly, Vol. 40, No. 3, 391-397.

Dubin, R., (1978), Theory Building, The Free Press, NY.

Francalanci, C., (2001), "Predicting the Implementation Effort of ERP Projects: Empirical Evidence on SAP/R3", Journal of Information Technology, Vol. 16, No. 1, 33–48.

Gregor, S., (2006), "The Nature of Theory in Information Systems", MIS Quarterly, Vol. 30, No. 3, 611-642.

Helfat, C.E., Finkelstein, S., Mitchell, W., Peteraf, M.A., Singh, H., Teece, D.J., Winter, S.G., (2007), Dynamic Capabilities: Understanding Strategic Change in Organisations, Blackwell, Carlton.

Jones, M., Karsten, H., (2008), "Giddens's Structuration Theory and Information Systems Research", MIS Quarterly, Vol. 32, No. 1, 127-157.

Lee, A., (2001), "Editor's Comments – MIS Quarterly's Editorial Policies and Practices", MIS Quarterly, Vol. 25, No. 1, iii-vii.

Lychnell, L.O., (2011), "An Event-based Approach for the "Intermediate Step" in Process Studies of IT-related Organisational Change", Systems, Signs, and Actions, Vol. 5, No. 1, 84-99.

Lyytinen, K., Newman, M., (2008), "Explaining Information Systems Change: A Punctuated Socio-Technical Change Model", European Journal of Information Systems, Vol. 17, 589-613.

Markus, L., Robey, D., (1988), "Information Technology and Organizational Change: Causal Structure in Theory and Research", Management Science, Vol. 34, No. 5, 583- 598.

McLeod, L., Doolin, B., (2012), "Information Systems Development as Situated Socio-Technical Change: A Process Approach", European Journal of Information Systems, Vol. 21, 176-191.

Milton, S., Rajapakse, J., Weber, R., (2010), "Conceptual Modeling in Practice: An Evidence-Based Process-Oriented Theory", Proc. of the 5th International Conference on Information and Automation for Sustainability, IEEE, 533-536.

Mohr, L.B., (1982), Explaining Organisational Behaviour the Limits and Possibilities of Theory and Research, Jossey-Bass, CA.

Neuman, W.L., (2000), Social Research Methods: Qualitative and Quantitative Approaches, 4th Ed., Allyn and Bacon, USA.

Newman, M., Robey, D. (1992), "A Social Process Model of User-Analyst Relationships", MIS Quarterly, Vol. 16, No. 2, 249-266.

Poole, M.S., Van de Ven, A.H., Dooley, K., Holmes, M., (2000), Organisation Change and Innovation Processes: Theory and Methods for Research, Oxford University Press.

Radeke, F., (2010), "How to Rigorously Develop Process Theory Using Case Research", Proc. of the 18th European Conference on Information Systems, Pretoria, South Africa.

Ramiller, N., Pentland, B., (2009), "Management Implications in Information Systems Research: The Untold Story", Journal of the Association of Information Systems, Vol. 10 No. 6, 474-494.

Recker, J., Rosemann, M., Indulska, M., Green, P., (2009), "Business Process Modeling - A Comparative Analysis", Journal of the Association for Information Systems, Vol. 10, No. 4, 333-363.

Sabherwal, R., Robey, D., (1995), "Reconciling Variance and Process Strategies for Studying Information Systems Development", Information Systems Research, Vol. 6, No. 4, 303-327.

Sabherwal, R., Hirschheim, R., Goles, T., (2001), "The Dynamics of Alignment: Insights from a Punctuated Equilibrium Model", Organisation Science, Vol. 12, No. 2, 179-197.

Shanks, G., Sharma, R., (2011), "Creating Value from Business Analytics Systems: The Impact of Strategy", Proc. of the 15th Pacific Asia Conference on Information Systems, Brisbane, Australia.

Shanks, G., Bekmamedova, N. (2012), "Integrating Business Analytics Systems with the Enterprise Environment: an Evolutionary Process Perspective", Proc. IFIP WG 8.2 International Conference: Fusing DSS into the Fabric of the Context, IOS Press, Amsterdam, NL.

Simsion, G., Milton, S., Shanks, G., (2012), "Data Modelling: Description or Design", Information and Management, Vol. 49, No. 3-4, 151-163.

Soh, C., Markus, L., (1995), "How IT Creates Business Value: A Process Theory Synthesis", Proc. International Conference on Information Systems, paper 4.

Sutton, R.I., Staw, B.M., (1995), "What Theory is Not", Administrative Science Quarterly, Vol. 40, No. 3, 371-384.

Teece, D.J., Pisano, G., Shuen, A. (1997), "Dynamic Capabilities and Strategic Management", Strategic Management Journal, Vol. 18, No.7, 509-533.

Van de Ven, A. and Poole, M.S. (1995), "Explaining Development and Change in Organisations", Academy of Management Review, Vol. 20, No. 3, 510-540.

Van de Ven, A., Poole, M.S., (2005), "Alternative Approaches for Studying Organisational Change," Organisation Studies, Vol. 26, No. 9, 1377-1404.

Wade, M., Hulland, J., (2004), "The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research", MIS Quarterly, Vol. 28, No. 1, 107-142.

Watson, H.J., Wixom, B.H., (2007), "The Current State of Business Intelligence", Computer, Vol. 40, No. 9, 96-99.

Weber, R., (2003), "Editor's Comments – Theoretically Speaking", MIS Quarterly, Vol. 27, No. 3, iii-xii.

Weber, R., (2012), “Evaluating and Developing Theories in the Information Systems Discipline”, Journal of the Association of Information Systems, Vol. 13, No. 1, 1-30.

Weick, K. E., (1995), “What Theory is Not, Theorizing is”, Administrative Science Quarterly, Vol. 40, No. 3, 385-390.

Wheeler, B., (2002), “NEBIC: A Dynamic Capabilities Theory for Assessing Net-Enablement”, Information Systems Research, Vol. 13, No. 2, 125-146.

Whetten, D., (1989), “What Constitutes a Theoretical Contribution?” Academy of Management Review, Vol. 14, No. 4, 490-495.

Yin, R.K., (2009), Case Study Research: Design and Methods, 4th Ed., Sage Publications, Thousand Oaks.