Linking Reasoning to Theoretical Argument in Information Systems Research

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Nixon Muganda Ochara, PhD
Department of Informatics, University of Pretoria,
Pretoria, South Africa
nixon.muganda@up.ac.za

ABSTRACT
This paper looks at the application of theory in research by linking theory use to reasoning and the influence of paradigms. The paper relies on how theory is conceptualized in the philosophy of science and an argument is advanced that theoretical reasoning is the basis of logic in the research process. Theoretical reasoning, which we consider as a social, interactive, goal-directed tool of persuasion for creating scientific knowledge, is considered as the precursor to argumentation typically visible in research products such as journal papers, theses, dissertations, working papers as well as public debates and arguments. Argumentation is then linked to the various reasoning modes: abduction, deduction, induction and retroduction. The function of theory in the various modes of reasoning is highlighted and examples provided.

Keywords
Information Systems Theory, Abduction, Deduction, Induction, Retroduction, Research, Philosophy

INTRODUCTION
In the 2003 AMCIS Conference, Truex, Holmstrom and Keil outlined a process of properly adapting theories in Information Systems research. They followed the conference paper with a paper in the Journal of the Association for Information Systems, (Truex, Holmstrom, & Keil, 2006) in which they further reinforce the need for proper procedures for adapting theories in research. In their latter contribution, and relying on the domain of escalation theory, they put forth recommendations related to considering: the fit between a particular theory and the object of inquiry; the theory’s historical context; impact of the theory on the chosen research method and how the theorizing process contributes to theory development. On the whole, Truex, Holmstrom & Keil (2006) predominantly focused on shedding light on why it is important to adapt theory by explicitly recommending the four principles, yet what was not reflected upon is how to attain the adaption of the theory to the object of inquiry, the research strategy and the theorizing process. So the contribution that we seek is focus on how to adapt theory to different modes of reasoning, especially relevant for IS research. We do not claim that the contribution is original, but that there is no cogent synthesis of how theory is linked to reasoning in extant literature. The literature that exists is sometimes domain specific, especially drawing on the nature of a particular philosophical perspective or paradigm, whether from critical theory, positivism, interpretivism or critical realism. So part of the claim we are making to theoretical contribution is coherently, in a single piece of writing, highlight how theory needs to be adapted in research, in spite of the philosophical orientation of research. So, the research question that we seek to address in this paper is: How can IS researchers adapt theory to particular modes of reasoning?

There are four general modes of reasoning in research that scientists use to developing theoretical arguments in order to generate new knowledge: retroduction, induction, deduction and abduction. Deduction and Induction are the two most common modes of reasoning in Western research that results in the acquisition of new knowledge (Spens & Kovacs, 2006; (Hyde, 2000). In deduction, a theory (or a set of concepts from various theories) is used to explain or make predictions about (deduce) what will be observed empirically (Miller, 2003). The deductive approach is a theory testing process. Inductive reasoning is a generalizing approach that entails a theory development process that starts with observations of specific instances and seeks to make generalizations regarding the object under inquiry (Lee & Baskerville, 2003). Retroduction and abduction, less well known and explicitly acknowledged in scientific contributions, stems from our perception that advances
in sciences are not limited to deductive and inductive reasoning alone, but that retroductive and abductive reasoning equally contribute to acquisition of knowledge in the research process. In Charles Pearce’s conception of abduction, retroductive is considered as a synonym or as a part of the abductive process; yet he left room for other conceptualizations that distinguished between the two terms. We consider abduction to be a reasoning process for explaining a puzzling observation(s). Pino-Perex & Uzcategui (2003) defines this form of reasoning as a process of inferring the best explanation of an observation. We see this as explanations sought for observations from other research processes such as induction and deduction which is related to its more recent use which is linked to the notion of ‘Inference to the Best Explanation’ (IBE) associated with the ‘Harmanian abduction’ (see Paavola, 2006). We relate the fourth mode of reasoning, retroduction, to the ‘Hansonian abduction’ (see Paavola, 2006) as a form of discovery for generating new ideas (research). Thus while abduction may account for discoveries or explanations during the latter stages of scientific inquiry, retroduction has potential for accounting for the generation of ideas and insights during the early stages of scientific inquiry.

There has been an inadequate and/or fragmented coherent synthesis and attention to how theory can be adapted to these four modes of reasoning which reinforces our focus on the research question posed above. Part of the issue relates to the influence of philosophical assumptions (Guba & Lincoln, 1994) - ontological, epistemological and methodological, that have been dominant in the Information Systems discipline. The ontological issue concerns a questioning of the nature of reality and truth and bring to light the essence of phenomena under investigation, by emphasizing beliefs about human rationality and beliefs about social relations (Orlikowski & Baroudi, 1991). The view as to whether the empirical world and its phenomena is objective and independent of human conception as opposed to a more subjective view which only exists by humans creating and recreating reality has been dominant in the Information Systems discipline. The epistemological issue is concerned with an examination of the conditions, possibilities, nature and limits of human knowledge and therefore which criteria need to be met to construct and evaluate knowledge (Dabermark, Ekstrom, Jakobsen, & Karlsson, 2002). The methodological question seeks to find ways of generating knowledge and how scientists go about obtaining it. There is no single choice regarding these ontological, epistemological and methodological issues, but these philosophical assumptions influence how we conduct research, including the theories that we use and how we use them (Klein & White, 1996). These assumptions help to distinguish between different categories of philosophies of science or paradigms (positivism, interpretive, critical, critical realism) that have had varied influences in Information Systems partly linked to a historical legacy. For instance, the influences of positivism and interpretive philosophies of science have had the most influence due to their long dalliance with the discipline, while critical realism (Dobson, 2002; Wikgren, 2005; Mingers, 2004; Wynn, Jr. & Williams, 2012) and critical research (Walsham, 2005; Stahl, 2008) are currently making headway. Therefore, as we develop the thesis of linking reasoning to theoretical argument (adapting theory to research), we take cognizance of these philosophical influences as a way of contextualizing theory use in research. When these assumptions become dominant within a particular scientific community, their influence becomes visible in the modes of reasoning adopted by the scientists within that paradigm. Thus from a historical perspective, you find deduction within the positivist paradigm; induction, within the interpretive paradigm; while retroduction and abduction within the critical realist and critical paradigms.

While the issue of adapting theory in research may be considered as a generic issue in many disciplines, we particularly focus on IS since it has broader transformational impact, transcending its traditional home in business schools towards greater diversity and linkage with other disciplines, that may yet provide a greater justification for in-depth understanding of the need to understand how to adapt theory (typically from various disciplines) in IS research. Thus the greater transformational impacts of IS, not only in business, but also in the public sector can help in realizing Baskerville & Myers’s argument that IS has come of age and should occupy its position as a reference discipline (Baskerville & Myers, 2002). Thus as IS transcends its traditional boundaries which largely focused on the application of IS in organizations, there is greater need to understand how the diversity of theories that have been used should be better adapted in research strategies. We recognize that there have been contributions that have highlighted how theory is used in research (see Klein & White, 1996); however, our contribution is in linking theory use to specific modes of reasoning.

This paper proceeds as follows: In section two, the role of theory in the philosophy of science is highlighted as well as discussing various theoretical categorizations in IS research. In section three, we discuss the meaning of reasoning and the logic of theoretical argument in order to provide traction; while section four explicates how theory fits within the different modes. In the last section, we conclude with a summary and a synthesis of preliminary implications for research and practice.

THEORY IN THE PHILOSOPHY OF SCIENCE

In this section, we seek to answer and remind ourselves of two questions: What is theory as used in the philosophy of science? What is the purpose of using theory in research? While the questions are broad and complex, the answers to these two questions shall provide traction to the succeeding argument on how to adapt theory for specific research strategies. Again, the paper does not lay claim to providing original answers, but only in as far as they aid in the narrative that is
developed throughout the paper. As a starting point, we broadly concur with Bacharach (1989)’s assertion that theory is a linguistic device which is used to organize a complex empirical world, and as such, Hall and Lindzey links it to its function as that of “preventing the observer from being dazzled by the full blown complexity of natural or concrete events” (Hall & Lindzey, 1957, p.9). Thus as a linguistic device, theory helps in organizing phenomena parsimoniously and in communicating clearly (Bacharach, 1989). We deliberately apostate towards the general view that theory is a linguistic device in order to advance the notion of science as being value laden and mediated by the theoretical choices that we make. The value – laden nature of theory orients subjective in which research propositions and their link to evidence are mediated by theoretical assumptions selected by a researcher. Such theoretical choices made by the researcher are a function of language, as a structuring device as well as for projecting a particular position(s) regarding a research phenomenon.

More specifically, and borrowing from the philosophy of science, theory is regarded as [...] a series of logical arguments that specifies a set of relationships among concepts, constructs, or variables, even though [...] a collection of constructs and variables does not necessarily make a theory (Bacharach, 1989; Whetten, 1989). From this conceptualization by Bacharach (1989), the primary goal of a theory is to answer the questions of how, when, and why related to the nature of a particular object of inquiry; in contrast to description which consider questions related to what. Other philosophers, such as Dabermark, Ekstrom, Jakobsen, & Karlsson, (2002, p.15) consider theory as a device used to understand the world pointing to something external to the theory; but recognize that theoretical influence is limited by stating that “facts are theory-dependent but are not theory-determined”. Part of their assertion is that we can understand the world through research and scholarly investigation, but also that reality cannot be determined through empirical observation alone. All theories also have a boundary which sets the limitations for applying the theory. These aspects of theory play a role in making the argument that the use of theory in research cannot be value-free.

The other question relates to the purpose and nature of theory. In understanding the purpose and nature of theory in research, Gregor, (2006) regards theory as abstract entities that are aimed are describing, explaining and enhancing understanding of the world, and in some cases, to provide predictions of what will happen in the future and to give a basis for intervention and action. In considering the nature of theory in IS, we recognize that there are two broad forms of theory: grand and middle range theories (Merton, 1967), even though there are other typologies (see Gregor, 2006). Merton (1967) considers grand theories as those that operate at a more abstract and general level; while middle range theories operate in a limited domain and represent an attempt to understand and explain a limited aspect of social life. Trux, Holmstrom & Keil (2006) acknowledge that while the theoretical typologies are different, they all share a common theme: that all research begins with a common research question of interest. It is these research questions asked that direct the researcher on how theory will be used or developed.

THEORETICAL REASONING AS THE LOGIC OF ARGUMENTATION IN THE RESEARCH PROCESS

For effective research, a researcher must understand the role of theoretical reasoning in the research process, bearing in mind that the goal of scholarly writing is to present original ideas and convince readers that these ideas are valid by setting forth well – reasoned arguments. Mills asserts that research without underlying theoretical reasoning is meaningless information; and on the other hand, that theory, without research is abstract and speculative (Mills W. C., 1959). The implication is that reasoning is linked to theory in research. We start by posing the question: What is reasoning? What is argument? What is deliberation? This paper does not purport to offer a conclusive definition of reasoning, deliberation and argument, since the three concepts are philosophical subjects and discourses surrounding their differences continue (see Walton, 1990; Mercier & Sperber, 2011; Godfrey-Smith & Yegnashekan, 2011; Mercier & Landemore, 2012). These discourses have been ongoing since the times of Aristotle to date, but scientific inquiry has continued and contributions to scientific knowledge continue despite differences. Therefore, we adopt and adapt definitions that take cognizance of that fact and realize that underlying the research process; the concepts of reasoning and argument play a part. Govier (1989) considers that:

“An argument is a publicly expressed tool of persuasion. Typically it takes thinking to construct an argument. Reasoning is distinguished from arguing along these lines: reasoning is what you may do before you argue, and your argument expresses some of your (best) reasoning. But much reasoning is done before and outside the context of argument

“[Govier, p. 117]

What is our understanding of this definition? (1) argument, in the context of research that we do, is a tool (such as a thesis, paper, dissertation, various forms of presentations and speech acts), used publicly with the intention of persuading others. (2) Therefore, what researchers express in these public outlets are their best forms of reasoning; implying that researchers may discard other arguments that are not as persuasive as the one(s) that are publicly expressed. However, what is publicly expressed does not necessarily imply the only form of argument possible. (3) Constructing an argument requires thinking which can be either an internal process in which reasoning is considered as a mental and psychological procedure for changing one’s point of view (Harman, 1984); or an external linguistic sociological process of interaction. In both (internal
and external), the emphasis is on the thinking process, which is not complete until we make public commitments to our point of view. (4) Reasoning precedes argument, and is done outside the context of argument. This latter aspect of the definition brings out an important distinction between the two concepts which is related to the purpose of the two. The first is that reasoning does not always occur in argument, implying that reasoning (outside the context of argument), can be aimless; while argument is goal-directed. Of course this form of reasoning also implies that there is a purpose (such as solving a practical problem), but the “aimless” connotation of reasoning is where there is no form of argument. This brings us to the notion of argument which is considered by Walton (1990) as a social and verbal means of trying to resolve, defend or criticise a thesis (point of view) where a difference or conflict exists. It is in this process of defending, criticizing or contending with a point of view (claims, propositions, and premises) that best reasons are advanced to resolve differences. Thus in this sense, when a researcher takes a particular position (thesis), they go through a process of reasoning, which, once public expressed (in dialogue), become and argument.

We would therefore place many of the scientific writings, such as journal paper, theses, literature reviews and academic presentations in the category of dialogue. Thus in research, as a goal-oriented activity, reasoning must take place in an argument. We therefore define theoretical reasoning as a social, interactive, goal-directed tool of persuasion for creating scientific knowledge. The implication for such a view is that the function of reasoning relevant for the research that we do is argumentation – devising and evaluating rational theoretical arguments intended to persuade as well as to form new conclusions and beliefs (Godfrey-Smith & Yegnasahkaran, 2011; Mercier & Sperber, 2011; Driver, Newton, & Osborne, 2000). We argue that reasoning, while in many cases, is implicit to the logic of scientific inquiry; the need to be more explicit may improve the evaluation and contribution to scientific knowledge.

APPLYING THEORY IN THE REASONING PROCESS

One issue remains: how do researchers and scientists use theoretical arguments in the reasoning that they engage in? If, as we had argued earlier that reasoning precedes argument, then the reasoning styles and their application becomes a primary part of the scientific process, with the various methodologies as subservient to the reasoning process. Thus, when Walsham (1995), as well as Eisenhardt (1989), propose that theory (theoretical argument) maybe involved in research in a number of ways: as an initial guide to research design and data collection; as part of an iterative process of data collection and analysis and as an outcome of the research project; the role of a particular reasoning mode must be explicit in order to appropriately situate the scientific contribution. It is how reasoning styles are applied in these theoretical roles that are currently problematic and it is our hope that synthesizing these roles in a single paper will enable researchers and students appreciate the role of reasoning in science. In the following sub-sections, we explore how these modes of reasoning link to theoretical argument in the research process.

Retroduction: Conceptualizing the Process of Discovery

Research continues to recognize the role that theory plays during problem conceptualization. Sæther (1998), while writing on the concept of retroduction, argues that an understanding of how to use theory either as an ‘ordering framework’ or as a ‘conceptualization’ is still problematic. Seeing theory as an ‘ordering framework’ permits observational data to be used for predicting and explaining empirical events, since empirical investigations are necessarily theory laden (Sæther, 1998). Theory as a conceptualization means prescribing a particular way of forming ideas and notions about the phenomena studied which makes it possible to consult and redevelop theory in a close relationship with empirical investigation (Sæther, 1998). It is this latter view (i.e. theory as ‘conceptualization’) that we believe make theory a critical and explicit component of research problem conceptualization. In this view, we find support from Lynham (2002) who linked conceptual development of theory as emanating from “informed conceptual framework that provides an initial understanding and explanation of the nature and dynamics of the issue, problem, or phenomenon that is the focus of the theory” (p. 231). Our interpretation is that one way or another, theory or theoretical concepts (from various theories) must form the basis for a preliminary understanding that a researcher has of a research problem (remember: it could be individual, organizational or societal issue). DiMaggio (1995), while reiterating the three views of what a theory should be, captures one of its uses as that of providing ‘enlightenment’; and Gelso(2006) specifically mentions that theory can be used for idea generation. Thus the use of theory in the initial process of research problem conceptualization is well established (Sæther, 1998; Udo-Akang, 2012; Gelso, 2006; DiMaggio, 1995; Lynham, 2002) and there are other exhaustive sources that have addressed the issue.

Some examples of how theory has been used as part of idea generation suffices are this point. Let us take the issue of requirements engineering (RE) as a process in information systems development (ISD), which is concerned with developing accurate requirements for a proposed information system, primarily by eliciting information from users and other organizational stakeholders. RE is therefore an inherently social process, involving the contribution of individuals working in an organizational context. Furthermore, failures in the RE process will potentially lead to systematic failures in the products...
that are produced as a result. Thus literature still considers RE to be a problematic process in ISD and studies continue to date that tries to address the issue (Appan & Browne, 2012; Muganda, Asmelash, & Mlay, 2012). Appan and Browne (2012), in their study, try to understand the problem of RE, looks at the impact of analyst-induced misinformation during the RE process. They look at the RE problem from a communication perspective, by linking the concept of misinformation as a general phenomenon in human behaviour, which helps them to build a case for viewing RE’s failure to be linked to the misinformation effect. In their own words, they state that:

\[\ldots\] we use the misinformation effect literature to develop our own theoretical basis to argue that when asked to provide requirements, users are likely to recall misinformation introduced by analysts rather than their true beliefs and knowledge of facts (Appan & Browne, 2012, p. 86).

The authors clearly admits to using misinformation effect literature to build a case for viewing RE as a communication problem; however, by no means does it suggest that when starting out, they only looked at misinformation effect literature. They may have looked (reasoned) at various other theoretical bases, before deciding on the misinformation effect as a more plausible lens for positioning the problem, in a preliminary sense. Thus the authors argument for using the misinformation effect literature and theories does not exclude the fact that they explored other theoretical bases, and what we see in their paper (as a public expression) simply crystallizes their argument. The question is: so what? Yes, it has been established that theory is used in the initial development of a research problem, but we feel, that while researchers employ theory to aid in an initial understanding of a problem, the explicit recognition of the underlying reasoning mode is rarely explicit or acknowledged. We make the case that implicitly or not, researchers who employ theory in problem conceptualization engage in retroductive reasoning.

The basic idea behind retroduction dates back as far as Aristotle, and much more recently Charles Peirce, but we adopt Roy Bhaskar’s conceptualization that refers to the use of reason and imagination to create a picture or model of the structures or mechanisms that are responsible for production of observed phenomena. The logic of retroduction involves moving back from observations to the creation of a possible explanation. Let us dissect the word ‘retroductive’ in order to understand the true meaning of this reasoning process. The prefix "retro," originates from Latin and has to do with going backwards and Chiasson (2005) emphasizes that there is an implication of deliberately going backward for a particular purpose. In other words, the implied meaning of the word “retroactive” is choosing to go back to an earlier stage to make something operative (or to explain something better, or to improve something).

Earlier in this section, we highlighted how research ideas are formed, which we argue, relates to the ‘hunch’ highlighted in the quotation. In other words, research starts with some form of hunch, either by observing (individuals, organizations, society, and artifacts); which, if they are in an undesirable state, we seek to research on (to understand, explain, explore, predict). However, from a retroductive perspective, it behooves researchers to explore further on the “hunch”, by focusing on the context (case) that interest them and by attempting to frame the research problem from a particular theoretical base. In other words, in an attempt to understand the problem that a researcher has a hunch about, they inevitably and recursively explore further into literature and initial empirical observations in order to frame the problem better. The hunch can be regarded as the initial empirical observation of events and the probing into literature for a theoretical framing a researcher to establish, a priori, a theoretical boundary. This affords us to make the claim that before proper conceptualization of the problem, scientists go through the retroductive process of establishing the fundamental models or theoretical frames of reference which they use to organize their initial ideas, observations, hunches and reasoning. What eventually appears as an argument (as a public expression) belie the fact that there has been a recursive process that has been followed before a particular argument is put forth for justifying the conceptualization of a problem. Thus it is claimed that in retroductive reasoning, theory comes before research in order to discover the processes and /or structure that can be used in a preliminary sense to understand or explain a problem.

In concluding this section, what researchers need to ask themselves is: what is the role of theory during the retroductive process? Of course the role of theory is implied in the discussion above, however, we emphasize, borrowing from Klein & White (1996) that theory plays two major roles in retroductive inference:

1. **Establishing Connectedness:** Theories are used during the retroductive process to conceptualize research problems by seeing how various ideas and “hunches” by the researcher are interconnected. The various conceptual elements within a theory (theories) allow the researcher to see distinctions and commonalities that are useful in framing the research problem in tandem with particular theory/theories.

2. **Interpretation:** Theories help make sense of the mechanisms by which certain phenomena operate. (Truex, Holmstrom, & Keil (2006) emphasize this role further by stating that: “[…] theory guides the process of making sense of complicated and often contradictory real-world phenomena. Theory acts as a lens through which we focus and magnify certain things, while filtering out others things presumed to be “noise.” (p.800). A researcher, on starting out on a research journey, is faced with a context that displays some interesting problem/opportunity worthy
of study, which requires some preliminary interpretation to understand. Thus some theoretical perspective may be used to interpret the context before data collection starts, even though there is caution that researcher should be careful not to fall into the trap of the ‘blinking effect’ where later analysis and conclusions are influenced by the guiding theory.

Deduction: Theory Testing

Deduction or deductive reasoning, typically linked to research in the positivist tradition or paradigm, uses ‘explicit theories’ (Miles & Huberman, 1984) considered as sets of organised concepts and their interrelationships; as an organizing model for an empirical study. In deductive reasoning, a researcher is required to postulate an explicit theory (ies) that can be tested and the results of such testing will enable us to learn whether the theory fits the observed facts. The theory is then revised accordingly to help in better predicting the reality we are interested in understanding. Dubin notes that using theory as an organizing model requires a researcher to consider three main elements that need to be considered: a set of well-defined concepts (or constructs); interrelationships between the units; and a boundary within which the theory holds (Dubin, 1978). We use a prototypical example of global e-commerce adoption to illustrate the nature of deductive reasoning and how a theoretical argument is developed based on the three elements of explicit theory that need to be considered (See Dubin, 1978).

Gibbs, Kraemer, & Dedrick (2003), an article titled “Environment and Policy Factors Shaping Global E-Commerce Diffusion: A Cross-Country Comparison” were interested in understanding the extent and impact of Internet and e-commerce diffusion among different countries, vis-à-vis the globalization debate. They specifically focused on identifying the key factors shaping e-commerce diffusion across ten countries. They developed a conceptual framework in which they posited that the adoption of e-commerce is driven by forces in the global environment that are intermediated by national environmental and national policy factors (Gibbs, Kraemer, & Dedrick, 2003). In other words, e-commerce adoption is a function of global environment, intermediated by national environmental and national policy factors. They frame their study from a globalization perspective by considering only four main concepts. The first concept is linked to the problem they seek to address, i.e. to understand the extent and impact of e-commerce adoption. They limit their definition of e-commerce to Internet-based e-commerce, which is excluded from the non Internet – based forms such as Electronic Data Interchange (EDI). The second, global environment with its indicators comprising of processes such as globalization of production and markets, multinational corporation (MNC) strategies, open trade regimes, and global competition. The third concept, national environmental factors related to a country’s demographics, economic and financial resources, information infrastructure, industry structure and competition, organizational environment, and social and cultural factors such as consumer preferences. Lastly, national policy factors such as liberalization of telecommunications and IT markets, government promotion initiatives for e-commerce and IT in general, and e-commerce legislation. In their findings, confirm (through empirical testing) that the conceptual framework they posited is a useful way of organizing the key factors influencing e-commerce diffusion. While Gibbs, Kraemer, & Dedrick (2003) develops their conceptual framework by adopting a globalization perspective, Zhu & Thatcher (2010) adopts an institutional perspective by positing that global e-commerce adoption is influenced by the national information ecology (government policy; legal environment; social and cultural infrastructure) moderating by GDP per capita. The key constructs for Zhu & Thatcher (2010) are government policy, legal environment, social cultural infrastructure.

In light of Dubin’s elements of theory, we notice the following: first, at the conceptual level, a researcher needs to identify constructs (in the case e-commerce adoption, global environment, national environment and national policy) developed from a particular theoretical perspective (globalization). Klein & White (1996) consider that scientific theories, as lenses to a particular phenomenon, do not examine every possible aspect of the object under scrutiny. Therefore, when Gibbs, Kraemer, & Dedrick (2003) adopted a globalization perspective; while Zhu & Thatcher (2010) adopted an institutional view, a theoretical boundary is being imposed on the phenomenon under study which has implications on the generalizing claims that can be made in deductive approaches. So, a key process in developing theoretical arguments through deductive reasoning is to clearly delineate the theory perspective, in other words, which theory will explicitly be used to understand, explain and predict the phenomenon you are interested in studying. So, while theory use in retroductive reasoning was used for idea generation and problem conceptualization, in deductive reasoning, a particular theory is now applied to the problem in order to test the veracity of the propositions developed from the theory in relation to the research problem.

Secondly, after identifying the constructs, each must theoretically (clarity of meaning from a particular theoretical perspective) and operationally (variables and indicators for measurement) be defined. Operational definition directs a researcher to think about the indicators of the constructs, in other words, how the constructs are to be measured. For instance, national environmental construct is found in the conceptual model by Gibbs, Kraemer, & Dedrick (2003), with one of its indicators (measures) identified as information infrastructure. The measure for information infrastructure is taken to mean...
the number of telephone subscribers per 1000 in the population. The intention of providing such precise definitions is to enable researchers collect data for relevant for the specific variables (such as information infrastructure). Therefore, when Klein & White (1996) suggests that one of the functions of theory is to provide guidance, we see this as implying that theory enables data collection. Relate this to survey research, where researcher have to construct a questionnaire for data collection. Typically, the questions in the questionnaire are the variables, and these are typically adopted or adapted from existing questionnaires from particular theories or theoretical frameworks. Of course when a researcher is adapting or adopting a questionnaire, it must have been developed from a particular theory of conceptual framework (derived from a number of theories or concepts) and the purpose of the instrument is to help in data collection. The idea is the data so collected, can only be interpreted, in light of the propositions that were developed from the theory that has been adopted. Therefore, the subsequent analysis is geared towards testing these propositions or hypotheses.

Thirdly, the adoption of theory implies that the deductive reasoning process assumes an objective reality, which can rationally be investigated, explained and predicted (Guba & Lincoln, 1994). This assumption is in line with Dabermark, Ekstrom, Jakobsen, & Karlsson, (2002, p.15) assertion that theory is a device used to understand the world and points to something external (reality) to the theory. In other words, the propositions (from theory) that are posited by the researcher have some logical connection to the reality of the phenomenon being investigated. The researchers then use the facts (data collected) to confirm or refute the logical connections that were postulated from the theory. The confirmation and refutation of the logical connections are attained by adopting particular research methods. It is thus true, when Klein & White (1996) reason that theory can be used for explanation as well as prediction. From a theoretical perspective, and given the assumption that reality is objective, the theory preliminarily provides an explanation of why and how the reality logically works; while the confirmation or refutation is realized through observations of how reality actually works. We emphasize the role of the research methods since different research techniques provide different ways of helping the researcher link the theoretical logical connections to the observations. For instance, regression analysis usually employed as an associational technique in statistical analysis enables a researcher for explanation as well as for prediction.

In the process of constructing a theoretical argument by using theory from the positivist perspective, three functions can be identified from Klein & White (1996) description of theory purposes; guidance, prediction and explanation:

1. **Guidance**: Theories guide researchers in developing and testing hypothesis. Research can be designed in an effort to support or refute a specific theory or concepts from various theories connected in the form of a conceptual framework. In this role, existing theory informs the development of hypotheses, the choice of variables, and the resultant measures (in questionnaires or interview schedules) which researchers intend to use.
2. **Prediction**: Theories should be useful for predicting future outcomes found in research. Knowing what a theory predicts can contribute to guiding research toward confirming or invalidating the prediction. Even if predictions are not confirmed, however, it may be the conditions under which the theory operates that need to be adjusted, rather than discarding the theory itself.
3. **Explanation**: Theories provide possible answers to “why” and “how” questions

**Induction: Towards Abstraction**

Handfield & Melnyk (1998) reminds us that a major objective of any research is to create knowledge by “building new theories, extending old theories and discarding either those theories or those specific elements in current theories that are not able to withstand the scrutiny of empirical research” (p. 321). This is considered as a key objective of any inductive research active, which implies that development of theory is a key outcome especially research undertaken from an interpretive mode. Venkatesh, Brown, & Bala (2013) links theory development to induction, which they consider as a process of developing meta-inferences from observations undertaken qualitatively or quantitatively. Of course, the process of developing meta-inferences can be associated to a deductive process as well; however from an inductive perspective, researchers should first develop a substantial body of empirical observations (data) that will allow them to formulate concepts that are fundamental to the theory that is developed (Locke, 2007). Forming logical connections from the concepts so derived by identifying causal mechanisms lead to the development of a coherent theory as an outcome of the research process. Therefore, in as far as empirical observations and findings of the research process can be generalized to more abstract and coherent concepts; the outcome of theoretical argument using inductive reasoning is theory. Thus in inductive reasoning, we begin with specific observations and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories – a process of abstraction.

However, in order to ‘see’ the role of theory in abstraction, Klein & White (1996) suggest interpretation as a useful metaphor that can aid in our understanding the process of theory development. We see the process of interpretation as an activity of ‘theme’ identification and development towards the goal of evolving concepts as a precursor to a theory (theoretical modification). From an epistemological perspective, this view allows us to make a claim that forms of interpretation for
theory development involve some form of ‘inductive thematic analysis’ and grounded theory approach (see Braun & Clarke, 2006). First, in an inductive approach, the themes identified are strongly linked to the data themselves (Patton, 1990), and as such, this form of interpretation allows us to link the data directly to the concepts that are eventually developed for the final product: the theory. As an illustration, research by Leidner & Kayworth, (2006) provides a useful illustration of how interpretation results in theory development. The authors sought to improve understanding on the linkage between culture and IT, by looking at how the two concepts have been reported in academic journals. Their ‘data’ was the journal articles, but may as well have been interviews, primary documents, observations, etc. They adopt thematic analysis leading to the development of six themes of IT-culture research emphasizing culture’s impact on IT, IT’s impact on culture, and IT culture. Building upon these six themes, they develop a theory of IT, values, and conflict (Leidner & Kayworth, 2006).

We also see Klein & White’s (1996) function of accumulation as playing a role in the process of theory development, especially in situations where interpretative data analysis is analyst – driven based on a researcher’s theoretical interest. Theories or a theoretical framework can be used inductively to accumulate and organize their research findings. A theoretical framework can help select and arrange research findings in ways that are meaningful and helpful for improving the overall understanding of the empirical observations. Theory becomes part of an iterative process of data collection and analysis: The iterative approach allows the theoretical position to be developed as data collection and analysis proceed. For instance, Braun & Clarke (2006) talk of ‘theoretical’ thematic analysis which is driven by the researcher’s theoretical or analytic interest in the area, and is thus more explicitly analyst-driven. This form of thematic analysis tends to provide less a rich description of the data overall, and more a detailed analysis of some aspect of the data, guided by a particular theoretical lens. Studies in information systems (Ngwenyama & Lee, 1997; Cukier, Ngwenyama, Bauer, & Middleton, 2008; Muganda, Joubert Jr, Du Toit, & Johnson, 2012) employ the ‘theory of communicative action’ (TCA) as a conceptual lens for understanding discourses surrounding information systems artifacts. In these studies, TCA is specifically employed as a theoretical frame, whose concepts or themes are used, not only to guide in data collection, but more important in data interpretation. Using theory in this form allows a researcher, faced with large volumes of data, to pick only those aspects of the data that align with the theory that has been adopted. Thus the theory acts as a frame for data accumulation, which aids in structuring the interpretation according to the analyst’s theoretical interest.

This means that once a researcher has collected data, mostly case study data, then the researcher ‘looks’ for a theory or model or groups of themes (from various data sources/models) to help in analyzing and understanding the data. Thus, some prior theoretical categorization or influence during the process of data collection and analysis is inevitable during the research process. The link of theory to data accumulation and analysis is in line with Mills C. W. (1959) comment that research without any underlying theoretical reasoning is simply a string of meaningless bits of information. In sum, developing theoretical arguments using inductive reasoning requires that theory is used for accumulation of research findings; and through the process of interpretation, theory also becomes an outcome of the process.

**Abduction: Seeking the Best Explanation**

The prefix “ab” originated from Latin and means “away from”. When the “ab” (away from) is combined with the suffix “ductive” (to lead), then abduction means “leading away from”. In a researcher’s perspective, what is the implication of leading away from? We arrive at these scientific laws through logic and evidence. So, having looked at retrodiction, as instrumental in conceptualization of research problems; induction as a bottom up approach towards theory construction and deduction as a mode of reasoning for theory confirmation; we turn to abduction, as the mode of reasoning that aids scientists in forming the best explanation during the process of creating scientific knowledge. Recall that in all the reasoning approaches so far, there is some aspect of empirical observation involved, where a researcher has to collect data to assess how it fits the context under investigation. There comes a time when a researcher has to be able to explain their observations or evaluate the confirmation/theory employed through the process. In attempting to make explanations, a researcher may further seek out literature inferences to help in confirming/rejecting theory/hypotheses or seek some other creative or insightful explanation and/or prediction outside the domain of current knowledge. It is this process that is referred to as abduction and in line with its semantic meaning of “leading away from”, the implication is that the researcher seeks the “best explanation” as inferred from empirical observations or from confirmation/dis confirmation of theory used to evaluate the empirical observations. Harman (1984) refers to this abductive form of inference as “Inference to the Best Explanation”.

Josephson & Josephson (1994) explains it further by considering it as a form of theory – forming or interpretive inference, where one goes from describing something to a proposition that best explains or accounts for the data. Abduction is further considered by Danermark (2002) as providing an opportunity for scientists to understand something in a new way by observing and interpreting this something in a new conceptual framework; while Minnameier (2004) emphasizes Charles Peirce characterization of abduction as the only type of inference that is creative in the sense that it leads to new knowledge, especially to (possible) theoretical explanations of surprising facts.
In summing up the role of theory in abductive reasoning, we note that in scientific writings, what appears as the synthesis of data analysis, after further interrogation of literature as well, conclusions are arrived at through a reasoning process referred to as “inference to the best explanation”. Again, by the time the knowledge is written or publicly expressed in some way, it becomes an argument and sometimes the intended audience is unaware of the various alternatives that were discarded before the researcher arrived at what they consider as the best explanation. During abduction, theory becomes an outcome of the scientific process of research. Thus, when researchers are involved in research where they end up with frameworks, models, theories or even hypotheses, abductive inference is employed towards realization of the outcome.

CONCLUSION

Part of our argument in this article, was to position reasoning as a precursor to theoretical argument while the outcome of such a process, and the outcome of an argument, publicly expressed, is scientific knowledge. Thus far, we have been able to link reasoning and argument to theory; and theory is used in various ways during the knowledge generation process as nets to catch ‘the world’ (Karl Popper, 1992 – 1995, philosopher). By using Klein & White (1996) categorization of functions of theory, we pinpointed how theory is used in the four main modes of reasoning: retroduction, deduction, induction and abduction. A number of implications are envisaged:

First, in developing a theoretical argument, researchers need to realize that rarely does all researchers problems are approached from a particular theoretical perspective, which informs how research problems are conceptualized. In formulating a research problem, a theoretical perspective, which may not necessarily inform the rest of the research, is therefore at play. Predominantly, the theoretical perspective at this level is typically at macro-level, influencing how we conceptualize a research problem. We positioned the retroductive mode of reasoning as critical at this stage of problem conceptualization. Secondly, while deduction and induction have received extensive treatment in the literature and links with the two main paradigms of positivism and interpretivism that are predominant in Information Systems, there has been no explicit recognition that retroductive reasoning is actually employed at the beginning of the research process. By placing the retroductive mode of inference at the beginning of the research process, we recognize that there is no research that begins without some form of theoretical influence. As researchers, we have historical, cultural, personal, professional and educational influences which ‘nudge’ as to look at research problems or opportunities from a particular perspective. Explicitly recognizing the role of retrodution in research is likely to enable our theoretical arguments resonate better with our audiences. Thirdly, if the goal of any research endeavour is to generate scientific knowledge (theory, modified theory), then research carried out from any paradigmatic influences must engage with the abductive mode of inference at the end of the research process. So, while recognizing that retroduction and abduction are sometimes treated as synonyms (see (Josephson & Josephson, 1994), we get support from the distinction we have made between the two (See (Dabermark, Ekstrom, Jakobsen, & Karlsson, 2002) to ground their use, from a practical research perspective, for different roles in the research process. We feel this is a more pragmatic view, especially for emerging researchers and students who are typically concerned with epistemological issues related to research.

REFERENCES


