REVOLUTIONARY RESEARCH STRATEGIES FOR E-BUSINESS MANAGEMENT: A PHILOSOPHY OF SCIENCE PERSPECTIVE FOR RESEARCH DESIGN AND DATA COLLECTION IN THE AGE OF THE INTERNET

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ABSTRACT

Just as the Internet has changed the way many businesses conduct business, the Internet can also change the way academic researchers gather data. We describe revolutionary research strategies that employ six new data-collecting methodologies that can be employed using Internet technology. *Data-collecting agents* can gather very large amounts of data from the World Wide Web in a fraction of the time and the cost that it takes to gather data using traditional research methodologies. *Online experiments, online judgment tasks,* and *online surveys* expand the reach and reduce the cost when compared to traditional experiments, judgment tasks, and surveys. Because of the vast amounts of data available online, *quasi-experiments* can be conducted that allow the researcher to find subjects that meet some stimulus and some control without taking them out of their own environment. Finally, *log files* track a person's movements and actions through a Web site. This article investigates the use of these relatively new tools from a philosophy of science perspective. We find that these new data collecting tools can enable research that is difficult or impossible when using traditional, non-online research methodologies. Using Runkel and McGrath's (1972) "Three-Horned Dilemma" model for traditional research methodologies as a base, we develop a framework that illustrates the strengths and weaknesses of these new tools. This article also provides a critical review of the literature that analyzes how these revolutionary data-collecting techniques are employed when examining theoretical development of e-business phenomenon.

KEYWORDS: Data collection, electronic commerce, empirical research, information systems, philosophy of science, research methodologies, online surveys, software agents.

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INTRODUCTION

The United States Census Bureau defines *e-business* as any process that a business organization conducts over a computer-mediated network, such as the Internet (Mesenbourg, 1999). This includes electronic commerce transactions, reputation system postings, and other activities that business may conduct over the Web. There has been tremendous growth in e-business transactions over the last several years, despite the dot.com bubble burst, and this growth trend is likely to continue. BizRate (www.bizrate.com), an online business tracking company, reports that business-to-consumer (**B2C**) e-commerce spending increased 34% in 2002, from US$36 billion in 2001 to US$48 billion in 2002. Reports for business-to-business (B2B) sales are even more impressive, with relatively conservative estimates from *eMarketer* (www.emarketer.com), a market research firm, showing that world-wide B2B sales have increased from US$474.32 billion dollars in 2001 to US$823.48 billion dollars in 2002 and are expected to reach US$1.41 trillion dollars in 2003 and reach the US$2.37 trillion mark in 2004.[1] Online auctions are included in the B2C surge. In the second quarter of 2003, eBay, the premier online auction retailer with over 80% of the online auction market share, reported record net revenues of US$509.3 million, up 91% from the same period in 2002.

For researchers, the growth over the last five years in e-business has produced a wealth of data that few might have imagined would become available. For example, most online auction sales are public and viewable by researchers. And e-tailers, such as Amazon (www.amazon.com) and Barnes and Noble.com (www.bn.com), list their prices online, allowing researchers to track price changes

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[1] For details, the interested reader should visit the *eMarketer* Web site, www.emarketer.com, and other sites. The numbers presented here are conservative. Forrester Research (www.forrester.com) projects US$ 6.2 trillion by 2004 and Global Reach (www.glreach.com) projects an even higher US$ 6.8 trillion by 2004.

and competition. Meanwhile, the UseNet news group lists have messages that number in the trillions. Moreover, online comments are available on everything from reactions to transactions with "bricks and mortar" business to reactions to online auction sales to growth projections from stock analysts.

While much has been written about the benefits that the Internet will have on the ease of commerce, very little has been written on the benefits that the Internet will have on research data collection and research design. Researchers have often been faced with problems involving inadequate sample size, unrealistic representation of constructs, faulty time constraints, and unacceptable cost constraints. This article discusses revolutionary strategies for research design and data collection for e-commerce and e-business-related research in a way that reflects a maturing awareness of the new capabilities of information technology and the World Wide Web. We do this with a philosophy of science perspective, so that it is possible to see how current advances have the capacity to conceptually change our conduct of research. We also consider some of the newer approaches to data modeling and hypothesis testing, such as structural equation modeling, where there are new opportunities and emerging research techniques that make it possible to obtain more subjects in a population sample, in turn, supporting more valid and statistically significant findings and new depths of managerial insight. Some of the new research tools that we will discuss also reflect somewhat different approaches, making substitution of new research designs and analysis methodologies for some of the old, tried-and-true ones. Data collection on the Internet has the potential to provide virtually equivalent data collection capabilities that can generate more subjects with lower costs, fewer strict assumptions, greater realism, and less contamination of research subjects.

We develop theory-based arguments and illustrations that are intended to answer the following research questions:

- How can data collection be enhanced through the use of Web tools?
- What types of research are made possible using Web tools that were previously infeasible with traditional research methodologies?
- What different approaches are required for specific types of e-business research?
- How can we understand the nature of the underlying changes in research from the multiple points of view that are present in the philosophy of science?

We answer these questions by examining the use of new data-collecting tools in the context of existing literature. We develop a framework that illustrates the strengths and weaknesses of these new tools from a philosophy of science perspective. We then examine articles that employ these data-collecting techniques with respect to theory generalization, theory building, theory verification, and hybrid theory construction to address specific challenges in e-business research. Overall, our conclusions point to the revolutionary nature of the advances that are occurring in research design and data collection for a variety of e-business management research.

LITERATURE

Before we discuss how more efficient data collection techniques change our capabilities to develop effective research designs that will answer key research questions, we first consider the basis for this kind of an inquiry in philosophy of science terms, and with respect to the current measurement models that are typically used in IS and e-commerce-related research. Our assessment is based on existing literature and it highlights the advantages of efficient data collection using data-collecting agents. It also points out a new way for researchers to think about some of the

emerging opportunities that they are likely to encounter, affecting their ability to produce useful knew knowledge to improve the process of e-business management.

Inquiry Systems and Empirical Research

C. West Churchman (1971), the leading commentator on the practice and process of management science research in the last generation, defines *inquiry* as an activity that uses observational data to produce knowledge. The approach to developing new knowledge in the Churchmanian view allows for the possibility of behavioral adjustments to be made by researchers, when the circumstances of scientific inquiry change or evolve. This occurs, for example, when new technologies allow the investigation of emerging research questions and innovative research designs to be undertaken, when they would be difficult or impossible without this new technology. Churchman describes five different inquiring systems that can be used for research: the Leibnizian, Lockean, Kantian, Hegelian and Singerian. The first four inquiring systems are named for different philosophers, each of whom viewed knowledge acquisition through a particular inquiring system lens. The fifth, Singer, was Churchman's doctoral advisor, and someone who made had a great personal impact on Churchman's view of inquiring systems. Mason and Mitroff (1973) suggested that Churchman's models of inquiry would be useful as a basis for creating evidence in the context of management IS research. We believe that this is also true for research designs and data collection involving, e-commerce, e-business management and the Internet. In this section, we describe each of the *inquiring systems* in terms of their key characteristics and approaches in research.

Theory Generalization Research. *Leibnizian inquiry* involves theorizing first through deduction and then collecting data to support an appropriate theory. From a research perspective, Leibnizian analysis involves forming hypotheses based upon widely accepted current research

models, or from models that are used in similar situations. Using this methodology, researchers are able to confirm existing theory and to extend accepted theory into new areas. In this article, we will refer to research that examines data with a Leibnizian perspective as *theory generalization research*, since research articles of this type tend to generalize theory to show applicability in other areas.

Theory Building Research. *Lockean inquiry* involves data collection or observation first and then development of theories through induction that describes the observations. From a research perspective, Lockean analysis involves developing theories when there is a wide consensus about an unexplained relationship. It also involves testing the limits of existing theoretical models based upon observations, especially when these observations do not fit within an existing theoretical framework. The existing theoretical models, then, are adjusted to accommodate the new observations. When contrasted with Leibnizian inquiry, Lockean inquiry is used to describe a situation where there is no argument about the observations of the phenomenon, but little in the way of explanatory theory, whereas Leibnizian inquiry is used when theory exists to explain this phenomenon or similar phenomena. If opposing theory already exists, then the Lockean approach cannot be used, giving way to the need for more in-depth induction. We will refer to research that examines data in using Lockean inquiry as *theory building research*.

Theory Verification Research. Building on our comments in the prior paragraph, we next come to *Kantian inquiry*. This approach is used to delve deeply into a research phenomenon of interest through *induction*. In contrast with Lockean inquiry—which is also inductive by its nature—Kantian inquiry is not concerned with preserving existing theory. Instead, it seeks to rigorously test existing theory and, if needed, develop new theory to explain new observations. Kantian analysis is mainly concerned with maintaining objectivity in the face of existing explanatory theory. It tends to be employed when researchers think an existing theory proves itself

to be inadequate based on inconsistent research, or is fatally flawed in its explanatory power based upon new observations. We call this kind of inquiry *theory verification research.*

Hybrid Theory Construction Research. *Hegelian inquiry* involves conflicts and clashes between theoretical interpretations of similar phenomena in research. The Hegelian approach is to combine two or more conflicting theories to arrive at an explanatory combination of theories. This process encourages the researcher to assess conflicting theories through deduction to determine the range of their appropriateness. Thereafter, it is appropriate for the researcher to collect data to see whether it supports the new "hybrid theory." Hegelian research, then, concentrates on bringing conflicting theories together as it examines limitations that exist for each theory, and when each might be appropriately used. We will refer to Hegelian inquiry as *hybrid theory construction.*

Meta-Research. Singerian inquiry is a meta-inquiry approach. It directs the researcher toward the selection of the proper inquiring system that will support advances in the acquisition of knowledge related to some problem or phenomenon of interest. Since Singerian research does not analyze data, we will not concentrate on Singerian inquiry. However, the reader should recognize that this article might be considered as an instance of Singerian inquiry, since it discusses how other inquiring systems can be implemented within e-business research, and what synthesis is possible for shedding light on how e-business research insights are acquired with new data-collecting tools.

All these inquiring systems eventually involve some sort of data collection, but at their heart lay either the process of induction or process of deduction. *Induction* stresses the importance of data and observation. These data and observations lead the researcher to develop new theories. However, one concern with induction is that, when a small sample is used, its results cannot be generalized to an entire population. As a result, theories developed through induction are suspect for their lack of validity across other samples in the population. Conversely, *deduction* uses logic to arrive at a

theory and then tests that theory using data and analysis. To support deductive efforts, data collection also is required. With the use of appropriate statistical analysis tools, the larger the data set, the less likely the researcher will draw misleading conclusions from the analysis of the data (Beutler, 1996; Kendall and Flannery-Schroeder, 1998). In the past, Churchman (1971) has stressed that researchers should pursue ways to automate the collection of data, or means to assist human researchers with data collection, so that they will be freed up to concentrate on research design and the interpretation of the research results.

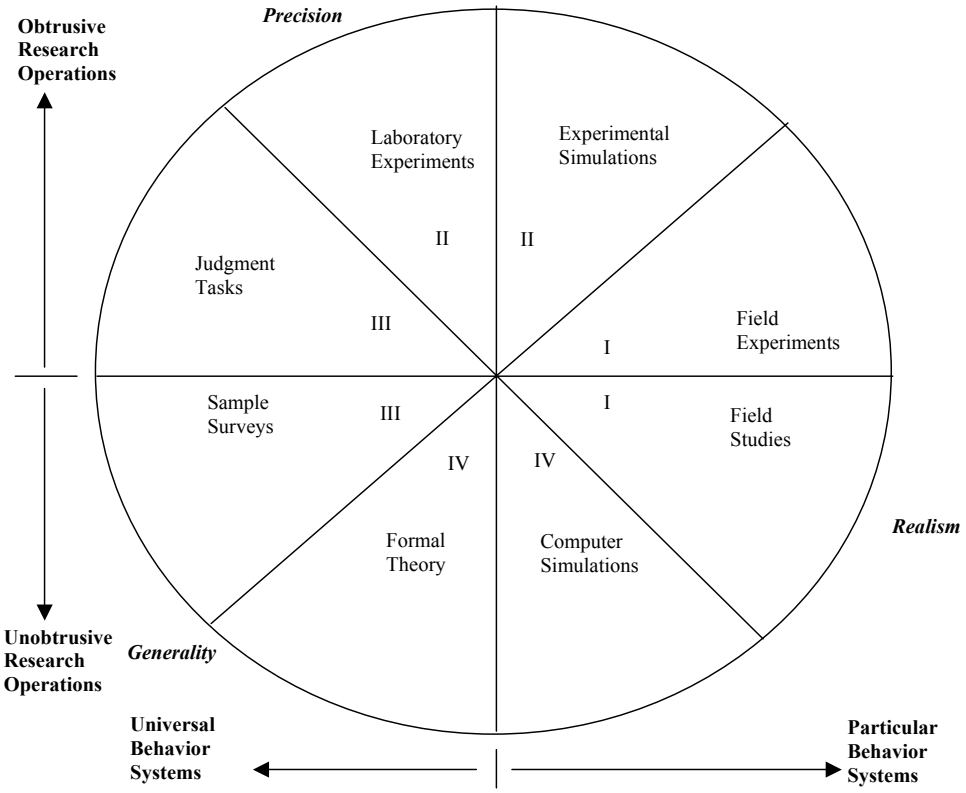
The challenge with deduction is that initial theory must be reasonably "fully formed," because otherwise empirical researchers will exclude essential aspects of the phenomenon under study (Mitroff and Mason, 1982). Induction answers this problem by allowing the examination of data to find patterns or relationships that may exist. Induction requires even more data than deduction though. When induction is used, researchers will often split their data sets into two or more portions. One portion of a data set is used to develop an initial reading on what relationships may exist. Then deduction is used to develop theories as to why these relationships exist. Thereafter, other portions of the data set can be used to statistically verify the new theoretical relationships that are asserted. As the reader might guess, each data set must be large enough so that the statistically significant relationships can be observed. In addition, the size of each data set is especially important when using modern statistical analysis techniques, such as panel data econometrics, structural equation modeling and confirmatory data analysis. The tension that exists, however, is that we have rarely—and usually only with some difficulty and cost—been able to develop data sets large enough to afford a researcher the necessary degrees of freedom to make this process of testing, deduction, and retesting easy to accomplish.

A Philosophy of Science Assessment of Alternative Data Collection Methodologies

Data collection plays an intrinsic role in the execution of the inductive and deductive techniques in empirical research that were mentioned in the last section. Data collection not only involves retrieving data, but also interpreting data and coding data. When introducing a new data collection methodology, it is appropriate to review and assess existing methodologies in order to determine how the new methodology compares.

McGrath (1982), who helps us to put this comparison in a philosophy of science assessment perspective, discussed how different research methodologies may have recognizable strengths in one area but may be flawed in other areas. Figure 1 shows the "three-horned dilemma" attributed to Runkel and McGrath (1972).

Figure 1. Runkel and McGrath's Three-Horned Dilemma for Research Methodologies



Note: **I** -- Natural settings; **II** -- Contrived settings; **III** -- Settings not altered; **IV** -- No data collection.

The “three horns” of Runkel and McGrath’s framework are *realism*, *generality*, and *precision*. Because of data collection limitations of the traditional data collection methods, no method can be general, realistic and precise all at the same time. Although Runkel and McGrath's research describes research methodologies, these research metrologies are *dilemmatic* because of the nature of data collection performed in each research approach.

Consider the following eight different research methodologies in terms of the manner in which they enable the researcher to collect data:

- *Formal theory and computer simulations*. These methods actually require no data collection. Instead, they generate their own data and results, and, as a result, can be used to test ways of thinking about relationships between and among constructs.
- *Field studies*. These involve primary data collection and case studies, for which a researcher collects data from a research site or multiple sites.
- *Experiments* involve testing the effects of some stimulus against some control. Runkel and McGrath's study mentions three types of experiments:
  - *Laboratory experiments* allow researchers to examine situations stripped of environmental context.
  - *Field experiments* are often undertaken in the context of the firm, and therefore are more realistic, but less precise than laboratory experiments, since the latter attempts to control every aspect of an environment to eliminate "noise" from construct relationships.
  - *Experimental simulations* try to mimic the content of the real world without actually placing the subject in the context of the real world.

- *Judgment tasks* are types of experiments that involve interviews and verbal protocols to be are used when subjects possess data (such as mental processes, inside information on historical happenings, etc.) that are not readily available for retrieval by the researcher using other methods.
    - *Sample surveys* are used to collect data about specific characteristics of a sample population to deductively test a theory.

In this research, we discuss how data collecting agents, as a type of field study, can change the dilemmatic nature of research methodologies, and thus affect the choices a researcher makes when delving into which methodology will be most effectively for the creation of new knowledge in a given research context.

DATA COLLECTION METHODS AND ASSESSMENT FOR E-BUSINESS RESEARCH

We have stressed how data collection is important for the process of theory development, and how different traditional research methodologies used to collect data have strengths and weaknesses that can cause some research to be dilemmatic in the investigation of certain topics. In this section, we discuss new data collection methodologies that are made possible through Internet technology, and how these new methodologies can resolve some of the dilemmas of traditional research methodologies. However, they also have strengths and weaknesses that are intrinsic to the methodology, and so we conclude this section with an extension of Runkel and McGrath's (1972) dilemmatic framework to examine the strengths and weaknesses of them.

Data Collection Methodologies Made Possible By the Internet

Let us consider six new and different data collection methodologies that are now possible because of the wide availability of Internet technology. Our overall argument is that the new

capabilities that Internet technology offers requires a shift in our thinking about what is possible in research design terms, as well a reconsideration of how we go about making choices about the kinds of inquiry systems that empirical analysis involving the Internet can support relative to various aspects of e-commerce and e-business management.

Data-collecting agents. *Data-collecting agents* are software tools that are implemented when researchers want to collect data by examining Web pages that available to the public on the Internet. (Data-collecting agents are sometimes referred to *spiders* or *spyders*.) Data-collecting agents tend to be heavily automated, allowing direct downloading from the Web into a database, spreadsheet, or data file, based on the specifications that a researcher designs into the too for collection of specific kinds of data (e.g., product prices and discounts, shipping costs, number of participants in an electronic auction, and so on). Also in this category, however, are the tools used by researchers who implement existing and publicly available software agents, such as the major search engines (e.g., Google, www.google.com), well-known shopbots (e.g., MySimon, www.mysimon.com) or a specific searches for products or comments within a single company. The latter capability, available through several online retailers, such as Amazon (www.amazon.com) or eBay (www.ebay.com), utilizes Internet browsers such as Internet Explorer to discover a smaller dataset that can be manually entered into a database, spreadsheet, or data file to support a research investigation. It turns out that much information is available publicly and is readily accessed online, including: auction transactions, comments and evaluations about products, people, and companies; prices charged by B2C vendors; and information on available bundles of information goods. Kauffman, March, and Wood (2000) point out how data-collecting agents can gather copious amounts of information for relatively little cost compared to traditional data collection methodologies. Such large data sets allow specialized data analysis techniques to be applied with

real world data. The methods include large-scale econometrics, structural equation modeling, paired-observations duration modeling, social network analysis, data mining and pattern recognition, and so on, that would be challenging to implement with traditional experiments due to sample size limitations.

Web log files. Companies use Web log files to track the navigational, transaction-making, and decision behavior of human users throughout their systems. These log files usually contain more information than would ever be made publicly available on the Web. For example, log file traces of user navigational on a Web site can include sites visited before and after reaching the company's site, movements (such as mouse movement and clicks or selections) while on the site, and indications of the patterns of use of the organizational hierarchy of information that is available on a Web site. In practice, such data may reach into the tens of thousands or even millions of records. Occasionally, vendors and firms make these log files available to researchers, giving them data analysis opportunities that heretofore have not been available. As with data-collecting agents, the acquisition of such large datasets allows analysis of realistic situations in e-commerce and e-business that would be difficult to implement with most traditional assisted data collection techniques, and would be infeasible for manual data collection approaches.

Online experiments. Researchers also now have the capability to conduct online experiments over the Internet to set up different situations in which subjects can respond. Even though the researcher is bound to lose some control over the subjects that participate in these tests (e.g., eBay auction participants, customers of an electronic grocer's Web site, users of an online search engine) when compared to traditional experiments, the researcher's access to subjects is much greater, and the costs of data acquisition are considerably lower.

Quasi-experiments. Quasi-experiments in the IS and e-commerce research setting aim to take advantage of naturally-occurring conditions in the real world to capture data that enables a researcher to distinguish between outcomes associated with different levels of influence, access or use of information technology. In the case of the Internet, there are many naturally settings that permit quasi-experimental research designs to be developed for the study of human decision making, business processes, and organizational performance outcomes in the presence of technology. The sources of data for quasi-experimental research designs include log files or customized data from a data-collecting agent. They permit researchers to restrict the data they collect to support quasi-experimental research designs. In our experience (e.g., Kauffman and Wood, 2000 and 2003c), when so much data becomes available, it is relatively easy to find individuals who meet multiple control and stimulus conditions. These individuals can remain in their own context and need not be taken to a laboratory setting for an experimental test. This is important given that other research process observers (e.g., Lave, 1988; Scribner, 1984) have pointed out that subjects do not behave as they normally would when taken out of their own context. However, such realism necessitates acceptance of somewhat less control over the subjects.

Online judgment tasks. Online judgment tasks can be used to examine motivations for actions on the part of human subjects. Often, judgment tasks are done within a context of settings that most observers might interpret to be experimental research settings (e.g., involving decision making and discrimination, interpretation of the conditions that are present in some context, reactions to various stimuli, materials or other contextual elements, etc.). By their nature, these judgment tasks often take on an experimental quality. We note that this often will in the realistic context being stripped out of the data collection, so that the researcher can more clearly examine some relationship of interest. Thus, online judgment tasks are typically used inside hypothetical environments,

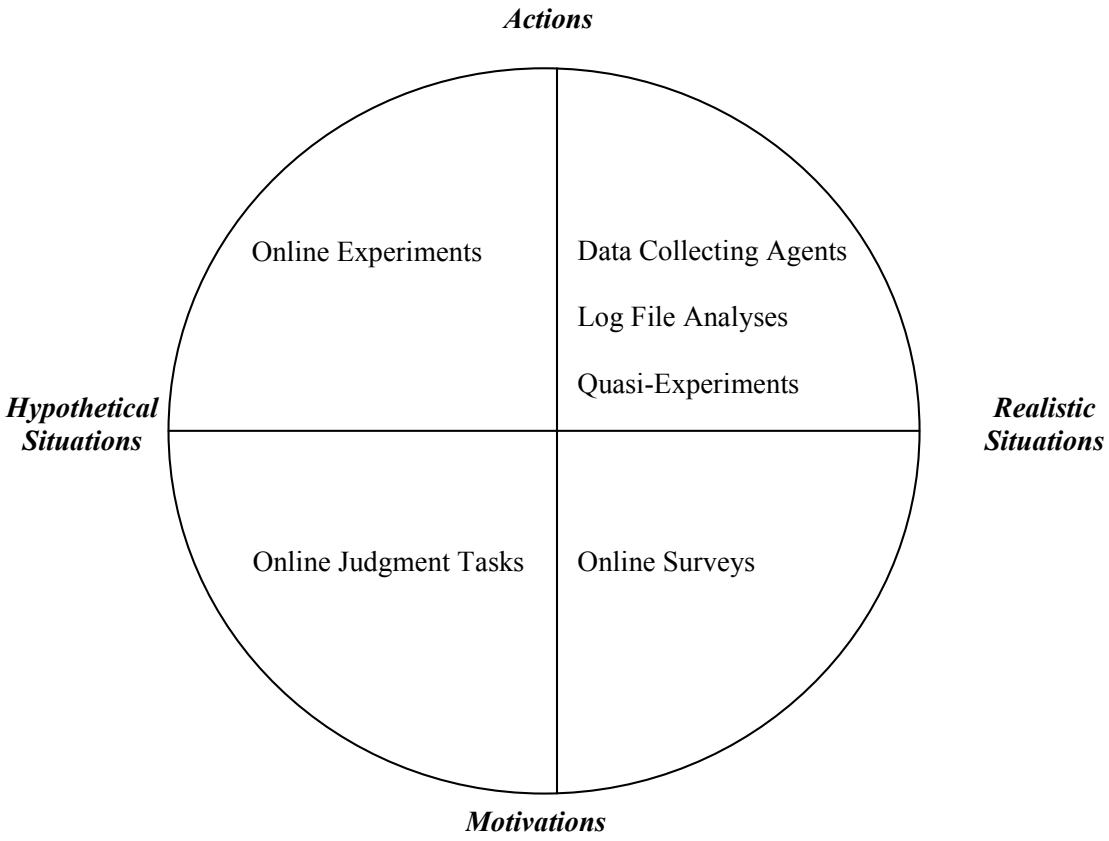
hypothetical decision making settings, or contrived situations where the research is looking for specific kinds of reactions and responses. In addition, the tasks cannot be used to examine actions, but only to infer actions from task results and the questioning of the participants in the study.

Online surveys. Online surveys, including surveys done by email and surveys that are presented using data collection tools embedded in a Web site, can be used to question about actions and motivations. Online surveys usually can be done more quickly and cheaply when compared to traditional surveys, and often with a broader reach for subjects and participants. However, like online judgment tasks, online surveys cannot be used to directly examine actions. One can only infer actions from survey responses, since the data collected are subjective rather than objective. There have been many studies that compare responses in online surveys or email surveys to traditional surveys (e.g., Church, 2001, Mehta and Sivadas, 1995) or even between different online implementations of the same survey, such as with an embedded or attached survey (Dommeyer and Moriarty, 1999 / 2000). Most of these studies show little or no significant change in response, thus allowing researchers to pick a survey instrument on the basis of ease of implementation rather than on the basis of data quality.

Assessment of the Data Collection Methodologies

In keeping with Runkel and McGrath's "three-horned dilemma" model, we contend that Internet technology has altered the process of data collection. For instance, the low cost to implement an Internet agent or a Web log allows observations that span across different companies (e.g., Brynjolfsson and Smith, 2000; Clay et al., 2002; Kauffman and Wood, 2000), making these field studies more generalizable. We concentrate on how the strengths and weaknesses of online data collection methodologies compare to each other and to traditional research methodologies. Figure 2 shows how these data collecting methodologies compare to each other.

Figure 2. Trade-Offs in E-Business Data Collection Methodologies



We note that: (a) data-collecting agents, log files, and online quasi-experiments are best for e-business research in realistic situations where data are available; (b) online experiments are useful for studying human actions inside hypothetical environments or when realistic data is not available, (c) online surveys and online judgment task experiments support the examination of the motivations behind human actions in realistic situations as well as the motivation for human actions inside hypothetical environments. Table 1 shows the strengths and weaknesses for the research methodologies presented earlier in Figure 2.

Table 1. Strengths and Weaknesses of E-Business Data Collecting Research Methodologies

DATA COLLECTION METHODS	STRENGTHS	WEAKNESSES
Data Collecting Agents	☐ Inexpensive way to capture large amounts of transaction data ☐ Realistic, with actual transactions and actual observations ☐ Non-intrusive ☐ Multiple simultaneous data sources available ☐ Does not require vendor cooperation ☐ Often is easily repeatable	☐ Can be burdensome to host computer ☐ Data must be present online, and all types of data (buyer identity, etc.) are not available ☐ Can only infer motivations
Log File Analyses	☐ More types of data (buyer identity, etc.) available ☐ Extremely large data sets ☐ Non-intrusive ☐ Realistic, with actual transactions and actual observations	☐ Usually single data source ☐ Can only infer motivations ☐ Requires cooperation from vendor
Online Experiments	☐ Far reaching experiments ☐ Inexpensive compared with traditional experiments ☐ Can test hypothetical environments	☐ Technology may bias results ☐ Control (e.g., environment, sample selection) may not be as broad as with traditional experiments ☐ Responses are *not* in context-full environment
Quasi-Experiments	☐ Used in conjunction with data collecting agents or log file analyses ☐ No contamination of subject ☐ Realistic responses are in context-full environment	☐ Technology may bias results ☐ Weakest control (e.g., external environment stimuli, etc.) of any experiment type ☐ Can only infer motivations
Online Judgment Tasks	☐ Can be used to examine motivations ☐ Can be used with hypothetical environments ☐ Inexpensive compared to the set up of traditional judgment tasks	☐ Can be biasing, corrupting, or unrealistic because of the technology involved ☐ Actions can only be inferred from questions (self reporting bias, memory bias, etc.) ☐ Training of the task may be problematic
Online Surveys	☐ Can be used to examine motivations ☐ Less expensive than traditional surveys ☐ Faster than traditional surveys	☐ Actions can only be inferred from survey responses (self reporting bias, memory bias, etc.) ☐ Realism of results can be questionable

Just as in Runkel and McGrath's original framework, a researcher may use a methodology that is not necessarily suggested by the above framework. For example, while motivations usually cannot be directly examined with data-collecting agents or log file analysis, they can be inferred in situations where surveys or judgment tasks are impractical or where the participant would hide actions or motivations, such as in the case of fraud or opportunism (e.g., Kauffman and Wood, 2003c; Wood, Fan, and Tan 2003).

Runkel and McGrath point out that it is important for the researcher to understand and acknowledge the research dilemma and its implications when justifying the research methodology. Weaknesses notwithstanding, the strengths of these relatively new techniques allow examination of research questions that was previously impossible or impractical due to costs, contamination of subject, etc.

INQUIRY SYSTEMS, DATA COLLECTION METHODS AND E-BUSINESS RESEARCH

The grid shown in Table 2 illustrates a juxtaposition of the first four of Churchman's five types of inquiry systems in research with the six data collection methodologies. It also gives examples of how a methodology was implemented in the context of various topics in e-business research. As shown by the distribution of the literature that we have sorted according to the dimensions in Table 2, certain data-collecting methodologies are more disposed to support research investigations within specific types of theory development. Based upon this literature review, it appears, for example, that data-collecting agents seem to be the most used methodology for data collection in e-business research. This is understandable. Data-collecting agents are inexpensive to run, gather large amounts of data, and do not require the permission of the hosting Web site. The rest of this section incorporates a literature review according to our framework's classification to discuss theory

development in e-business research and how researchers have implemented data-collecting tools for empirical research in e-business.

Table 2. Inquiring Systems, Data Collection Approaches and E-Business Research

Data Collection Method	Theory Generalization	Theory Building	Theory Verification	Hybrid Theory Construction
Data Collecting Agents	Ba & Pavlou, 2002 Bajari & Hortacsu, 2003a Bajari & Hortacsu, 2003b Brinkmann & Seifert, 2001 Dewan & Hsu, 2001 Livingston, 2002	Ariely & Simonson, 2003 Bapna et al., 2001b Bapna et al., 2003 Dans, 2002 Dellarocas et al., 2003 Eaton, 2002 Ederington & Dewally, 2003 Gilkeson & Reynolds, 2003 Kauffman & Wang, 2001 Kauffman & Wood, 2003c Lucking-Reiley et al., 2000 Massad & Tucker, 2000 Park & Kim, 2003 Segev et al., 2001 Standifird, 2001 Wood et al., 2003	Bapna et al., 2000 Houser & Wooders, 2000 List & Lucking-Reiley, 2000 Lucking-Reiley, 1999 Melnik & Alm, 2002 Ow & Wood, 2003 Wilcox, 2000	Easley & Tenorio, 2003 Kauffman & Wood, 2003a Kauffman & Wood, 2000 Resnick & Zeckhauser, 2002 Yamagishi, 2003
Log File Analyses	Hahn & Kauffman, 2003 Murphy et al., 2001	Catledge & Pitkow, 1995 Tillotson et al., 1995	Brynjolfsson & Smith, 2000 Lee, 1998	Clay et al., 2002
Online Experiments		Bapna et al., 2001a Jin & Kato, 2002 List & Lucking-Reiley, 2002 Rafaeli & Noy, 2002	Resnick et al., 2003	
Quasi-Experiments		Kauffman & Wood, 2003b Roth & Ockenfels, 2002	Jap, 2003	
Online Judgment Tasks	Ba & Pavlou, 2002	Bapna, 2003		
Online Surveys	Chen & He, 2003 Ferl & Millsap, 1992 Lederer et al., 2000	Earp & Baumer, 2003 Sheehan, 2002 Yin, 2002	Gardyn, 2003 Gordon & Lima-Turner, 1997	

Theory Generalization Research

As shown in Table 2, experiments and quasi-experiments are not often used to generalize existing theory into different areas in the e-business research context. This is understandable and expected. The nature of experiments is to apply a stimulus and a control to a subject, and the

impersonal nature of e-business often makes such application difficult. However, other data-collection methods are more apt to facilitate theory generalization in e-business research.

Data collecting agents can be used to examine existing theory in the context of the new e-business environment. Bajari and Hortacsu (2003a) examine how the typical empirical economic regularities from a sample match the observed patterns in data found in other samples of online auctions. The authors also examine the exact effects of the "winner's curse" (where the auction winner overpays) in online auctions (Bajari and Hortacsu 2003b). Brinkmann and Seifert (2001), Dewan and Hsu (2001), and Livingston (2002) all find that trust does increase the willingness to pay by the consumer, as predicted by trust theory. Ba and Pavlou (2002) also find a trust effect. They conduct an online judgment task for students to complete, and follow it by analyzing data that has been collected online using a data-collecting agent. Both Hahn and Kauffman (2003) and Murphy (2001) apply different aspects of theories that explain the efficacy of Web design to develop hypotheses about Web site performance. The authors show how the analysis of log files helps to shed light on optimal Web site design.

Online surveys can also be used for theory generalization. Chen and He (2003) develop a theory of online technology adoption with respect to a specific retailer. Then they validate this theory using online surveys in conjunction with structural equation modeling. Lederer, et al. (2000) apply a similar technique and validate the *technology acceptance model* (**TAM**) for work-related tasks and Web applications. They also employ a survey with structural equation modeling to test TAM in this environment. Ferl and Millsap (1992) also conduct an online survey to show how technology acceptance is dependent upon ease of use, as predicted by the TAM model.

Theory Building

Theory building is the area where most of the research has concentrated in e-business research. This is understandable, since e-business is a relatively new business phenomenon, and thus, it affords us with many opportunities to try to understand business relationships within e-business.

Data-collecting agents have been shown to be a great tool for theory building because of the large amounts of data that can be collected from a multitude of sources without prior approval from a company. Ariely and Simonson (2003) develop new theory examining bidder behavior with pricing and the effect of competition within online markets. Bapna, Goes, and Gupta (2001b and 2003) examine bidder types and bidder behavior in online auctions especially as this behavior relates to price paid and bidder timing. Dans (2002) discusses new business models that are made possible by Internet technology. Dellarocas, Fan, and Wood (2003) examine factors that influence bidder participation levels in online auctions using an extensive dataset collected on eBay's Web site. Wood, Fan, and Tan (2003) examine how sellers with higher reputations behave in such a manner as to reduce the amount of positive buyer comments from transactions. Jin and Kato (2002), Eaton (2002), and Park and Kim (2003) examine eBay data and show how additional information can reduce the information asymmetry inherent in e-business transactions, resulting in a buyer's willingness to pay more for an item and increasing a buyer's commitment to a seller.

In a similar vein, Kauffman and Wang (2001) examine the effect of buyer arrival with group-buying Websites. Ederington and Dewally (2003), Lucking-Reiley et al. (2000), Gilkeson and Reynolds (2003) and Standifird (2001) use data collected with data-collecting agents to examine factors that affect the final price bid in online auctions. Kauffman and Wood (2003c) examine the possibility of shilling through the examination of a massive data set that examines bidder behavior during concurrent auctions selling the same item. Massad and Tucker (2000) compare online

auctions and traditional auctions, and find, surprisingly, that online auctions lead to higher dollar values in initial bid prices and in final bid prices, when compared with physical auctions. Segev, Beam, and Shanthikumar (2001) develop a new theoretical model for prediction of final auction price, and test this model using auction data collected with a data-collecting agent. Catledge and Pitkow (1995) and Tillotson et al. (1995) were among the first researchers to examine Internet browsing behavior through the use of log files.

Online experiments are extensively used in e-business theory building, especially in hypothetical situations. In a laboratory experiment, List and Lucking-Reiley (2002) show how bundling items within auctions can result in large price premiums. Bapna, Goes, and Gupta (2001a) use a laboratory experiment to analyze different price-setting processes in online auctions. Rafaeli and Noy (2002) find that interpersonal additions to online auctions that can mimic face-to-face contact increase transaction amount.

Quasi-experiments can also be useful in finding relationships that are difficult to examine in traditional environments. Kauffman and Wood (2003b) establish controls and stimuli for weekend and weekday buying, and buying with and without a picture of the trade item. They find that there is a weekend effect, and that pictures and reputation scores also affect the final price. Roth and Ockenfels (2002) examine bid sniping (bidding at the last possible moment) with auctions on Amazon and eBay, and find that the fixed closing time on eBay motivates more sniping than the variable closing time on Amazon. By examining judgments in an online environment, Bapna (2003) also explores bid sniping to determine whether a newly-proposed auction microstructure might possibly eliminate its negative effects.

Earp and Baumer (2003) and Sheehan (2002) use online surveys to test the privacy concerns of online shoppers. Both find some skepticism about providing personal information in online

transactions, although Sheehan finds that education levels will mollify privacy concerns. Yin (2002) surveys and tests the effects of price dispersion with selling price.

Theory building research is extremely data-intensive, involving induction from observations, and then, to test the theories, empirical examination to determine if the new theories are applicable to an environment. We show here how new data-collecting techniques, especially data-collecting agents for the Internet, Web log file analysis, or Internet-based surveys, are useful to collect the data needed for the task of theory building.

Theory Verification

Often, theory verification results in the questioning of some theory's validity within the context of a given environment of research interest. Because of the easy access to data that the new data-collecting tools support, theory verification has become more attractive. For example, Bapna et al. (2000) examine data in online auctions to reject the often-used auction theory assumption that bidders are homogeneous. They then go on to illustrate different bidder types. Ow and Wood (2003) examine the effect that winner's curse has in online auctions and find that buyer experience leads to an increase in willingness to pay in online auctions. This is the opposite of the findings that obtain in traditional markets. Houser and Wooders (2000) examine both online auctions and online reverse auctions, which involve contract bids where the lowest bid wins. They find that although a seller's reputation affects the final price in online auctions, a buyer's reputation does not affect price in reverse auctions. List and Lucking-Reiley (2000) examine several theoretical auction models advocated in economic theory, yet find no significant difference in revenue between these different types of auctions. Similarly, Lucking-Reiley (1999) finds that Dutch auctions generate approximately 30% higher revenues in email and news group auctions than in traditional first-price and second-price auctions, contrary to theoretical predictions. Melnik and Alm (2002) examine

eBay data to determine the effect a seller's reputation has on price, and find only a small effect, contrary to other theory on this topic. Wilcox (2000) examines the timing of bids, and finds that experienced bidders bid in a way that is more consistent with theory over time than inexperienced bidders.

Using log file analysis, Brynjolfsson and Smith (2000) find evidence of friction in electronic commerce markets, which also is the opposite of what was expected predicted by prior armchair theory builders. Also using log files, Lee (1998) examines Aucnet in Japan, a automobile online auction, and finds that quality guarantees can remove price competition in electronic markets.

Resnick et al. (2003) examine what happens when they take a well-established eBay seller, and then set up a new eBay seller, and observe how they interact in terms of buyers' willingness-to-pay. Their research design involves having each seller sell the exact same item. They discovered an 8.1% difference in willingness-to-pay for the reputable seller. In another quasi-experiment, Jap (2003) investigates how price competition mechanisms affect buyer-supplier relationships, and finds that reverse auctions can increase the supplier's belief that the buyer will act opportunistically. Gardyn (2003) conducts an online survey of 871 children, ages 8 to 15. She finds, contrary to conventional wisdom, that older girls are more active computer users than their male counterparts. A survey by Gordon and Lima-Turner (1997) indicates that the social contract theories may be somewhat limited in areas of e-business.

Verifying existing theory requires much evidence, especially if that verification process yields a result that is contrary to conventional thought on a topic. As such, these new technology-based empirical data collection techniques are ideal for examining conventional theory, especially as this theory applies to e-business phenomenon. Here, we show how theory verification can be accomplished using the new research methodologies.

Hybrid Theory Construction

Rather than attempting to verify or validate a theory, hybrid theory construction techniques allow the researcher to examine theories that are often diametrically opposed. This permits the determination of the circumstances where one theory is suitable to a situation and when another theory would be more appropriate. Often, hybrid theory construction requires larger sets of data, and so it is understandable that data-collecting agents and log files--the techniques that are best able to generate the largest datasets—are observed to be for this type of inquiry. For example, when examining competition and tacit collusion, which are opposing viewpoints of competitor interaction, Kauffman and Wood (2000 and 2003a) find that market leaders often dictate the competitive dynamics for the rest of the industry, and that the same online companies react to competitors differently as members of different industries. Resnick and Zeckhauser (2002) examine reputation systems in online auctions and report many findings based upon economic theory. Also, contrary to other literature, they find that higher reputation scores do not result in higher prices paid for an item. Easley and Tenorio (2003) find that experienced bidders tend to bid in higher increments, which they call jump bidding, and they theorize about the cost of repeat bidding compared against the cost of jump bidding. Clay et al. (2002) describe how firm reactions to competitor price changes do occur, but not as often as one would expect. Yamagishi (2003) examines the effect of open vs. closed auctions. Although theory states that closed auctions will be less prone to opportunism and generate higher prices, Yamagishi finds that a reputation system can make an open market outperform a closed auction.

Of all theoretical development approaches discussed in this research, hybrid theory construction appears to be the one that is likely to be the most data-intensive. When there are conflicting theories, with each theory applying to different segments of a market or population (such as

competition and collusion), data is required to examine each theory to gain an accurate picture of how these competing theories interact. New data-collecting methodologies greatly simplify the task of data collection, and thus facilitate hybrid theory construction.

In this section, we have illustrated how different types of theoretical development are accomplished with less time, lower cost, and greater ease than when traditional data collection methodologies are used. We also have shown that these techniques are particularly well-suited to e-business research by demonstrating how researchers have successfully implemented these new techniques to accomplish their research objectives.

CONCLUSION

This research delves into the newest frontier of research design and data collection methodologies for e-business management. We examine these new methodologies from a philosophy of science perspective, and extend Runkel and McGrath's (1972) framework to illustrate different facets of these new techniques that extend beyond traditional research methodologies for data collection in empirical research. By leveraging Churchman's (1971) insights, we also illustrate how e-business researchers implement these techniques when developing theory that investigates e-business phenomena. The result of this examination is that we are not able to call attention to several research directions that can facilitate future e-business research.

Contributions

We investigate the strengths and weaknesses of these techniques with respect to the newest (and sometimes fleeting) developments in e-business. We pointed out, echoing the long-standing insights of others who have written on research methodology related to the philosophy of science, how these tools can be used in theory building, theory generalization, theory verification, and theory

combination. For this reason, we claim that it is critically important to appreciate how much impact they ought to have on the way that researchers conceptualize and go about design their research approaches for the exploration of current problems in e-business management. We found in our exploration that these new technology-based tools are able to resolve several issues associated with traditional data-collecting methodologies. This appears to be occurring because of researchers' new ability with the tools to inexpensively collect megabytes of data on individuals' actions. As a result, it is possible to use these approaches to mimic the data collection outcomes of traditional methods, without having to face up to their inherent limitations.

Research Directions with Data Collection Methodology in Mind

With these preliminary findings in mind, we think it is worthwhile to suggest some research directions involving new data collection methodologies that may be appropriate for future research on the spectrum of e-business management topics:

- **Massive quasi-experiments.** With so much data available, it is relatively easy to find individuals who meet multiple control and stimulus conditions, as we have seen in our prior discussion. These individuals remain in their own context and need not be taken to a laboratory setting for an experimental test. This is important, as many researchers (e.g., Lave 1988; Scribner 1984) have pointed out that subjects do not behave as they normally would when taken out of their own context. In addition, since large numbers in the population sample are frequently possible, this technique allows for the application of more sophisticated data analysis techniques. These would be difficult to implement with traditional experiments because of small sample size limitations.
- **Fast, cheap surveys.** Often, surveys can take months to implement. Pre-testing and revising a survey instrument can be costly and laborious. With online surveys, the

deployment is less expensive, the reach is greater, and the time required for the collection of responses is greatly compressed. Although we are not advocating a "quick and dirty" approach, we think it is important to point out that the fundamental cost-to-results quality relationship is undergoing significant changes.

- **Time-series and longitudinal research designs.** Many of these methodologies, such as online surveys or data-collecting agents, can be easily re-implemented. Thus, researchers can more easily gather time-series data on individuals, as well as panel data for a cross-section of individuals over time. Such data typically are not available when traditional data collection techniques are used, other than in the most extraordinary circumstances. Indeed, longitudinal research designs place the greatest cost and feasibility pressures on traditional data collection techniques, so it is likely that opportunities for Internet-based longitudinal research designs will dramatically change the cost-to-research quality relationship.
- **Theory building and empirical data analysis.** Many theories have not yet been tested extensively with realistic data. For example, Kauffman and Wood (2000) investigate the appropriateness of Bertrand competition assumption in online markets, a long-standing truism in the IS literature, and find that Bertrand competition is not sufficient to explain competitive interaction. Bapna, Goes, and Gupta (2000) investigate popular economic theories using online data, and find that many of them are not supported.
- **"Hidden" phenomenon.** One of the main concerns with traditional data collection is that some behavior (such as opportunism) is hardly ever exhibited when these techniques are used. This is because individuals can maintain control over the data that are presented to the researcher. Thus, a non-invasive data collection methodology is required to more closely examine the actions of individuals without those individuals changing their behavior

because they know that they are being examined. Data-collecting agents, quasi-experiments, and log-file analysis are natural tools for such investigation. For example, Kauffman and Wood (2003c) investigate online shilling by seeing which bidders have bids on items that have characteristics different than the normal bid. Then these bidders are examined for shilling-like behavior. Such a technique would be extremely difficult or impossible to duplicate using traditional data collection methodologies.

We have shown how cost-effective and time-saving these methodologies can be. A data-collecting agent can be developed by a single capable programmer in less than a month. If it is designed properly, it can collect literally hundreds of thousands of records in a single day. Surveys can be instantly deployed with no deployment cost and with a 24-hour response window. Agents, surveys, and quasi-experiments, with minimal adjustments, can be run repeatedly to gather additional data or to gather data that was omitted early in a study. With other data collection methodologies such as traditional surveys, experiments, or field studies, collecting new data may be extremely problematic. Indeed, the new empirical data collection methods for e-business are so effective, the researcher can spend the majority of her time thinking through the elements of the best research design, determining what data to collect, analyzing the available data, and figuring out how to best present the findings. As Churchman (1971) seems to have foreseen, this is all in sharp contrast to traditional data collection methodologies, for which the majority of the researcher's time must be spent on the data collection effort itself.

Next Steps: Transforming Our Thinking of How to Do E-Business Management Research

The technologies that have made e-business possible simultaneously have transformed many industries. But thus far academic researchers have evidenced little scientific awareness of the manner in which these technologies are also transforming the underlying processes of research

design and data collection. Many companies, such as General Electric, Dell, Microsoft and Cisco Systems, have recognized through their IT investments, how the efficiencies achieved through the Web allow them to function with greater responsiveness and with far less expense, supporting higher levels of profitability than might otherwise be possible. Even many consumers have recognized how the Web allows them to more easily search for information and do electronic shopping.

So too, we argue, will our thinking about research design and data collection in empirical research for e-business management have to be transformed. The new technologies will permit us to investigate areas emerging areas of e-business management interest for far lower cost and in far less time than we probably expected even five years ago. We predict that, in time, researchers will come to think of the World Wide Web as a data source and a research context where they can research their topics of interest with methodologies for data collection that are as new as the technologies of the Internet themselves. Surely, the use of traditional approaches to research design and data collection will remain appropriate for many types of projects. But, with this article, we challenge researchers in e-business management to give more thought to whether they will be able to cost justify total reliance upon them. In the future, researchers will not only need to understand the best ways to design e-business research to build, test and validate theory. They will also need to be aware of the best ways to construct and direct a data-collecting agent, how to incorporate data-collecting agents into research designs that also involve traditional data collection methodologies, and gauge the potential impact that data-collecting agents will have on what now becomes possible in e-business management research. This is a bright futurescape for the creation of new managerial knowledge.

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