A Complex Approach to Accounting Research: An Agenda for the Use of Complex Adaptive Systems and Agent-Based Simulation

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Abstract

This study expands on the calls for new decision-making paradigms that "push the boundaries of our understanding of complexity" and develops a research agenda for the accounting domain that considers the complexity and connectedness of the real business environment that organizations face in a knowledge-based economy comprised of networked agents acting and reacting to the actions of other agents in the environment. We propose a set of comprehensive research questions that integrate the key tenets of Complexity Theory/Science, Complex Adaptive Systems (CAS), and Agent-Based Computational Modeling (ABM) with a variety of accounting research streams.

Keywords: Complexity theory, complexity science, complex adaptive systems, agent-based modeling, agent-based simulation, accounting theory

Introduction

The knowledge-based view of the firm (Kogut and Zander 1992) contends that organizational knowledge is a valuable, rare, and inimitable resource that can contribute to the competitive advantage of the individual/organization possessing it and performance will be reflective of that knowledge (Rodgers et al. 2008). In this new knowledge-based economy, interactions with customers, business partners, competitors, regulators, and other entities in the environment impact the long-term success more so than ever and survival depends on the ability to explore new knowledge and maintain existing knowledge (Hall and Paradice 2005). However, decision makers' traditional knowledge sources and endowments may not be sufficient to address problems that are more complex and socially-oriented and are thus considered semi- or unstructured(Rodgers et al. 2008).

Often referred to as "wicked" (Rittel and Webber 1973) or "ill-structured"(Mason and Mitroff 1973), these decision-making scenarios are complex, highly uncertain, difficult to define, inextricably connected to their environment, and possess irreversible solutions. Such environments not only require organizations to be able to make decisions effectively and rapidly, but also be able to create knowledge and learn (Hall and Paradice 2005).
The current accounting model has been criticized as inadequate for valuing information-age companies and measuring the performance and resources of knowledge-based firms (Clikeman 2002). As accounting is commonly viewed as an information system (IS) for decision-making (Sunder 2002), leveraging IS research methodologies, applications, tools, etc. seems appropriate to help transform accounting research and practice to be relevant in the Information Age and beyond.

Courtney (2001) called for a new decision-making paradigm for decision support systems (DSS) to adequately address wicked problems in complex contexts. The new paradigm brings in the perspectives of many stakeholders in order to provide greater insight into the nature of the problem, relationships among the connected elements in the wicked system, possible solutions, and downstream effects of implementing various solutions. Knowledge from any discipline or profession may be included as needed to assist in understanding the problem. These types of problems require and need research that truly reflects the nature of the decision-making environment. Continuing this theme, Courtney et al. (2008) provide a starting point for IS researchers to "push the boundaries of our understanding of complexity" and comment on how organizations are dealing with technical and physical infrastructure complexity, as well as the application of complexity in specific areas as supply chain management and network management to more general organizational issues.

This study expands on these two calls to develop a research agenda for the accounting domain that considers the complexity and connectedness of the real business environment that organizations face in a knowledge-based economy comprised of networked agents acting and reacting to the actions of other agents in the environment. We propose a set of comprehensive research questions that integrate the key tenets of Complexity Theory/Science, Complex Adaptive Systems (CAS), and Agent-Based Computational Modeling (ABM) with a variety of accounting research streams. For instance, can financial auditors of public companies utilize ABM as a lens to view the potential financial state of their clients in lieu of common statistical modeling tools such as the Altman Z-score that have been proven to no longer hold relevance outside the original context of a more nationalistic, manufacturing industry in the 1960's? What role can CAS and ABM assume in a continuous reporting environment? As accounting researchers, what is our role in transforming the research domain to maintain relevance in the connected Information Age? Are there opportunities to lead practice in understanding and navigating through this new, continuously evolving environment of competing agent interests?

In addition, we examine the methodological issues related to complexity-oriented research in general, and the use of ABM in particular, as well as present lessons learned from an illustrative study derived from one of the research questions suggested. The next section briefly introduces the basic concepts of complexity, complex adaptive systems, and agent-based modeling including related research in the accounting and IS domains. Following, we present a general research agenda for complexity research in accounting. Based on one of the research questions developed, we summarize the associated, published case study that constructed an ABM as an information input for the auditor going concern opinion of Frontier Airlines and the methodological lessons learned from that study (Kuhn et al. 2011). Finally, we offer a few concluding thoughts on the vast possibilities complexity research holds in the accounting domain.

Theoretical Foundation

Complexity

Life on planet Earth, in general, is becoming ever more connected and complex. For instance, Wal-Mart Stores, Fortune's 2008 largest U.S. Corporation, operates more than 4,000 facilities in the U.S. and over 2,800 in Argentina, Brazil, Canada, China, Costa Rica, El Salvador, Guatemala, Honduras, Japan, Mexico, Nicaragua, Puerto Rico, and the United Kingdom (Quiros 2006). Their famed global distribution network works with more than 61,000 suppliers in over 55 countries around the world through a global procurement office and the company demands that their business partners meet specific environmental, social, and quality standards. Wal-Mart's corporate beliefs and values filter down throughout their massive business chain to the point of impacting the day-to-day lives of field workers picking cocoa beans in Nicaragua.

Since 1998, Wal-Mart Centro America has supported the region's social and economic growth by partnering with local farmers to learn new agriculture techniques through the Tierra Fertil program so they can produce high quality products for retail markets. Currently, the program helps 2,045 Costa Rican, 2,850 Nicaraguan, 155 Honduran, 16 Salvadoran, and 109 Guatemalan producers. The Wal-Mart global connection illustrates how advances in technology have and will continue to facilitate a flattening of the world, reducing time and space constraints. A true global community is emerging where the actions of individuals and organizations in one corner of the world affect many others residing in different locations around the globe. In order to make sense of such a connected world, researchers and organizational decision makers are increasingly turning towards complexity science and complex adaptive systems theory. So, what exactly does *Complexity* truly mean? Depends who you ask.

The Merriam-Webster Online Dictionary defines the word as "a whole made up of complicated or interrelated parts" (Merriam-Webster 2008). This understanding held true until about 15 years ago (Laurent and Koch 1999) when a new, deeper interpretation emerged distinguishing *complex* from *complicated* (Mikulecky 1999; Reitsma 2003). A *complicated* system (and the original view of complexity) can be completely and accurately described regardless of the number of individual components (Reitsma 2003); complication is a quantitative escalation of that which is theoretically reducible (Chapman 1985). A *complex* system, on the other hand, cannot be fully understood by analyzing the components (Cilliers 1998); the whole is greater than the sum of its parts where the dynamics of real systems arise from traits of the individuals and their environment (Siebers and Aickelin 2007). The core of complexity science lies in understanding the indirect effects that arise from the interactions of system components.

Collectively, complexity science and research have taken the "anti-reductionist" approach to analyzing phenomena. Chapman (1985) argued that if the world can be explained in a reductionist manner then complexity is not qualitatively different from simplicity but merely quantitatively different. The main task for complexity science is to explain how relatively stable, aggregated, macroscopic patterns emerge from local interactions of numerous lower level entities (Srbljinovic and Skunca 2003). Over time, the anti-reductionist view of complexity has become the dominant approach but as Edmonds (1999)noted, many techniques under the banner of complexity inappropriately apply the concept of complexity when describing complicated or difficult systems.

Within the ever-expanding circle of anti-reductionist complexity advocates, a wide variety of opinions exist as to the particulars of complexity science. Manson (2001) attempted to introduce some order by classifying the body of research (theories and models) into three, not mutually exclusive, groups of complexity research: algorithmic, deterministic, and aggregate. Aggregate complexity, the most commonly employed view popularized by the Santa Fe Institute (a private research organization focusing on complexity), focuses on the interaction of system components and truly epitomizes the anti-reductionist adage "the whole is greater than the sum of its parts." The varied and intertwined network of relationships among the system components extend beyond simple feedback into higher order, non-linear processes not amenable to modeling with traditional techniques (Constanza et al. 1993). This notion of aggregate complexity underlies the theory of CAS that lies at the heart of this research agenda.

Complex Adaptive Systems

CAS theory arose from the complexity theories spawned in the natural sciences to develop mathematical models of systems in nature. Although considered one stream of complexity research, many variations of the definition and key premises of CAS exist. A quote from John H. Holland, one of the original researchers in the area, best depicts the general principles underlying CAS:

"A Complex Adaptive System is a dynamic network of many agents (which may represent cells, species, individuals, firms, nations) acting in parallel, constantly acting and reacting to what the other agents are doing. The control of a CAS tends to be highly dispersed and decentralized. If there is to be any coherent behavior in the system, it has to arise from competition and cooperation among the agents themselves. The overall behavior of the system is the result of a huge number of decisions made every moment by many individual agents" (Waldrop 1992).

CAS examples include economies, social systems, ecologies, cultures, politics, technologies, traffic, weather, etc. (Dooley 1997). In order to adequately comprehend and utilize a theory that spans such a wide array of disciplines with varied interpretations, Choi et al. (2001) developed a comprehensive framework of CAS elements and attributes depicted in Figure 1. The framework consists of three interacting and intertwined main foci each with a subset of additional components: 1) internal mechanisms, 2) co-evolution, and 3) environment.

Agents represent the building blocks of CAS and are semi-autonomous units that seek to maximize 'fitness' or the general well-being of the system. Agents in a social CAS may include individual employees, departments within an organization, the organization as a whole, the organization's industry, and the global marketplace. This network typifies CAS in that agents and groups of agents represent a CAS while multiple CAS (e.g. organizations in an industry) can function in concert as sub-components of a larger CAS (e.g. global marketplace). The external agents in the larger CAS are referred to as "meta-agents" in relation to the lower-level CAS. Defining agents and CAS thus depends entirely upon the phenomena of interest.

Agents possess local rules of behavior and interact with other agents who have their own rules, both within their own system as well as with the environment which may include other CAS and their respective agents. The exchange of information and resources between agents facilitates the generation of schema (Schein 1992) defined as the norms, values, beliefs, and assumptions shared among the collective that dictate the manner in which agents interpret information and perform actions. An example from organizational leadership illustrates this point. Striving to instill effective corporate governance, executives often declare formalized mission statements, create codes of conduct, ethics statements, and other policies that represent core values to guide employee (agent) behavior, both within the organization as well as between employees and external stakeholders (e.g. customers, vendors, etc.).

Within the bounds of these "rules of behavior" and shared values, agents strive to increase fitness of their system relative to their environment. Agent actions can result in non-linear impacts to the local system and network of systems depending on level of connectedness; a more connected system will experience larger ripple effects throughout as agents interact in a dynamic fashion. Complex system behavior, therefore, can occur when multiple non-linear processes interact (Choi et al. 2001). Interested readers can refer to original work for detailed analysis of each framework element.

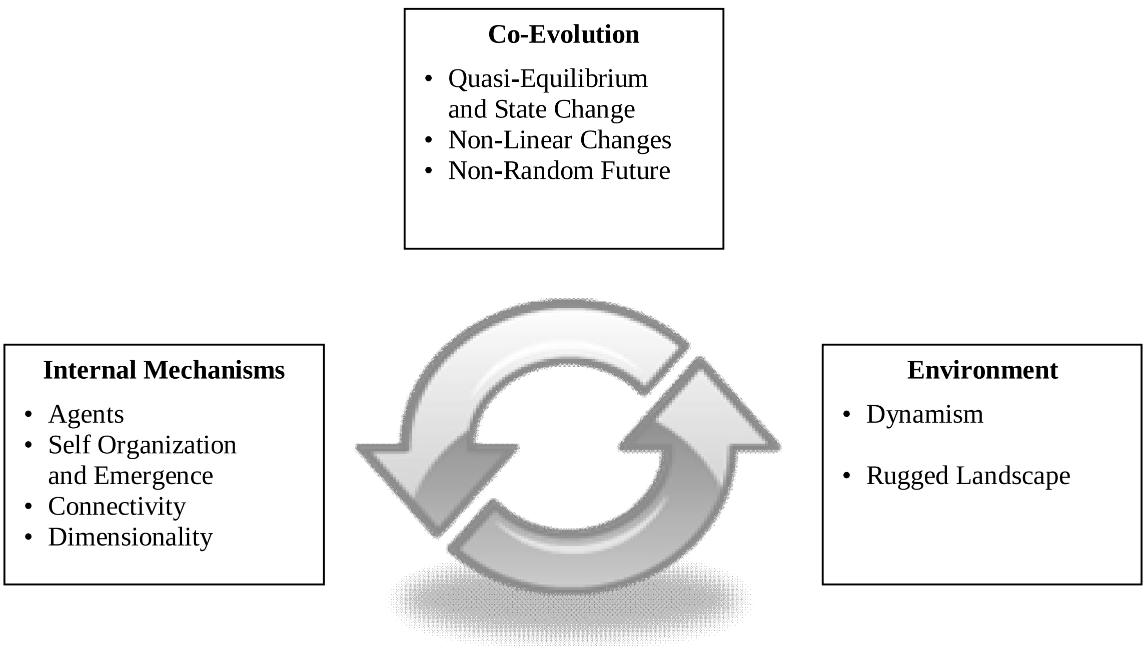

Figure 1: Underlying principles of complex adaptive systems.
Adapted from Choi et al. (2001).

Related Research in Accounting

Ballas and The oharakis (2003) explored the diversity in accounting research by conducting a survey of accounting faculty on their perceptions of the most prominent journals that publish accounting-related research. An extensive review of the 58 journals listed in that study revealed only three articles that specifically discussed and incorporated complexity and CAS theory into the core of the study. Mouck(1998) and (2000) explored the challenges that chaos theory and complexity science pose to the methodological views of capital markets research in accounting, the dominant paradigm in North America. The assumptions of neoclassical economics such as rational behavior, linearity, and predictability frankly fall short of accurately depicting reality and thus, leading economics researchers at the Santa Fe Institute have turned to CAS theory (Mouck 2000). More recently, Thrane(2007) examined the role and practice of accounting in dynamic and complex business networks, specifically how management accounting affects and effects change on complex inter-organizational systems. The author concluded management accounting in complex evolving inter-organizational systems acts as a source of instability rather than stability and as a source of emergent, unintended order rather than planned or institutional change. This view represents a stark contrast to the commonly-held belief that accounting rules and principles provide structure, consistency, and predictability.

The literature review also identified a few studies ancillary to CAS and/or published in journals other than the original 52 examined. Continuing the theme of unpredictability, Gouws and Lucow(2000) claimed traditional financial analysis approaches are no longer valid in a constantly changing business environment and presented a dynamic balance model to establish whether entities are able to adapt, survive, and prosper. Clarke (2005) drew a corollary between the key concepts of CAS theory and corporate governance and reviewed details of the Enron fraud under this lens. In the author's opinion, corporate governance "must no longer confine its analysis to the relationship between managers, boards, and shareholders" as the dynamic complexity of corporate governance in a connected world requires new, fresh theoretical perspectives. In the final related article identified during the literature review for this study, Painter-Morland (2006) analyzed the central assumptions of the current view of accountability in business ethics and offered a re-conceptualized version based on CAS theory. Under this approach, accountability can be viewed as a relational responsiveness towards stakeholders. The shared norms and values that organize and guide business behavior develop and emerge on a contingent basis as colleagues, clients, and competitors interact. As the author states, "the orderliness of business life is a reflection of the fluid internal logic of business as a system of dynamic functional relationships."

Although few in number, the aforementioned articles indicate CAS theory is slowly making inroads into accounting research and literature. Traditionally, the accounting discipline has borrowed theories from other areas such as management, economics, psychology, sociology, etc. Management science has been examining large-scale complex systems for over two decades as evidenced by early works based on complexity science published in *Management Science* (Florian et al.1980; Tilanus 1981; Bitran and Yanasse 1982) and the inclusion of CAS theory in the Astley and Van de Ven (1983) discussion of central perspectives and debates in organization theory. The movement has persevered (see 1999 special issue on complexity in *Organization Science*) and continues today (see 2007 special issue on complexity in *Management Science*). By presenting a structured research agenda we strive to inform accounting researchers of the merits of examining accounting phenomena holistically as a part of and affected by dynamic, open systems that constantly ebb and flow as a result of the localized behavior of connected agents.

Simulation and Agent-Based Modeling

As discussed in the previous sections of this study, certain phenomena in nature and society are complex, dynamic, and impossible to break down into deterministic cause and effect relationships; no definable end point or optimal solution exists. Gaining insight, understanding, and knowledge of these events or happenings requires robust tools and technologies. Analytical models fail to adequately account for the indirect effects of CAS agent interactions. Computer-based simulation, on the other hand, offers the capacity and power to mimic real-world system behavior and observe changes in system states at any time rather than merely predicting the output of a system based on a set of inputs (Siebers and Aickelin 2007). The purpose of simulation is to better understand the inner workings of a system and/or to predict trends in system behavior. Siebers and Aickelin (2007) compared simulation to an artificial white-room that allows one to gain insight but also to test new theories and practices without disrupting the actual system's operation. Troitzsch (2000) stated that if the theory framed for a particular system holds and the theory has been adequately translated into a computer model, then the simulation can assist in determining 1) what kind of behavior a target system will display in the future and 2) which state the target system will reach in the future. Such predictions involve analyzing trends rather than generating precise and absolute predictions of system performance (Siebers and Aickelin 2007); Keen and Sol (2007) referred to this as "rehearsing the future." Simulation, therefore, should be viewed as a decision support tool that requires consideration of the context of the real system before moving forward to implement steps intended to alter the system's direction and influence future state changes.

Agent-based modeling (ABM) represents one type of quantitative simulation modeling and provides the capability to explore the non-linear, adaptive interactions inherent to a CAS (Srbljinovic and Skunca 2003; North and Macal 2007; Siebers and Aickelin 2007). The researcher specifies the rules of behavior at the micro-level for the individual agents and the interactions between agents. Structures then emerge at the macro-level due to the actions of these agents and their interactions with each other and the environment. The consequences at the macro-level that result from ABM many times are not obvious or expected. This discovered knowledge allows the interested party to identify potential system states that may not have been considered otherwise, thus enhancing the effectiveness of the decision making process.

Cederman(1997) noted the following as some advantages of ABM: 1) the possibility of modeling fluid or turbulent social conditions when modeled agents and their identities are not fixed or given, but susceptible to changes that may include birth or death of individual agents, as well as adaptation of their behavior; 2) the possibility of modeling boundedly rational agents, making decisions and acting in conditions of incomplete knowledge and information; and 3) the possibility of modeling processes out of equilibrium.

Complexity researchers began using ABM in earnest in the 1990's (Epstein and Axtell 1996) and the approach has become a well-established simulation modeling tool in academia (Siebers and Aickelin 2007). As an example, an entire specialty in economics called Agent-Based Computational Economics (ACE) arose from the CAS movement to computationally study economies modeled as evolving systems of autonomous interacting agents (Tesfatsion 2001). ACE attempts to understand why certain global regularities evolved and continue on in decentralized market economies despite the absence of a central controller (e.g. trade networks, currencies, and market protocols) and to examine the effects of alternative socio-economic structures on individual behavior and social welfare. ABM is also quickly becoming more commonplace in practice to solve real business problems such as examining customer behavior in a supermarket based on differing configurations of products in the store layout (Casti 1997) and stakeholder (investors, market makers, and issuers) reactions to proposed changes to the tick size on the NASDAQ stock exchange (Bonabeau 2002).

A General Research Agenda for CAS and ABM in Accounting Research

The world is becoming increasingly complex and interrelated. The combination of drought in Australia, flooding in Europe, and the increased production of biofuels (farmers more interested in growing corn and soybeans rather than hops) have resulted in a shrinking supply of hops forcing beer breweries in Minnesota to find alternative and more expensive sources; experts predict some varieties of hops will increase in price by 400 percent and local beer prices may rise as much as 15 – 20 percent as a result of events occurring on the other side of the world (Dyslin 2007). The networked business environment requires accountants and accounting researchers to broaden their perspectives to include a more holistic view of how key participants act and react to each other's behaviors and changes in the environment whether that be physical (e.g. Australian drought), regulatory (e.g. convergence of U.S. Generally Accepted Accounting Principles and International Financial Reporting Standards), or political (e.g. power shifts in dominant countries). This next section offers a "taste" or sampling of how complexity, CAS, and ABM can be utilized as a viable research lens (and tool) for a variety of accounting-related research domains.

In the post-Sarbanes-Oxley (SOX) era much focus has been directed towards corporate governance by auditors, investors, regulators, political factions, academics, and others. A significant level of research effort examined relationships of internal control weaknesses to corporate financial reporting, disclosures, and stock market effects (Ogneva et al. 2006, Raghunandan and Rama 2006, Doyle et al. 2007a, Doyle et al. 2007b, Hammersley et al. 2008, Li et al. 2008) and a lesser amount explored the connection of IT governance and technology-based control weaknesses to overall firm performance, health, and shareholder value (Weill and Ross 2005; Ahuja et al. 2009; Canada et al. 2009; Ahuja et al. 2010) statements. Of critical importance to effective internal control is the control environment (an entity-level control) established by management's philosophy, operating style, integrity, and ethical values (PCAOB 2007) that affect employee behaviors and views of internal controls. This leads us to ask the following questions:

RQ 1: Do individual moral development, personality traits, and financial pressures (i.e. individual agent properties) influence employee behavior?
RQ 2: Do work group norms (i.e. emergent behaviors) influence employee behavior?
RQ 3: Does the work culture that represents organizational controls and policies about ethical behavior (i.e. the environment) influence employee behavior?
RQ 4: How do different types of management control design affect individual employee and overall firm productivity?

Another key entity-level control of SOX and corporate governance relates to companies' risk assessment process (PCAOB 2007). The global economy offers many opportunities that did not exist just 10 years ago but flattening of the Earth via the internet and extensive outsourcing have also presented organizations with many risks that can be broadly categorized as one of four types: strategic, organizational, compliance, or operational (Liebesman 2008; Miller et al. 2008).

Strategic risk focuses on the ability to achieve high level goals and requires consideration of technology changes, competitors' actions, economic conditions, political conditions, and customer needs (Liebesman 2008). Organizational risk arises from an organization's structure that includes the type of industry, firm size, ownership structure, etc. (Alessandri and Khan 2006). Compliance risk relates adhering to legal and regulatory requirements (Wunder 2009). Operational risk concentrates on the efficient use of resources that include internal management control systems, customer satisfaction, supply chain partners, information security, logistical processes, and natural/environmental forces (Liebesman 2008; Anderson and Dekker 2009). Some related research areas appropriate for a complexity-oriented approach may include:

RQ 5: How do key risks (and types) interact to affect firm performance?
RQ 6: Can certain control mechanisms effectively mitigate specific risks? If so, are there any unanticipated effects due to the interrelationships of various risks?

Up to this point, the focus of the research questions has been on organizational issues related to the crucial corporate governance aspects of culture and risk assessment. The next set of points present several opportunities for complexity research in the audit domain – again, not an exhaustive list but rather introducing a few ideas to stimulate interest. Accounting regulation mandates that auditors assess the ongoing viability of every client's business operations and report any substantial doubt about a company's ability to continue as a going concern for a reasonable period of time in the issued audit report that accompanies the financial statements. As such, auditors must gain an understanding and assess existing conditions that affect an organization, including those of others in the industry and the economy in general leading.

Somewhat related to the going concern opinion of existing clients is the acceptance decision of potential clients. The audit profession has repeatedly raised concerns that excessive liability exposure hinders auditors from accepting potential clients that pose higher risks, such as entrepreneurs and those in industries that inherently contain increased exposure (Laux and Newman 2010). Both the International Federation of Accountants and Public Oversight Board lament this situation and fear for access to capital of firms deemed higher risk. These two related auditor decisions lead to the following research questions:

RQ 7: What factors pose the greatest risks to the success or failure of audit clients?
RQ 8: Can the development of an agent-based model facilitate auditor understanding of possible future states for their clients' businesses? If so, how might one be designed and utilized?

Business operations today, in the new millennium is a multifaceted process that is continuously transforming due to the changing context of conducting business in a technology-aided economy, which brings us to a remarkably new environment for auditors and challenges in their work. This ever-evolving and complex business environment poses a significant issue for public accounting firms assigned with the duty of auditing public companies in the U.S. The Statement on Auditing Standards No. 59 *The Auditor's Consideration of an Entity's Ability to Continue as a Going Concern* (SAS 59) requires auditors to gain an understanding and assess existing conditions that affect an organization, including those of others in the industry and the economy in general. From an auditor's perspective, there are more variables than ever before that must be considered when assessing their clients' ability to continue on, there going concern.

Although not explicitly expected to predict future conditions or events by auditing standards, auditors historically have relied upon bankruptcy prediction models in their auditing practices due to the ease of use and ability to rely on a model to support the auditor's overall assessment, rather than mere gut feeling. Many of the commonly used bankruptcy prediction models in the auditing field today are not reliable and have inherent flaws where they do not necessarily account for the cause and effect relationships between factors that may be a significant cause of or at least related to the bankruptcy. Subsequent research has revealed that the models auditors employ and rely on to support their assessment and assumptions have been called into question and have shown to suffer from inability to generalize across industries and time periods. Therefore, the authors of this paper introduce and identify a simulation tool (Agent-Based Modeling) specifically designed to examine the interactive effects of multiple stakeholders, and discusses the use of it in an illustrative case study that explores the future possibilities for Frontier Airlines, based on the simulation results from the application of the ABM. Agent-Based Modeling is a stochastic modeling approach that provides the unique capability to explore the non-linear, adaptive interactions inherent to complex systems (Srbljinovic and Skunca, 2003).

In today's fast-pace, technology driven environment the creation and employ of the ABM is a prime example of the effective benefit of a technological tool that is relatively simple, and easy to use. Consequently, making the use of ABM a more feasible option for public accounting firms and organizations that face intricate decisions. As a heavily-regulated industry that services the general populace and is susceptible to external forces (e.g. oil prices), the airline industry (and Frontier, specifically) presents an interesting topic for ABM simulation. In this illustrative case study on Frontier Airlines, the author's present the details of an ABM designed to assist auditors in their assessment of an entity's ability to continue as an ongoing concern (SAS59). This paper presents practical case study material from an ABM designed to assist in estimating the market share for the routes that Frontier Airlines serviced in 2007. This key figure derived from the Agent-Based Model would help provide auditors with more reliable and realistic predictions for the next year's revenues, which is the single most important line item statement that drives financial performance, and assists in the auditor's consideration of on-going concern.

This paper ascertains some of the key initiatives for value creation and delivery by involving the vital resources of Frontier Airlines, as illustrated by the case study. It demonstrates and supports that our proposition to auditors to take advantage of advanced information technologies such as agent-based modeling (ABM) that is designed to capture complex interactions and its ability to handle massive amounts of data in order to assist in decision-making. No longer will financial auditors of public companies have to rely on outdated, unrealistic bankruptcy prediction models and/or key ratio analysis and "gut feeling" when evaluating the going concern status of their clients. In short, this case study demonstrates a number of practical advantages and capabilities that ABM can offer auditors in a complex decision-making scenario providing public accounting firms with significant aid in estimating the most essential and most difficult financial line item of them all, revenues, when developing their obligated going concern opinion (SAS59).

Summary and Conclusion

In summary, this introductory research agenda is based on the premise that by applying the theoretical concepts of complexity and CAS in conjunction with the associated ABM research tool, accounting researchers can lead practice in gaining insight into the dynamical, networked relationships of the accounting domain in an ever-flattening business world.

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