

Evolving Accounting Systems Research with Business Measurement Practice – a letter from the editor

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Introduction¹

Accounting, the science of organization measurement, is at a threshold of change. It either substantially changes or becomes irrelevant as an external corporate measurement. While external reporting has remained rather stationary and consequently has lost much of its relevance internal reporting with the adoption of ERPs, and the substantive computerization of business processes has become dynamic and creative. While instruction in Management Accounting still has some of its traditional cost emphasis, corporate practices related to the measurement of business processes have evolved fundamentally: (1) from the financial area to a wide scope of non-financial measurements, (2) in timing from quarterly to very rapid reporting, and in type from manual transaction processing to transaction, business process and account monitoring.

In this wave of change accounting research has a unique opportunity to lead and guide practice. Many areas have developed to satisfy business need, but unfortunately there is little conceptual guidance and integrative frameworks. Accounting academics (Alles et al., 2008) have the competitive advantage on this domain and should provide leadership and guidance. Volume 5 of JETA, the last in this editorship, aims to illustrate some areas of potential leadership. This editor's letter, foreword to Volume 5 of JETA, discusses some of this potential.

Volume 5 is divided into five main sections: 1) semantic analysis, 2) real time economy, 3) research studies, 4) analytic research studies, and 5) educational research. Each of these main sections will be described and discussed in terms of potential contributions to business measurement and assurance practice.

Semantic Analysis

JETA has published several studies on accounting semantics, meta structures of language understanding, applications to accounting literature, and knowledge extraction. While the progressive opening of corporate databases to stakeholders is inevitable, this process will be very slow and disclosure selective (*Gal, 2008*). Meanwhile the different disclosure methodologies that are not restricted to the financial statements but include press releases, special reports, and third party new pieces and analyses will provide rich content for semantic extraction and semantic understanding.

While this information substantially enhances the scope of potential financial analyses, it is limited in that 1) there are no easy comparison terms for base lining, 2) the information is not audited, 3) much of the information is not totally objective as it suffers from extensive public

¹ Italicized references are contained in this volume # 5 of JETA.

relations massaging, 4) in company disclosures the content is substantially positive biased , 5) there is too much latitude on methods and content of disclosure consequently methodologies of production and actual content are uneven, and 6) many other issues.

On the other hand, third party semantic data (e.g. analyst reports, news pieces, blogs, etc.) may suffer from a different set of biases and share the unevenness of format and content. Clearly an expansion of the domain of disclosure to non-financial information², the development of content clusters in search engines that “bundle” information about organizations (e.g. all information detected about IBM), and formal tools for extraction of content and meta-content (e.g. Fisher, 2005; Henry, 2007; Garnsey, 2007; Fisher and Garnsey, 2007) will create a different scenario of disclosure. Hopefully, eventually these will be incorporated in the decision context of measurement data stakeholders and improve the woefully low explanatory ability of measurement numbers (*Lev, 1989*).

The *Shirata and Sakakami (2009)* article joins semantic extraction methodologies to the rapid internationalization of accounting numbers. In Japan, accounting standards have been updated frequently creating confusion and difficulty for comparisons of financial information. Since 2004 Uncertain Risk Information, Management’s Discussion and Analysis, and Information related to Corporate Governance have been required. This additional disclosure increases the amount of material available for text mining/content analysis in evaluating companies’ conditions. The study using semantic analysis clarifies the difference between going concern companies and non-going concern companies. It analyzes non-financial (qualitative) information disclosed in Financial Report in Japan (Japan 10-K) using key words. The results of the study reveal that certain non-financial key words in financial reports can be very useful to evaluate corporate financial position.

Garnsey and Fisher (2009) use semantic analysis technology to understand accounting language. It provides a preliminary analysis of terms used in official accounting pronouncements and annual corporate financial statements. The results show that statistical natural language processing techniques provide a means of identifying new terms as they enter the lexicon. These techniques should be valuable in deriving a complete accounting lexicon as well as in constructing and maintaining an accounting thesaurus to support information retrieval.

Among the many paths of leadership for accounting research the following areas may be of great value:

1. Semantic clustering for financial analysis
2. Meta-semantic evaluation criteria (good cluster, bad cluster, unusual event, etc)
3. Unusual content in semantic streams
4. Semantic base lining for evaluative purposes
5. Extraction of accounting footnote information
6. Detection of voids in information supplied (semantic techniques to denote unusual lack of particular information)
7. Semantic crawlers to create corporate information clusters. Programs that travel the Internet looking for corporate information.
8. Specific accounting topic finders and extractors (a la FRAANK, Bovee et al. 2005)

² <http://raw.rutgers.edu/Galileo/>

9. Application of the understanding of the semantics in accounting and auditing knowledge to finding information in non-financial domains, its parsing, and its addition to relevant company information sets.

Real Time Economy: Continuous monitoring, reporting, and auditing

The real-time economy (Economist, 2001) has been motivated by the need of reduction of latency between processes (inter-process latency) and within processes (intra-process latency) in order to reduce the occupation of capital and accelerate business processes. This phenomenon, while complicating the frames of business measurement and assurance, has created many opportunities of incorporating technology and improving the scope and accuracy of these business processes. In the overall schema of electronization of business (Vasarhelyi & Greenstein, 2003) there is great change of methodology and innumerable opportunities of business advantage. The business measurement process that includes the progressively integrated internal and external business reporting area, can provide a wider set (including non-financial), more timely (close to real time; Gal, 2009), better and continuously assured (Brown et al, 2008), and actively monitored (Nigrini and Johnson, 2009) set of information.

Essential to these processes is:

1. The ability of monitor business processes on a close-to-real-time basis where very timely measurements are compared to models of performance and acceptable levels of variance.
2. The need for building adaptive benchmark models. These models should be taking in consideration cyclicity, one time surges, relationships between processes, and the characteristics of a particular account. These models must be much more sophisticated at adaptive than the simple minded fixed and variable budget models we use today. The models may be directed to single transaction monitoring as well as intermediate ledger accounts as well as final financial statement accounts at different levels of temporality (instant, daily, weekly, monthly). For example, Kogan et al (2009) illustrates this type of effort by developing continuity based equations to monitor a supply chain process at the transaction and account level.
3. With the emergence of “close to the event” control and data assurance an entire set of conceptual clarifications that will eventually flow into auditing standards must be made. New technological capabilities allow for process interruption at the detection of significant (material) inaccuracies, the assurance process by itself is a meta-control (Vasarhelyi, Aquino, and Lopes, 2008), the auditor must take an integral part on the meta-process (independence issues), etc.
4. Enhancements in automatic measurement (sensing) and modeling allow for an expanding reliable set of business measurements and disclosures. These are necessary in an age where business process and standard complexity is overwhelming. Vasarhelyi and Alles in the Galileo monograph (2009) propose an expanding scope of process measurements (non-financial / intangible), and the disclosure of the values of structural equations to present a better and more dynamic representation of corporate behavior and health.

5. As a transitional model for a radically different set of “financial statements” a set of “more continuous” reporting disclosures must emerge. These raise many unexpected issues that must be examined (*Gal, 200p*).
6. The need for practical solutions for the disruptive technologies described here include: 1) new assurance products to be provided by the profession, 2) better integration of third party audits (audit of outsourced processes), 3) an entire family of continuous audit processes in data and control assurance, 4) etc, etc, etc.
7. While the traditional audit model has developed over many decades creating what we call today GAAS, the requirement of internal control assurance over financial processes raised serious measurement issues that are not resolved. The field needs repeatable, objective, and quantitative measurements of internal control effectiveness encompassing measurement of specific controls and schemata for assessing control combinations.

The ensuing four papers, included in this Volume V, deal with some of these issues, but clearly we are in the pre-paradigmatic stage of real time measurement, monitoring and assurance.

Santos et al (2009) discuss the role played by organizational information systems in the maneuvering of organizations, particularly concerning their capacity to continuously adapt to new challenges using real time response. The process of evaluating and validating is one of auditing, which in order to be performed according to good practice should be based on an internal control system. They present a conceptual model for continuous organizational auditing using real time analysis and modern control theory. It includes: the consistent and coherent design of an internal control system based on modern control theory, the formal verification of the rules that make up the internal control system’s specific aims, a conceptual model able to support continuous organizational auditing using real time analysis.

Nigrini and Johnson (2009) describe a continuous monitoring methodology and case study in an environment with multiple cues indicative of fraud and errors. The case study describes an application by a restaurant franchisor on the monthly sales numbers reported by franchisees. The system scores each restaurant based on variables judged to be possible indicators of fraud or errors in the monthly sales reports. The variables are weighted according to their perceived importance to obtain a final risk score for each restaurant. The output is a small set of audit targets believed to have a high risk of reporting errors. The variables can be categorized as being (a) key performance indicators, (b) statistical irregularities, (c) motivation or pressure related variables, and (d) variables related to compliance with the franchising agreement.

Gal (2009) examines the forthcoming effects of more close to real time reporting. As the time between the event and the reporting of that event shrinks, several issues arise: the information to be disclosed, its level or detail, the time lag of its provisioning, and the methods to query the information. Furthermore information usage, information adequacy, and materiality emerge as additional issues of concern. These issues, while not discussed in the accounting literature, can benefit from learning from queries on statistical data such as the census and hospitals. Methodologies such as queries with the use of inference channels, inductive learning and query history are proposed as great importance for continuous reporting.

Bonsón-Ponte, Cortijo-Gallego and Escobar-Rodríguez (2009) analyze how XBRL (eXtensible Business Reporting Language) can contribute to EBR's (Enhanced Business Reporting) to improve financial reports' transparency. They examine XBRL's technological and organizational advantages that can facilitate the implementation of the EBR model. The XBRL framework can help EBR provide greater interaction with users, help companies identify relevant reporting data, and harness technological advances to overcome the weaknesses inherent in traditional business reporting models. EBR and XBRL efforts combined can work effectively to improve the current business reporting model.

The two key management infrastructures of business measurement (accounting) and assurance (information quality) are inextricably interlinked. It is useless to improve assurance of meaningless numbers. On the other hand, it is also of little value to have information of value if it cannot be relied upon due to poor data quality. Mock, Vasarhelyi, and Romero (2009) argue for the expansion of the business measurement range both in the wider scope of business activities, but also for a dimension of decision dependence (information to be disclosed contingent on the purpose of the decision) and time scope towards a more futuristic view of measurement. These items are further exposed in the last section of this note.

Research Studies

The above mentioned latency in business processes can best be addressed by automation. While ideally full reporting and assurance automation will be intervention free, in reality much time will elapse prior to this being possible. An interim issue of great importance is the progressive development of decision aids for improved analytic support as well as partial automation. Several issues must be treated by research, among which:

1. Adoption of technology tools by auditors
2. Biases and improvement facilitated by these tools
3. Tools available, features, and their evolution
4. Reasons for slowness in deployment
5. Linkages of decision aids to work paper technologies and continuous audit software tools such as ACL, IDEA and APPROVA.

Dowling, Leech and Moroney (2009) examine the usage of audit support systems in practice. Although these systems have existed for over a decade, they continue to evolve. Technological advances present audit firms with the ongoing dilemma of deciding the type and extent of decision support to embed within their firm's system. They complement the existing literature that has investigated the short-term consequences of providing decision support to auditors by investigating the association between the extent of decision support embedded within the audit support systems of three major international audit firms and the declarative knowledge possessed by long-term users. An experiment was conducted, which required auditors without the aid of their firm's audit support system to list the key business risks common to clients in an industry familiar to them (hereafter referred to as relevant risks). They find that auditors who normally use an audit support system that provides a low level of decision support list more relevant risks.

The self-organizing map (SOM) analytic technology has been in several literatures for a while, but its applications in accounting and auditing are very limited. The financial benchmarking application found in the *Eklund et al (2009)* paper could be useful for analytical review processes, disclosures, and many other forms of accounting benchmarking. Graphical techniques and visualization have been notoriously absent from the accounting and auditing literatures.

Eklund, Back, Vanharanta, and Visa (2009) examine the technology of self organizing maps as a methodology for financial benchmarking. Financial benchmarking is an essential component of competitor analysis, a task that increases in importance as markets expand. A survey of financial benchmarking methods in Finnish publicly-noted companies found that few advanced multiple ratio methods are currently used. The survey found support for the need for new, complexity-reducing tools in financial benchmarking. They create a model for financial benchmarking in the pulp and paper industry using the self-organizing map (SOM), which is evaluated by experts from industry. The study found that the managers considered the model better than many of their own methods, especially in terms of format. In particular, the model was found to be useful in strategic decision making settings.

Application of artificial intelligence technologies have nearly disappeared from the accounting literature since the early application pioneered over a decade ago. On the other hand, recent years have seen the resurgence of robust applications of neural networks, fuzzy sets, expert systems in a wide set of fields now in a mature, industry capable form. However, JETA has been the standard bearer for academic studies in some of these areas. In particular, it has published several papers using neural nets in different areas of accounting research. There is a wide set of questions re-emerging in the utilization of both neural networks and in the more general area of AI.

Srinivasan and Lavin (2009), apply neural networks methodology to the study of revenue restatements. They also compare the results of the neural network classification with classifications obtained from multiple discriminant analysis (MDA) and logistic regression (Logit) models. Six financial and governance variables were used to train the neural network on a sample of 180 firms, and the model was validated using a holdout sample of 51 additional firms. The results show that the neural network model has superior power for predicting revenue restatement firms when compared to the MDA and Logit models. However, the Logit and MDA models predict non-revenue restatement firms better. Moreover, when misclassification costs are included, the neural network (NN) model performs the best with the lowest relative misclassification costs.

The influence of the Web has been ubiquitous in business and academia. The second generation of Web tools, practices and structures has created XML and provides an important and substantive framework of interoperability. XBRL has emerged as the de-facto standard for the transmission of financial statements and some additional financial information across institutions. However, many other W3C guidance and tools are of interest to the academic and practical accounting worlds. *Cong, Du and Feng (2009)* discuss Web syndication, but in this generic arena many questions arise and currently the focus tends to be on XBRL.

1. How good is the XBRL technical standard?
2. What are the contingencies of XBRL acceptance and adoption?
3. Would a dramatically different standard, for example with atomistic data points, be better than the existing XBRL standard?
4. Optimal criteria for taxonomy granularity and other issue related to taxonomy organization and construction
5. Integration of ERP's with other XML derivative standards provisioning basic transactions and their relationship and information optimality with XBRL / GL and eventually FR.
6. What could be the social benefits of the wholesale adoption of XBRL FR and GL?
7. Is there a way to really measure the saving to the economy of its adoption as alleged by the sponsors of the Dutch XBRL "experiment?"
8. What could be done to accelerate adoption of tagged financial information?
9. What should have been done differently to increase the social benefits of "interactive data?"

Cong, Du, & Feng (2009) examine web syndication technology. Web syndication is an emerging technology that "feeds" website information to subscribers. It allows Internet users to collect, organize, and view frequently updated information from multiple sources effortlessly. They investigated whether using web syndication technology helps nonprofessional investors acquire and integrate relevant information, which has been updated frequently and is from multiple sources when the investors make decisions. They obtained evidence of this new technology's effects using an experiment where subjects visited either a syndicated web page or a non-syndicated web page and assessed two fictional companies' critical financial ratios and investment perspectives. Results indicate that individuals who use syndication technology are more effective in acquiring relevant information updated frequently and integrating information for investment decision making than individuals who do not use such technology. The results also suggest that web syndication may be used as an information integration tool for nonprofessional investors in assisting their decision making.

Analytic Research Studies

While accounting systems research is preponderantly normative and applied, many information theoretical and model building studies will eventually be part of the scenario. Methodologically it would be interesting to understand where analytic studies fit in the grand picture of AIS research and where they can provide guidance, insight, or a standard to orient other methods of research. Volume 5 includes two studies: one dealing with investment in technology (*Koo, Lin and Smedley, 2009*) and the other applying Dempster Shafer Theory of Belief functions to System Reliability and Security (*Li and Srivastava, 2009*).

Koo, Lin, and Smedley (2009) examine if investments in information technology can translate into benefits for investors. The study uses Bayesian theory to explore whether the benefits of adopting a technology (that increases the quality of information) extend to the investing community. An added value to firms investing in technology is that such investment may increase the demand for information from outside the firm. As the market demand for this

information increases, companies that seek capital in the security markets may have a greater incentive to adopt technologies that increase information quality.

Li and Srivastava (2009) develop comprehensive formulas for assessing the risk and reliability of “Systems Security” under Dempster-Shafer theory of belief functions using the Trust Services framework as proposed by American Institute of Certified Public Accountants (AICPA) and Canadian Institute of Chartered Accountants (CICA). In addition, they discuss how these formulas can be used for planning and evaluation of “Systems Security” risk under the SysTrust services. The analytical formulas are derived for a tree-structured evidential diagram, which is constructed by converting the exact network-structured evidential diagram. The use of an analytical formula eliminates the computational complexities of propagating beliefs in a network and allows the assurance provider to use simple spreadsheet to combine evidence. They provide theoretical justification and perform sensitivity analyses to show that the analytical formula based on a tree type evidential diagram is a good approximation of the exact network model under realistic situations. However, it has been shown theoretically and also through the sensitivity analysis that the analytical formula provides significantly different results when input beliefs are significantly negative. It should be noted that the analytical formula based on the tree model provides a more conservative assessment of information systems risk than the exact network model.

Educational Section

An important element of the extant AIS research scenario is its pedagogical component. The classroom environment has been exploding with technological aids from electronic textbooks, display technologies, PowerPoint slides, interactive teaching environments, automatic problem delivery and grading websites, etc. The change both in the technology of delivery as well as of teaching support has been immense. The research on the actual costs and benefits of these implements and their pedagogic contributions has been very limited. Consequently, very little guidance has been given to academics and academic administrators on the usage of these technologies. Some of this research has been performed in the area of education or other disciplines, but many questions should be asked specifically about accounting and auditing and their instruction as an academic discipline. While the scope of the potential research is immense, a few areas are obviously wanting and should be mentioned:

1. The role, cost, and educational contributions of material distribution and teaching support environments (e.g. Blackboard, WebCT).
2. The tradeoffs of packaged learning texts that include substantive teaching support and may be nearly self contained and the more traditional classroom teaching that rely on the experience and ingenuity of the instructor.
3. Contingencies of quality of the different distance learning technologies and their combination with the traditional or modified classroom teaching.
4. Usage of different Web technologies both in supporting materials as well as the medium of teaching.
5. Human information processing research to understand the effects of the availability of large corpuses for search and the basic knowledge necessary for this search. This fact

strongly affects the retention / memorization needs of students.

6. Cases on AIS technology that reflect the day-to-day needs of graduates.

Tam (2009) examines introducing dynamic content into accounting course materials. Accounting course materials are traditionally presented as static content. By enabling timely and informative interactions with the reader, dynamic content can enrich these presentations. The paper discusses benefits of dynamic content to accounting education, and it describes its application in an activity-based costing case. A technology road map to dynamic content development is provided.

The area of educational research, typically considered by academics of less prestigious nature, is tremendously wanting and can provide great value to the accounting academic profession and to the society at large. Recognizing this fact, JETA has created a special section of education research that contains efforts of research and some case educational content.

Conclusions

Accounting, the science of organization measurement, is at a threshold of change. It either substantially changes or becomes irrelevant as an external corporate measurement. The sub-prime crisis immersing the economy in a crisis not seen since the depression has clearly demonstrated this fact. Internal management of stalwart organizations was dumbfounded by the facts that could have easily been ascertained from their operating data structures.

“Almost no one expected what was coming. It’s not fair to blame us for not predicting the unthinkable.”— Daniel H. Mudd, former chief executive, [Fannie Mae](#).

While the emphasis on the popular press has been on greed and malfeasance, anachronistic information and assurance structures played a seriously compounding role. The following issues illustrate this point and are mapped to prospective potential business practice changes and their consequent needs for research:

1. Firms (just as in the savings and loan crisis) with clean opinions failed precipitously short periods of time after audit statements were issued
2. Firms seen as “safe” and leading the modern economy failed or had to be protected by the government after just days of market collapse
3. Intermediate financial markets dried up in days prompting the government to drastically intervene
4. The fair value rule has been deemed at a major causing factor of the crisis

Meanwhile, some technological issues and capabilities that has bearing on the crisis and on the path for future AIS research:

1. Unless serious forecasting, contingency analysis, and risk analyses are performed and assured the clean opinion / failure phenomenon will continue to happen.
 - a. Research on forward looking reporting (Mock et al, 2008)
 - b. Research on enterprise risk management and its assurance
 - c. Research on supporting and analyzing the risk factors section of 10Ks
2. Acceleration of the reporting cycle not only towards close to real time, but also from the prospective standpoint is needed. While this information by itself may be destabilizing, its association with new regulation on governance, management action, measurement, and assurance can bring the system back to the self-regulating status.

- a. Research on continuous reporting
 - b. Research on economic stability and arbitrage / self-regulating systems
3. Measurements not only on the firm and its up-chain and down-chain partners, but in the metrics of the intermediate markets it relies upon:
 - a. Research on consolidation modeling among the firm, its related entities, and on the nature of the market upon which the firm relies
 - b. Research on formation structures of the following elements: risk elements of the firm (inform 10K), interconnectivity between the firm and its suppliers / clients and outsourcers and outsources, intermediate market liquidity and supply and demand characteristics
4. The equation of the cost x benefits of quantity of information reporting has change dramatically. Regulation in this case ossifies the change. Standard setters cannot see the possibility of providing different forms of valuation to be used in different scenarios and decisions. Some changes in the speed and dynamics of the industry are de-stabilizing for a while. The argument of not supplying “fair value” but to supply obsolete valuation information is wanting. Clearly the solution is to provide contingency related information with probabilistic assessments.
 - a. Research of the dynamics of intermediate markets and their valuation
 - b. Research on the relation of economic contingencies and value
 - c. Research on relevant data for specific decisions
 - d. Research of measurement at much earlier indicators of business activity (mock et al, 2008)

This note has discussed many potential paths for AIS research, its urgent need in light of rapid business change and the obsolescence of the business reporting and assurance model. It is also imperative that AIS be brought into the mainstream of accounting research and that AIS scholars also produce “professional articles”, as well as impound their leadership into teaching and “educational research” to effect the needed transfer of technology.

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