Continuous Assurance for the Now Economy

A Thought Leadership Paper for the Institute of Chartered Accountants in Australia

Miklos A. Vasarhelyi
KPMG Professor of AIS
Department of Accounting, Business Ethics and Information Systems
Rutgers Business School

Michael Alles
Associate Professor
Department of Accounting, Business Ethics and Information Systems
Rutgers Business School

Katie T. Williams
Senior Manager
Global Services Centre
KPMG LLP

February 2010

Contents

Summary of figures

Summary of tables

Glossary of acronyms and definitions

AICPA American Institute of Certified Public Accountants
AIS Accounting Information System
AUASB Australian Auditing & Assurance Standards Board
ASEC Assurance Services Executive Committee
BP Business Process

CAAT Computer Assisted Auditing Techniques
CAP Continuous Audit Procedure
CCM Continuous Control Monitoring
CDA Continuous Data Auditing
CDOs Collateralised Debt Obligations
CE Continuity Equation
CICA Canadian Institute of Chartered Accountants
CISA Certified Information System Auditor
CPAS Continuous Process Auditing System
CPE Continuous Professional Education
CRM Customer Relationship Management
CRMA Continuous Risk Monitoring and Assessment
DMV Department of Motor Vehicles
EAM Embedded audit module
ERM Enterprise Risk Management
ERP Enterprise Resource Planning
ETL Extract, Transfer and Load
FD Fair Disclosure
GAAP Generally Accepted Accounting Principles
GNP Gross National Product
GRC Governance, Risk and Compliance
GTAG Global Technology Audit Guide
IA Internal Audit
IFRS International Financial Reporting Standards
IIA Institute of Internal Auditors
ISACA Information System Audit and Control Association
IT Information Technology
JIT Just in Time
JSON JavaScript Object Notation
KPI Key Performance Indicators
MCL Monitoring and Control Layer
PDA Personal Digital Assistant
RTE Real-Time Enterprises
SEC Securities and Exchange Commission
SOA Service Oriented Architecture
SOX Sarbanes Oxley Act
SQL Structured Query Language
XBRL Extensible Business Reporting Language
XBRL/FR XBRL Financial Reports
XBRL/GL XBRL Global Ledger
XML Extensible Markup Language

Executive summary

The world we have created today, as the result of our thinking, thus far has problems which cannot be solved by thinking the way we thought when we created them.
Albert Einstein

Over the last few decades businesses in Australia and around the world have been utterly transformed by powerful information technologies, from the PC and the internet to email and cellular phones – to the extent that a new type of economy is said to have been created: the 'Now Economy' which is characterised by 24/7/365 globalised operations, customer interaction and management decision making. By contrast, the way in which these entities are audited has not experienced an equivalent evolution. Over the last century, external auditors have tended to examine an entity only once a year and listed entities themselves only report quarterly in many parts of the world and half yearly in Australia, even though the capability exists for both reporting and auditing on a much timelier basis. The emerging field of Continuous Auditing (CA) attempts to better match internal and external auditing practices to the reality of the IT-enabled entity in order to provide stakeholders with more timely assurance. The dramatic collapse of leading banks around the world makes it all the more important that external and internal auditors take full advantage of modern technology to provide shareholders and managers with the most timely and relevant assurance.[1]

Our experience with the emerging Continuous Assurance industry over the last decade indicates that traditional auditing will give way to a progressive form of 'close to the event' assurance. The obvious economic benefits to be gained from better matching internal and external assurance with the pace of their operations, combined with lower costs and increasing capabilities of the driving technologies, fosters the emergence of Continuous Assurance. However, it is likely that first, professional organisations and then, standard setters, as well as governments, will issue guidelines for progressively real-time assurance procedures.

External auditing involves an assessment by the auditor that reports prepared by the entity are in accordance with the relevant framework. Responsibility for recognition, measurement and disclosure is clearly the responsibility of those charged with the governance of the entity: senior management and the board of directors. Hence, the auditor's job is to assess if the entity has met its obligations by examining the entities' transactions and other parameters. As those transactions increasingly only exist in digital form, the audit process will have to change accordingly. The question is whether that change will be minimal – with the formerly manual procedures simply redone electronically – or whether auditing will be re-engineered fundamentally, to rethink how auditing can be done most effectively when it no longer needs to be done manually, and hence only periodically and with limited data.

Continuous AssuranceCA is a progressive shift in audit practices towards the maximum possible degree of audit automation as a way of taking advantage of the technological basis of the modern entity in order to reduce audit costs and increase audit automation. Given the emphasis on the transformation of the entire system of auditing, the development of Continuous Assurance requires a fundamental rethink of all aspects of auditing, from the way in which data is made available to the auditor, to the kinds of tests the auditor conducts, how alarms are dealt with, what kinds of reports are issued, how often and to whom they are issued, and many other factors, the importance of some of which will only become apparent as Continuous Assurance is implemented. It is important for the profession and other stakeholders to start thinking about the impact of Continuous Assurance on auditing now, when it is easier to put in place the foundations for this change, rather than when technologies and practices have already become established.

---

[1] Bear Stearns received an unqualified audit opinion on 28 January 2008. However, by 10 March 2008 its financial problems hit the headlines and on 14 March 2008, with state support, it was sold to JP Morgan Chase (Sikka, 2009).

While audit standard setters are letting Continuous Assurance reach a more mature level before developing standards around it, Continuous Assurance has already been the subject of white papers by several important professional bodies. The Canadian Institute of Chartered Accountants (CICA) jointly with the American Institute of Certified Public Accountants (AICPA) issued their 'red book' – entitled *Continuous Auditing* – in 1999. The US-based Institute of Internal Auditors issued a Global Technology Audit Guide (GTAG) entitled *Continuous Auditing: Implications for Assurance, Monitoring, and Risk Assessment* in 2005[2], while Information System Audit and Control Association (ISACA) International has also recently issued an exposure draft on Continuous Assurance, written in part by an Australian, Kevin Mar Fan, CISA, CA, of the Brisbane City Council.[3] It is important to recognise, however, that there are no established procedures for Continuous Assurance at this time, and this is not the time for anything to be considered settled. Rather, it is a time for experimentation, to 'let a thousand flowers bloom', in order for auditors to figure out what they should be doing in this new technological business age, and how they should be doing it. Standard setters and other regulators, accounting bodies and the government have to continue to play more of an educational and advocacy role at this stage, to encourage the adoption of Continuous Assurance and its continuing evolution. The rapid rise of the Continuous Assurance industry following the 1999 'red book' indicates that this strategy has paid dividends and that there is evidently no rush by any of these bodies to change their role.

Another key role in the evolution of Continuous Assurance will be played by the universities and accounting bodies that train the next generation of accountants. This next generation will spend much of their working lives in an environment where Continuous Assurance will no longer be an emerging audit methodology, but simply the everyday way in which auditing is done. However, much of current audit education reflects a manual, periodic accounting paradigm. Accounting information systems, for example, are often dispatched with a single support course, rather than being integrated into all aspects of the curriculum. The mindset and skill set of an auditor who uses technology to enhance and expand auditing is very different from one who simply takes as given whatever technology their entity happens to choose to introduce, and whose IT infrastructure is often much less sophisticated than that of the clients whose processes they are auditing. Students need training not just in technology, but also in advanced statistics since that technology enables far more complex analytics than are utilised today. Vasarhelyi et al. (2009e) discuss how audit education will have to change in response to the shift of auditing to Continuous AssuranceCA.

The external audit profession, internal auditors, software vendors and academics are all busily developing new procedures for taking advantage of access to a universe of data in close to real time. Although technology is advancing at a faster rate than the slower moving processes of change management within organisations, a discrepancy is visible both in audit entities and their clients, as well as in the standard setting process. Moreover, Continuous Assurance is emerging far faster than the real-time reporting which is an important complement[4] to more frequent assurance; again, a not unexpected development given that much of reporting is determined by legislation and risks of litigation. But the bottom line is that a fundamental shift is taking place, slowly but surely, in the way in which external and internal audits are carried out, and this document both explores those changes and hopes to drive it forward in Australia and internationally.

This monograph is intended to stimulate thinking about the issues that need to be addressed in a world where Continuous Assurance has become, or aims to become, the standard for auditing both externally and internally. It examines how the audit profession needs to respond if that vision of IT-enabled real-time auditing is to become a reality, and this requires an understanding of how IT is transforming the modern large entity and how internal and external auditors are dealing with these changes.

The recent development of data interoperability standards such as the extensible markup language (XML)-based Extensible Business Reporting Language (XBRL) promises a much needed

---

[2] Available at http://www.acl.com/pdfs/GTAG_ContinuousAuditing-05.pdf.
[3] http://www.isaca.org
[4] Real-time or close to the event information feeds are essential to a continuous audit. Continuous reporting is desirable for many reasons but not a requirement for a continuous audit.

interconnectivity in the information highway. Creative organisations are bringing many of their processes into real time. The many processes being accelerated include financial-related processes such as business measurement, financial management, business reporting (continuous reporting) and business assurance (Continuous AssuranceCA).

In a typical medium or large enterprise today, the IT environment encompasses the potential for automatic event sensing, automatic generation of transactions, electronic feeds from everywhere, integrated business management software (enterprise resource planning [ERP]), standards of universal data transfer (e.g. XBRL) and automation of many processes. This 'Now' or 'real-time' economy uses the above components to increase the speed through which processes are performed and data is shuttled among processes. This acceleration provides substantial economies to business as 'time is money'. Furthermore, it places pressure on all competitors to further their automations. The latencies (delays) that are being eliminated in the Now Economy include: 1) the time taken to perform a process; 2) the time it takes to transmit information from one process to the next; 3) the time taken to make a decision; and 4) the time it takes for the decision to have consequences.

Many processes can be classified in four different overlapping ways:

- Processes that are supported by real-time systems
- Processes which are monitored on a close to continuous basis
- Processes that are highly time dependent
- Processes where timely decisions give competitive advantage.

Continuous AssuranceCA was first reported in 1991 at the well-known AT&T Bell Laboratories (Vasarhelyi and Halper, 1991) which was, at that point, one of the leading world research institutions where the transistor, much of lasers and modern telephony were developed. It encompassed the monitoring and real-time assurance of a large billing system focusing on the data being measured and identifying through analytics methods faults in the data that lead both to control and process diagnostics. This is now called continuous data auditing (CDA).

It took another 10 years for the accounting entities to take notice of these developments and propose some guidelines / standards for Continuous AssuranceCA. First the CICA/AICPA and the Institute of Internal Auditors (IIA) issued guidance. The collapse of Enron, Arthur Andersen and WorldCom in the early part of this decade brought the *Sarbanes Oxley Act* (Sarbox) into being in the United States and similar focuses on internal controls in other countries which not only distracted organisations from improving their accounting data assurance but also brought attention to internal controls, their measurement, and statutes requiring their assurance. The attention to Sarbox section 404, associated with the fact that most large organisations use ERP and their controls cannot be visually observed, brought in the need for monitoring and evaluating controls on close to a real-time basis. This is called continuous control monitoring (CCM). While much of the attention paid to Continuous Assurance in this period was undertaken by internal auditors responding to the need to improve their entity's financial reporting controls, external auditors are now benefiting from these technological advances. External auditors were always involved in the development of Continuous Assurance by internal auditors because of their need to rely on the work performed by internal auditors when issuing their own audit opinion. Hence, anticipating the needs of the external auditor was a major factor in the shape of Continuous Assurance systems created by internal auditors. What is different now in this third decade of Continuous Assurance is that external auditors are themselves taking the initiative in investing in Continuous Assurance practice and technology, with all the major audit firms having their own home-grown Continuous Assurance systems and procedures. In recent years we have also witnessed the emergence of an industry of software to support Continuous Assurance including ACL, Caseware, Approva, Oversight, and SAP governance, risk and compliance (GRC).

The meltdown of the financial system of 2008/2009 has focused attention on the lack of adequate risk measurement, modeling and evaluation. Modern technology allows for closer and more realistic measurements of risk and continuous risk monitoring and assessment (CRMA). Consequently what we call today 'continuous audit' is the conjunction of CDA, CCM and CRMA. CRMA, however, is far more

than just the continuous monitoring of major risk factors. We foresee that one day it will evolve into a mechanism for evolving the entity's Continuous Assurance systems themselves to better focus on those risk factors. In other words, while the emphasis today is on developing a Continuous Assurance system in the first place, the focus will inevitably have to shift towards how to make those static systems dynamic in order to maintain their relevance to the auditor over time.

Continuous AssuranceCA has been the subject of extensive experimentation and implementation. The authors of this paper have been involved in Continuous Assurance since its inception and have conducted a series of Continuous Assurance development projects in cooperation with the Big 4 and leading internal audit (IA) organisations. These projects have helped define the emerging field of Continuous AssuranceCA.

The first reported Continuous Assurance effort took place at Bell Systems (now AT&T) in the USA from 1986 to 1991 (Vasarhelyi & Halper, 1991). This gave rise to a series of questions about data, the architecture of Continuous AssuranceCA, models to compare data, etc. Research work with a large health organisation allowed for experimentation of modelling the supply chain and the creation of mathematically-based adaptive standards. The developed rules served to detect and remove two types of data errors that are largely caused by many unmatched records among different business processes:

- Data integrity violations
- Referential integrity violations.

.
An example of Continuous Assurance in practice can be seen at Itau Unibanco, one of Brazil's largest private banks. Over the last five years it has monitored its network of 1400 branches on a daily basis using a set of 18 analytic tests. This monitoring has reduced the average time for an onsite branch audit from 160 hours to 40 hours and has changed the scheduling and oversight procedures of branches. Five auditors perform this monitoring and issue from 200 to 400 alerts a week. The bank feels that its savings on this effort are ten times its cost..

Over the last four years, the giant German firm Siemens has experimented with the concept of CCM through a joint research program with Rutgers University's CarLab[5]. Its project aims to investigate the extent to which Continuous Assurance techniques: 1) can be applied to their existing audit process; 2) help implement an automated Continuous Assurance system that frees up IA work force; and 3) 'Continuous Assurance Continuous Auditing-enable' established manual audit procedures by re-engineering them. The two phases of this project, which focused on the automation of SAP-related audit actions, indicated that close to 68 per cent of the traditional audit steps could be automated. Furthermore, many audit steps could be performed more frequently and remotely. These facts raise interesting issues about the need to re-engineer the entire audit process in view of more frequent evidence, the locus of the auditor, and new types of systems and architectures.

A wide variety of supporting software and experimental considerations has emerged in Continuous AssuranceCA. Today we talk about continuous audit that brings assurance procedures closer to the moment of the event, but in reality the audit of the future will use continuous evidence gathering and much of the Continuous Assurance methodology discussed in this paper to gather its evidence into a timely semi-automated audit process.

In addition to the methodology issues discussed there are a series of practical steps that must be followed in the implementation of Continuous AssuranceCA. Six steps are recommended: 1) establish priority areas; 2) identify monitoring and continuous audit rules; 3) determine the process's frequency; 4) configure continuous audit parameters; 5) follow up; and 6) communicate results.

---

5 Continuous Audit and Reporting Laboratory, http://raw.rutgers.edu.

Rethinking auditing

Inspection Program Details
New Jersey must comply with standards defined in the federal Clean Air Act *by inspecting every vehicle's catalytic converter and emissions system. Several types of tests are now used in New Jersey. For vehicles manufactured before 1996, a treadmill is used to monitor emissions during acceleration. For vehicles manufactured in 1996 or later, New Jersey uses the On-board Diagnostics, or OBD, test. OBD allows technicians to download emissions information from an on-board computer found in most vehicles manufactured in 1996 or later. MVC analyzes emissions data in this way to determine if the vehicle passes inspection.*
New Jersey Driver Manual pages 79-80

In Australia, as in most other countries, the government agencies tasked with inspecting motor vehicles and issuing licenses are usually held up as the epitome of inefficiency and archaic bureaucracy, the kind of organisations people wish to avoid interacting with. Yet the Department of Motor Vehicles (DMV) in the US state of New Jersey offers some very useful insights into the impact of technology on everyday life.

For instance, it is a requirement in New Jersey, as in many other jurisdictions in this environmentally conscious age, that drivers take their vehicles in every few years for an inspection of their safety and emissions controls. That inspection process has been revolutionised in recent years thanks to advances in technology in both the automobile and the inspection station.

Once entirely mechanical cars are now highly computerised, so much so that the backyard mechanics who once spent their weekends tinkering with vehicles are now officially discouraged from doing much more than checking the oil and tyre pressure. As a result, the DMV no longer has to run the engine of the vehicle and sample the exhaust air when inspecting its emissions; instead, the inspector plugs a handheld device into the car's computer and downloads records of the vehicle's performance which enables its emissions to be tracked more accurately and over a wider range of actual driving conditions. So much better are these measures – and so much better controlled are these computerised cars – that inspections are now only conducted every two years instead of annually as in the past, and new cars are not even required to be inspected in their first four years.

When one considers that the DMV is effectively evaluating the performance of cars against the clean air standards that they are required to meet by US national law, it is apparent that what is taking place here is analogous to auditing as it applies to the accounting realm. And just as the authorities had to rethink the way in which they do vehicle inspections to take advantage of modern technology, auditors around the world are developing new practices and modifying existing methodologies to exploit the power of the IT that underlies modern entities, especially the largest ones. It would make little sense for auditors to retain practices first developed when audits became mandatory 70 years ago when their clients have been driven by the competitive necessity to be more like a high-tech, high-performance sports car than the pioneer automotives preceded by a man holding a warning flag. As with any analogy, the parallels are not exact, but the point of making such a comparison is to encourage looking at auditing from a new and different perspective.

This paper discusses the emerging field of Continuous Assurance and places it within the context of the IT-enabled business world which facilitates and gives rise to Continuous AssuranceCA. It is a world where transactions are processed and tracked electronically, thus making business much faster than before, while the tagging of financial data with the XBRL promises to make business information communication equally rapid. And, as the speed of business increases, so does the demand for auditors, both external and internal, to provide assurance closer to the transaction date than is typically made available in traditional auditing which is currently centered on the annual audit of paper-based income statements.

A final recourse to our automobile analogy: Over the last century of motoring, it is not only the technology of the automobile that has changed, but the entire system of roads, traffic management, petrol distribution, etc. that supports driving, that has altered in tandem. It would hardly make sense, for example, to replace a Model T Ford of the 1920s with a modern Jaguar XF if it were forced to drive on the 'macadamised' single lane roads of that earlier era, with petrol carried along in jerry cans to make up for the lack of refuelling facilities along the way. Similarly, Continuous Assurance is but one manifestation of the fundamental changes in the entire accounting environment that technology will make inevitable. It does not take much foresight to predict that in 20 years it will be incomprehensible to report only annually, when one day closing, ERP systems, the internet and XBRL will make continuous reporting trivial. The roles of all parties in the reporting and auditing fields will change accordingly, and now is the time to begin planning for this eventuality.

This paper begins by considering the 'real time' or 'Now Economy' and understanding the technological infrastructure of the modern, large, global entity. It is on this foundation that the future of auditing is in the process of construction.

The Now Economy

Introduction

Defining and classifying latency

> *In years to come, experts predict, many companies will use information technology to become a 'real-time enterprise' – an organization that is able to react instantaneously to changes in its business. And as firms wire themselves up and connect to their business partners, they make the entire economy more and more real-time, slowly but surely creating not so much a 'new' but a 'now' economy. The Economist, 1 February 2002.*

> *We have only just said goodbye to the new economy, yet it's time to say hello to the 'Now Economy'. Never heard of it? You're not alone. Even technology gurus sing different tunes when describing the newest buzzwords. The now, or real-time, economy is a complex set of enterprise software products and services that could transform the way companies work. This software could speed up supply chains, cut inventory costs, facilitate cross-company process reengineering, and put more oomph into CRM. The McKinsey Quarterly Newsletter, February 2002.*

Four major types of latency (delay) are being addressed with improved incorporation of technologies:

- Intra-process latency: the time it takes for a process to be performed (e.g. processing accounts payable). These latencies are addressed by increased automation of process steps. Automating the verification of ERP controls (Alles et al., 2006) falls into this category.
- Inter-process latency: the time it takes to pass data between processes. These latencies are addressed by the progressive adoption of methods of passing information between processes progressively adopting interoperability standards like XML. The financial value chain will be substantially accelerated by the inclusion of XBRL as the conduit for the financial value chain, when other XML-derivative language tagged transactions will flow coherently into XBRL/GL.[6]
- Decision latency: the time it takes for a decision to be made, reduced to nanoseconds if decisions are made automatically but rigidly in approach. Auditors make a series of examination decisions based on error detected in a sample or population. These decisions take time and human

---

[6] XBRL/GL is an XBRL dialect aimed at providing tagging at the ledger level and consequently allowing for direct postings of transactions tagged in other XML languages. For example, a transaction tagged in the XML standard for information on electronic tags can be directly converted to an entry on XBRL/GL and automatically feed the financial value chain.

intervention. Rules can be developed to automatically highlight items for further examination or accept the sample as representative.

- Decision implementation latency: the time it takes for implementation of a decision, contingent on the nature of processes and about the types of interconnected processes. Once a sample is deemed to need more examination, original documents need to be scrutinised or subject to further analysis. Automation can reduce this latency by automatically submitting a sub-sample to increased filtering and analysis.
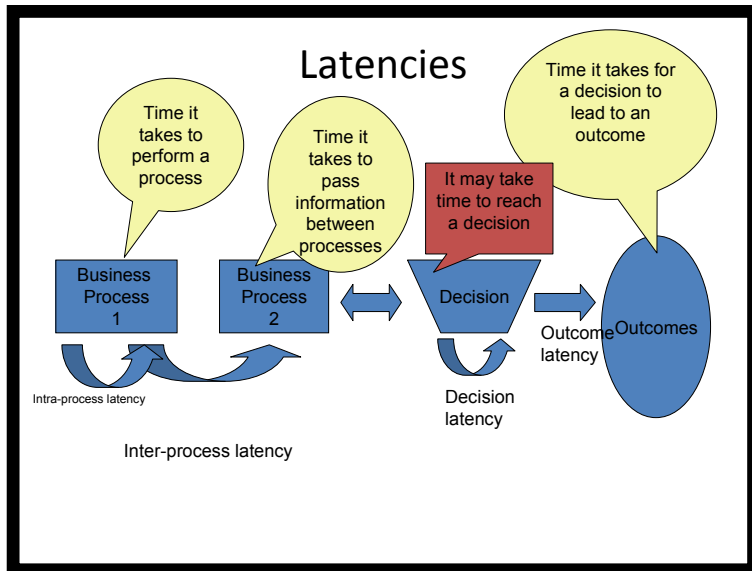
Figure 1: Intra, inter and decision latencies

The essence of the progress towards the Now Economy is the reduction of latencies. Manual processes are very costly and time consuming but under certain conditions are necessary or unavoidable or render better outcomes than simple embedded computer-based rules. The balancing of these considerations and the progress in automation dramatically changes the competitive scenario.

Some key concepts

Businesses are taking the lead in adapting to and accelerating the development of the Now Economy through the widespread adoption of integrated company software such as ERPs, modern communication technologies that ensure workers are on the job 24/7/365, and monitoring systems that give a greater range of managers the ability to track and control key business processes. All this allows businesses to manage their processes based on up-to-the-minute information and to achieve rapid adjustments of tactics and strategies.

Both *The Economist* and McKinsey (see quotes above) have adopted the terminology as a way to describe a complex set of evolving changes that are bringing the provisioning of information closer to the causal events. Their adoption of the term 'Now Economy' indicates its progressive understanding in the business community:

> *Never mind New Economy vs. Old Economy industries. What matters is if your business enjoys intelligently revised and technologically enhanced business processes. Business process innovation is beginning to move in concert with accelerating technological*

evolution. Say goodbye to the New Economy; meet the Now Economy. We are witnessing the emergence of real-time enterprises (RTEs) that will comprise the bulk of the Now Economy. In the Now Economy, information flows rapidly through supply and demand chains, crossing corporate boundaries, ensuring maximum efficiency and responsiveness.

The ideal vision of the RTE is one of companies where information moves without hindrance, and business processes are continuously monitored and trigger rapid reactions, usually automated according to embedded business rules. RTEs also sense shifts in tastes and practices and respond by offering new products and services. Automated processes easily traverse corporate boundaries, time zones, media and systems. Batch processes and manual input are minimized by ensuring that real-time information among employees, customers, partners and suppliers is current and coherent. The Now Economy is the instantaneous, frictionless economy of economists' legend – the mythical beast that may finally be emerging from the mist. The Now Economy is a web of RTEs that form a virtual supply and demand chain continually seeking information, monitoring, and responding, guided by humans, mostly at the highest strategic level (Fingar and Bellini, 2004).

The Now Economy is characterised by a substantive reduction in the latencies discussed above. For example, companies must manage their cash on a day-to-day basis to be able to apply it and borrow it overnight; manage receivables and payables on a day-to-day basis to take advantage and grant discounts; and manage inventories up to the minute to do just-in-time factory management. These are just a few examples of the advent of a real-time economy. Moreover, the effects of wireless technology, radio frequency identification and sensors and integrated software are just now starting to emerge. The coming years will bring in more nimble and adaptive companies integrated in the world. The evolution of these technologies, and their integration into business, also brings in behavioural effects that may accelerate or delay progress.

The Economist (~~31~~ 30April 2002) points out the issue of instant gratification:

Instant Gratification: To advocates of the concept, the real-time enterprise is a giant spreadsheet of sorts, in which new information, such as an order, is automatically processed and percolates through a firm's computer systems and those of its suppliers. Thus a simple inquiry such as, 'When is my order being shipped?' can be answered immediately, and not six phone calls and three days later, explains Vinod Khosla, a partner with Kleiner Perkins Caufield & Byers and one of the most notable advocates of the real-time concept. Many consumers have already encountered real-time business without realizing it, for instance when they order a Dell computer. The firm's website allows customers to check the status of their order at any time.

But the real-time enterprise is not simply about speeding up information flow. It is also, as GE's example shows, about being able to monitor a business continuously and react when conditions change. Today, businesses 'are mostly shooting in the dark', says Michael Maoz, a research director at Gartner, an IT consultancy, and one of the pioneers of the concept. Real-time technology, he predicts, will give firms a window into their business they never had before.

While the technological underpinnings of the Now Economy continue to evolve and emerge, it is also important to focus on the changes it brings about to the mentality of management, in particular, the decrease of latency between transaction and decision point, which means that processes have to be viewed with these delays in consideration. These real-time processes can be classified in at least four different overlapping ways, each with different implications for decision making, control and monitoring:

- Processes that are supported by real-time systems
- Processes that are monitored on a close to continuous basis

- Processes that are highly time dependent
- Processes where timely decisions give competitive advantage.

The classification of processes into these categories is not static, but dynamic with respect to technology, business process re-engineering and competitive pressures. Thus, as an increasing number of processes at more entities fall into the first and second categories, then the more likely they are to be used as sources of competitive advantage. Eventually, such practices become ubiquitous in an industry, at which point they stop providing a competitive advantage, but become a minimum necessary to stay competitive. Examples of such dynamics are the development of SABRE at American Airlines, the assignment of real-time seat choice on airline websites, the onslaught of online payment mechanisms, or the ability for consumers to track packages at UPS and FedEx and even the United States Postal Service (Wiseman, 1988).

The acceleration of business processes and their accompanying decision points necessitates access by a larger range of people within businesses to high quality data with the ability to drill down and search unconstrained by traditional data aggregation methods, such as into income statements. Thus, a large percentage of large entities today use ERP systems that integrate their information flows into one easily accessible data processing system. Add-on software, such as those providing increased business capabilities and customer relationship management, enables rapid and detailed analysis of that flood of data to allow decisions to be made at a level not possible before, such as treating each and every customer differently based on their individual profitability. Thus, the connection between technology and management use of that technology is clear:

> In the past, firms have faced a trade-off between being integrated and being flexible. New software technology promises to ease that trade-off, or even do away with it altogether. At the same time, new hardware, such as wireless sensors, makes it possible to gather ever more information about the physical world and feed it into a company's computer systems. Turbines made by GE are equipped with sensors that allow the firm to tell its customers online how efficiently their machinery is operating. Similarly, companies can now collect more data about people, even tracking their location. By themselves, these data would just contribute to the increasing information overload. But they present a new business opportunity: to develop software that analyses them and suggests ways of optimizing the supply chain, or even automates the response to certain kinds of new information (The Economist, 2002)

A more recent example from *The Economist*[7] (2009) demonstrates that these predictions about the use of real-time information to drive new businesses have come to pass:

> High above the Pacific, passengers doze on a long flight from Asia to America. Suddenly a bolt of lightning cleaves the air. Those startled by the flash and bang soon settle back into their dreams. But on the other side of the world, in Derby, in the English Midlands, engineers at Rolls-Royce get busy.
>
> Lightning strikes on passenger jets are common – a couple every hour – and usually harmless, but this one has caused a cough in one of the engines. The aircraft will land safely, and could do so even with the engine shut down. The question is whether it will need a full engine inspection in Los Angeles. That would be normal practice, but it would delay the return journey and keep hundreds of passengers waiting in the departure lounge.
>
> A torrent of data is beamed from the aircraft to Derby. Numbers dance across screens, graphs are drawn and technicians scratch their heads. Before the plane lands, word comes that the engine is running smoothly. The aircraft can take off on time.

---

[7] *The Economist*, Rolls-Royce, Britain's lonely high-flier, 8 Jan 2009.

Rolls-Royce's global operations room in Derby, with 24-hour news channels, banks of computer screens and clocks showing the time around the world, looks and feels like a currency-trading floor. It seems far away from the grubby manufacturing that Derby has pioneered since the dawn of the industrial revolution. In fact, a few hundred yards down the road, furnaces roar, cutting tools whine and giant workhorses of the air take shape. The operations room is the heart of a vast industrial enterprise …

The operations room … continuously assesses the performance of 3,500 jet engines around the world, raising an almost insurmountable barrier to any rival that hopes to grab the work of servicing them. The data collected can be invaluable to airlines: it enables Rolls-Royce to predict when engines are more likely to fail, letting customers schedule engine changes efficiently. That means fewer emergency repairs and fewer unhappy passengers. The data are equally valuable to Rolls-Royce. Spotting problems early helps it to design and build more reliable engines or to modify existing ones. The resulting evolution of its engines has steadily improved fuel efficiency and over the past 30 years has extended the operating life of engines tenfold (to about ten years between major rebuilds). 'You could only get closer to the customer by being on the plane,' says Mike Terrett, the company's chief operating officer.

It is obvious then that the Now Economy is driving major changes in the way in which businesses operate, beginning with the larger and more innovative entities and moving on to becoming a way of life for all types of entities. Not so long ago in most countries, and even today in some developing ones, buying a product meant going to a store, picking out the item and then going from counter to counter, getting a receipt from one clerk, paying another and picking up the purchase from a third. By contrast, consumers today buy many products online and expect immediate email confirmation of the transaction, its payment and order tracking, and would discontinue their business with the retailer if these services were not provided. And yet, while all this would have been utterly unfeasible even a decade ago, these consumer-oriented activities pale in comparison to the range of services provided in the business-to-business realm, as the Rolls Royce example shows.

But, as accountants, we can look back at these changes and recall that the reason for the labour intensive practices in that long-ago retailer was to ensure control and avoid pilfering of either products or cash. Thus, the electronisation of these business processes came about not only through the development of such technologies as the internet, but because of improvements in transactional control practices such as secure communications, digital cash management, seals of approval, privacy practices and regulations, and so forth. And that transition leads us to ask how the accounting profession, and in particular auditing, both external and internal, is responding to the arrival of the Now Economy.

Automation

The electronisation of business is being driven by the need for latency reduction and is facilitated by progressive technological developments and their integration in the fabric of society, in particular, business processes. Automation is the core concept in electronisation and is composed of a large set of mechanisms. Experience with the early introduction of computers in business processes shows that highly formalised, repetitive, labour intensive processes are easier to automate and their economic benefits are simpler to quantify. On the other hand, more complex automation resulting in qualitative improvement is much more difficult to justify. For example, early labour replacement computer applications, such as billing for a large utility, were of obvious and dramatic justifiability. At first glance it was difficult to justify the replacement of a large number of spaghetti code legacy applications by cleaner but rigid and costly ERPs. For many entities it took the troubles of the Y2K bug to justify a serious data processing investment.

Business versus audit automation

The auditing area has witnessed a similar phenomenon. It took little time from the introduction of PCs for the big audit firms to purchase masses of the devices replacing the much dreaded adding, extending and ticking by data extraction routines / software and a friendly spreadsheet. On the other hand, the next obvious step in automation of assurance which also entails integration of different steps of the assurance process, has lagged behind dramatically leaving the toolset of the auditor second generation in a fourth generation computer world.

While in business systems there is across application integration, in auditing there is software extraction (e.g. using focus), which is cumbersome to import into spreadsheets and requires much manual manipulation. While in business there are dashboards and executive information systems spitting out status every six hours, in auditing there is a statute-driven manual reporting schema. The research projects at Siemens and Itau Unibanco described in this paper show useful paths in automatic data extraction and dashboarding for audit decisions. While in manufacturing there are fully automated paper pulp and iron ore mills mixing and controlling the output automatically, in auditing there is a failure prone manual judgment process where organisations are deemed healthy one month but fail the next. The economic crisis only makes it all the more urgent to recognise the reality that the current system of reporting and auditing is unable to keep up with the demands of the modern IT-enabled business, of which the financial service entities, with their continuous trading of derivative instruments whose value can only be calculated by computer, is the leading example.

Components of audit automation

Some elements of the basic business process can be segregated and their automation discussed. A much deeper discussion of these factors is performed by Vasarhelyi et al. (2009d).

Figure 2

Figure 2 displays some of the elements that in a socio-technical system are being progressively automated.
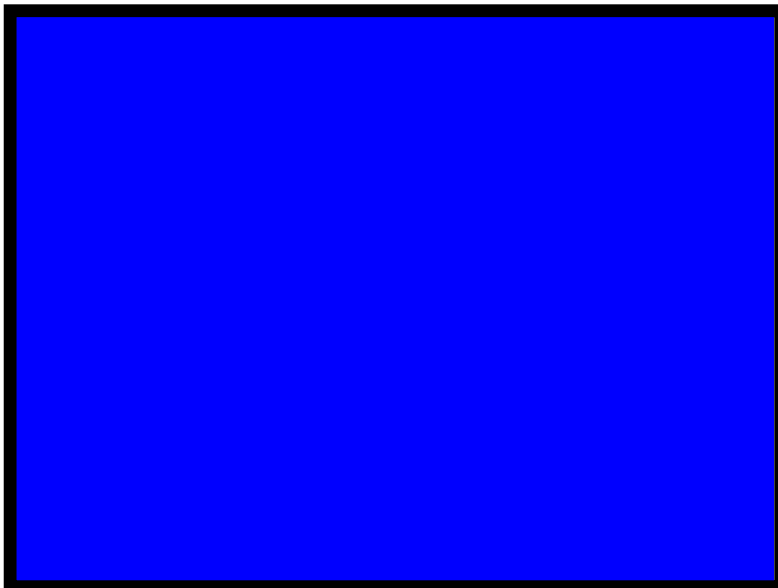
Figure 2: Module integration

The elements of
Figure 2
~~Figure 2~~ are as applicable to computer-based corporate systems as they are to the evolving world of audit automation.

- The automation of data captures (sensing) floods corporate systems with large quantity of ~~data~~ information with a quasi error-free data inflow. While this is progressively the norm in business, in the ~~auditing~~ assurance area only in Continuous Assurance applications create automatic extractions of data and integration into alerting systems.
- Corporations are progressively flowing these sensed data directly into applications. FedEx uses manually or automatically scanned barcodes all along its value chain to manage, distribute, decide and inform about its packages. Some vendors of Continuous Assurance software have created increased transitivity from systems such as SAP into some of their more integrated applications (e.g. ACL CCM module).
- Discontinuities in the flow of data though business processes have created the frequent need for data re-keying which inserts large numbers of errors and costs in the data flow.
- While ERPs bring together applications in common databases the area of automated work papers (and its obvious core database) is primitive to say the least. The natural evolution would make core work paper summaries the 'decision dashboard' for audit decisions.
- Auditor reports of different types should be corporate shared documents leading to control management and improvements with inputs from CCM, CDA and CRMA. Increasingly IA organisations and auditees work in common documents across the audit domain. Much automation and technology could be used to improve these processes. The main sharing mechanisms currently used are office automation tools (e.g. MS Office) which are powerful but not adapted to the dynamic needs of the assurance process.

Next we discuss in more detail the facilitators of automation necessary to the automation of audit.

Making the Now Economy happen

Analogous to the DMV example above, new technologies have to be invented and developed causing substantive change in processes and human behaviour. The main technologies that are causing / facilitating the Now Economy are discussed next.

Sensors

The manual capture of data is probably the main cause of delay and error in business processes. Modern technologies have progressively allowed business to detect and electronically record transactions, products, decisions and other business relevant business elements. In the early days it was telephone switches that collected telephone call information without human intervention. Today most e-commerce transactions are captured at the point of inception and executed with minimum human involvement.

Enterprise Resource Planning systems

Enterprise Resource Planning (ERP) systems emerged in the late 1990s to integrate corporate applications. ERPs such as SAP, PeopleSoft, BAAN and Oracle Business Suite brought together a disparate set of corporate applications around a relational database system allowing corporations to have integrated systems that facilitated inter-functional management. These systems, associated with progressive sensing of economic events, provide a close to real-time environment accelerating the bases for (automated or not) business decision making.

Extensible Markup Language dialects

The advent of the internet propitiated the development of tools to improve the use of this ubiquitous intercommunication platform. A very valuable set of tools is the extensible markup language (XML) defined by Wikipedia[8] as:

> *The Extensible Markup Language (XML) is a general-purpose specification for creating custom markup languages.[1] It is classified as an extensible language, because it allows the user to define the mark-up elements. XML's purpose is to aid information systems in sharing structured data, especially via the Internet,[2] to encode documents and to serialize data; in the last context, it compares with text-based serialization languages such as JSON and YAML.[3]*

Several hundred extension standards have been developed by different industry groups to facilitate interoperability in its domain. Extensible Business Reporting Language (XBRL) has been developed to facilitate the transmission of financial reports (XBRL/FR) among elements of the financial value chain as demonstrated in Figure 3Figure 3. This figure incorporates XBRL/FR (which aims to facilitate the transmission of financial reports from the business to analysts, investors and policy makers) to the less mature XBRL XBRL/GL aimed to facilitate the exchange of information among modules/processes of the business enterprise as well as its outsourced entities. The development of XBRL is particularly important for external auditors who will face a world in which the financial statements they audit will be disseminated far more rapidly and widely than ever before and in a form in which the individual components of the statements will be disaggregated from the whole. New concepts of reporting and assurance will have to be developed to deal with XBRL as the primary means of reporting audited statements as opposed to the paper or pdf files of today.

Over recent years several regulatory entities in different countries have progressed to require part of the corporate business report to be filed using this data interchange standard. Of special note is the Dutch eEffort on Standard Business Reporting (Burg, 2009) that brought together mandates by ministries, its required reporting function, the revenue services and their statistical gathering into a common set of data. This reduced the potential preparation of a couple of hundred thousand data fields to about eight thousand (Burg, 2009). The Dutch government and the governments of Australia, New Zealand and the United Kingdom have been progressing on forms of the XBRL Standard Business Reporting[9].

The Securities and Exchange Commission (SEC) mandate (effective mid April 2009) requires the filing of financials in XBRL format by all US public companies and foreign private issuers (this will affect all Australian SEC registrants directly in terms of corporate reporting). However, while mandatory XBRL for Australian companies is still some way off, Australia appears to be making considerable progress in taxonomy development.

While XBRL emerged as a voluntary standard it progressively became evident that it must be mandatory both for its adoption as well as for obtaining a commonality of standards. This approach will substantially facilitate the transmission of data downstream the financial value chain represented in Figure 3Figure 3.

---

8 http://en.wikipedia.org/wiki/XML
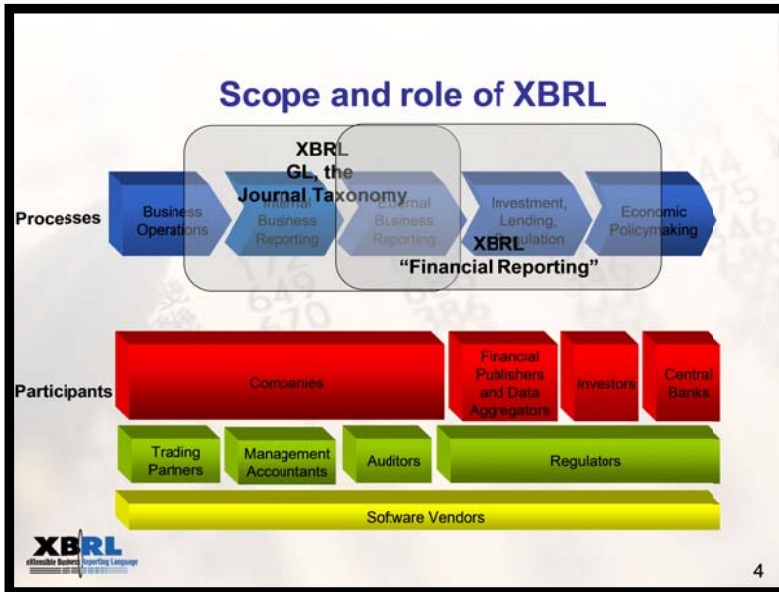9 Feb 2009, Sanders, F., XBRL Borders.

Figure 3: The financial value chain[10]

Re-engineering

In addition to the actual technological elements of the Now Economy environment some major process changes are finally occurring. One of these is the process of re-engineering[11] where businesses are rethinking how they impound new technology into their processes. In general it is not a good idea to bring in substantive technological change without seriously rethinking business processes. For example, the inclusion of a data warehouse for data mining will require the rethinking of media acquisitions, contacts with clients and provisioning methods.

Electronisation of business

The introduction of technology into business processes has often been the main driving force of change. Vasarhelyi & Greenstein (2003) define electronisation as:

> *The wider phenomenon of* electronization of economic activities *encompasses the digitalization of all processes of economic wealth generation including economic analysis, production, storage, information provisioning, marketing, etc. Consequently, within the more general phenomenon of digitalization of modern life, we find a very important phenomenon – the increasing electronization of business.*

General Electric[12] is known for its almost obsessive quest for perfection and its chief information officer heads the company's most important initiative: 'digitising' (to be used interchangeably with electronising) as much of its business as possible. That means that buying and selling most things online as well as setting up a digital nervous system connect anything and everything involved in the company's business: IT systems, factories and employees, as well as suppliers, customers and products.

---

[10] Picture adapted from http://www.xbrl.org.
[11] Davenport & Short, 1990.
[12] 'Real time economy', *The Economist*, 31 January 2002.

Electronisation may be effected through the main areas of business as described in Figure 4Figure 4. These main areas are: 1) e-commerce; 2) post-transaction care; 3) supply chain; 4) financial; 5) human resource; and 6) others.
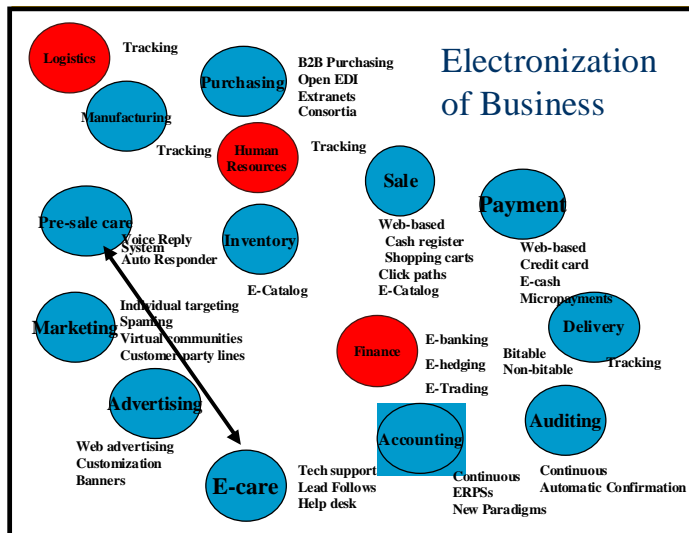
Figure 4: Electronisation of business processes

The electronisation of the financial area of business processes has affected everything from accounting recording (through sensors, standardised data collection screens on ERPs, and mostly the automatic importation of other types of XML-represented transactions), ledger posting (through XBRL/GL), system reports, data assurance (through continuous audit), financial reporting (through XBRL/FR), treasury function, corporate financial management, investment management, etc.

Continuous audit, part of the electronisation of the audit, will change the nature of this process, focusing on the improvement of data quality.

Deconstruction of business

One of the key electronisation effects is the deconstruction of business where organisations focus on retaining key competitive advantage processes while passing over the ones in which they cannot excel. Organisations will focus on their strengths and attempt to garner the strength of other organisations to their advantage. If your organisation has inferior internal auditing and cannot provision it cheaply or competently why not go to your competitor and pay for such a service at a lower rate than it would cost you? The outsourcing argument has been adopted and used for a long time but the evolution of a ubiquitous communication platform (the internet) and a plethora of tools to make it more useful and functional have made this argument substantially stronger. In general deconstruction of business (Vasarhelyi & Greenstein, 2003) entails breaking down your business into key processes, keeping the processes that you consider the 'filet mignon' (core competencies) and passing the rest to better performers.

The breakup of the value content

The traditional product

Outsourcing
Alliances
Competitors

Product
Information
Financing
Logistic

R&D
Manufacturing
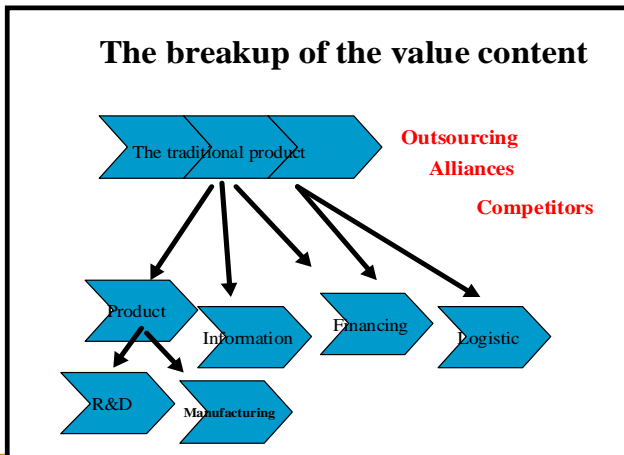
16

Figure 5: Deconstruction of business

Furthermore, with the emergence and evolution of Service Oriented Architecture (SOA), where the internet is fully utilised, many functions / sub-functions can be efficiently sub-contracted in a competitive advantage mode. For example:

- Tax tables: the United States has a wide set of taxing jurisdictions which have different tax rates and taxation rules. The collection and maintenance of these rules is expensive and cumbersome. It is to everyone's advantage that these be made into a SOA service feeding the many countrywide e-services.
- Statutory reporting: recent years have witnessed the emergence of potent organisations that as a service prepare fillings for businesses. For example, R.R. Donnelley prepares SEC fillings for many organisations and these services are going to be substantially stretched with XBRL fillings.
- General Ledger Fraud Examination: several large audit firms are outsourcing the examination of audit trails to India as this part of the audit process that can be done off-loco.

In addition to the use of SOA, companies are delegating many of their key financial processes to subcontractors including data warehousing, ERPs, treasury, etc.

Managing financial processes in real time

Modern corporations cannot survive well without managing certain processes on real time. Corporate Management Accounting is now the owner of a wide set of information. In the modern world, state-of-the-art companies have much online / real-time information. For example:

- No bank could live without their current daily financial balance closing as they would not be able to apply it overnight
- No manufacturing concern could live without real-time inventory information as they would not be able to practice just-in-time manufacturing
- Most companies would have great competitive difficulties if they did not have real-time payables and receivables information to collect or provide discounts based on time characteristics.

20

Examples of companies in the Now Economy

Modern companies have developed a wide scope of applications in many domains to explore the benefits of the Now Economy. Vasarhelyi (2009b) has collected a wide array of examples.[13] Some of these examples include:

- Advertising: Doubleclick and Yahoo
- Logistics: Amazon, Boeing, Dell, Fedex
- Customer relationship management (CRM): Anheuser-Bush, E-Bay, Jet Blue Airways
- Dashboards: General Electric, California Heart Center Foundation
- Financial: Dow Chemical, Prestige Capital, Scottrade
- Infrastructure: AT&T, Sun Microsystems, Traffic.com, Xenogen
- Others: American Airlines (online reservations), Citrix Systems (per seat on demand jet travel), Gm GM(in-vehicle safety), GN (advanced automatic crash notification), IBM (e-procurement).

Many of these applications were considered strategic information systems where they actually changed dramatically the nature of the business and forced competitors to copy or to perish. Real-time applications in financial systems such as real-time reporting, real-time monitoring, and Continuous Assurance will eventually fall into this classification.

Comparing the Now Economy with the 'snail' economy

While the emergence of the Now Economy has provided us with startling new examples of efficiency and improved management, its emergence is a slow and confusing process. The level of electronisation of an entity often indicates its progress in moving towards the Now Economy. A diagnostic of its progress in this direction can be obtained by careful review of processes and their automation. Table 1Table 1 indicates some factors that compare a traditional (snail) economy to the Now Economy process.

---

[13] Vasarhelyi, M.A. 'Real time economy examples', http://raw.rutgers.edu/RTEexampls

	Traditional	Evolutionary	Now Economy
Medium	Paper	Hybrid	All electronic
Agent	Human processing	Use computers	Automated processes
Geography	Local	Multinational	Integrated processes across countries
Marketing	Traditional marketing		One-to-one database marketing
Accounting	Accounting – file systems	Accounting software	ERPs
Auditing	Ex-post facto auditing	IT audit procedures	Close to the event real-time audit
Stock	Large inventories	JIT	Integrated supply chain, JIT, supplier managed inventory
Human resources	Personnel management		Real-time human resources, home work, extensive usage of labour pools
Customer care	Store-based technical support		Real-time CRM with considerable automation, substantially outsourced

Table 1: Evolving towards the Now Economy

Most processes evolving towards the Now Economy will go through an evolutionary process. Table 2 illustrates a view of the evolution of IA in a maturity model that evolves towards the Now Economy (Vasarhelyi and Kuenkaikaew, 2009c).

	Stage 1	Stage 2	Stage 3	Stage 4
	Traditional audit	**Emerging**	**Maturing**	**Continuous audit**
Objectives	• Assurance on the financial reports presented by management	• Effective control monitoring	• Verification of the quality of controls and operational results	• Audit by exception • Improvements in the quality of data • Creation of a critical meta-control structure
Tooling	• Manual processes and separate IT audit	• Spots of IT and financial / OA audit integration	• Auditing links financial to operational processes	• Most of audit automated
Approach	• Traditional interim and year-end audit	• Traditional plus some key monitoring processes	• Use of alarms as evidence • Continuous control monitoring	• Audit by exception
IT/Data access	• Case-by-case basis • Data is captured during the audit process	• Repeating key extractions on cycles	• Systematic monitoring of processes with data capture	• Complete data access • Audit data warehouse, production, finance, benchmarking and error history
Audit automation	• None	• Audit management software • Work paper preparation software	• Automated monitoring module • Alarm and follow-up process	• Continuous monitoring and immediate response
Audit and management sharing	• Independent and adversarial	• Independent with some core monitoring shared	• Shared systems and resources where natural process synergies allow	• Purposeful Parallel systems and common infrastructures
Management of audit function	• Financial organisation supervises audit and matrix report to the board of directors	• Some degree of coordination between the areas of risk, auditing and compliance • IT audit works independently	• IA and IT audit coordinate risk management • IA shares with IT audit automatic audit processes	• Centralised and integrates with risk management, compliance and SOX/ layer with external audit. High level of reliance.
Analytical methods	• Financial ratios	• Financial ratios at sector level	• KPI level monitoring • Structural continuity equations • Monitoring at transaction, account and financial report account level	• Corporate models of the main sectors of the business • Early warning system

Table 2: The internal audit maturity model

In Table 2 a series of elements of the audit process are related to an evolutionary framework of increasing audit automation (Vasarhelyi and Kuenkaikaew, 2009c). Vasarhelyi and Kuenkaikaew (2009c) examined four leading world organisations and rated them by levels of progress.
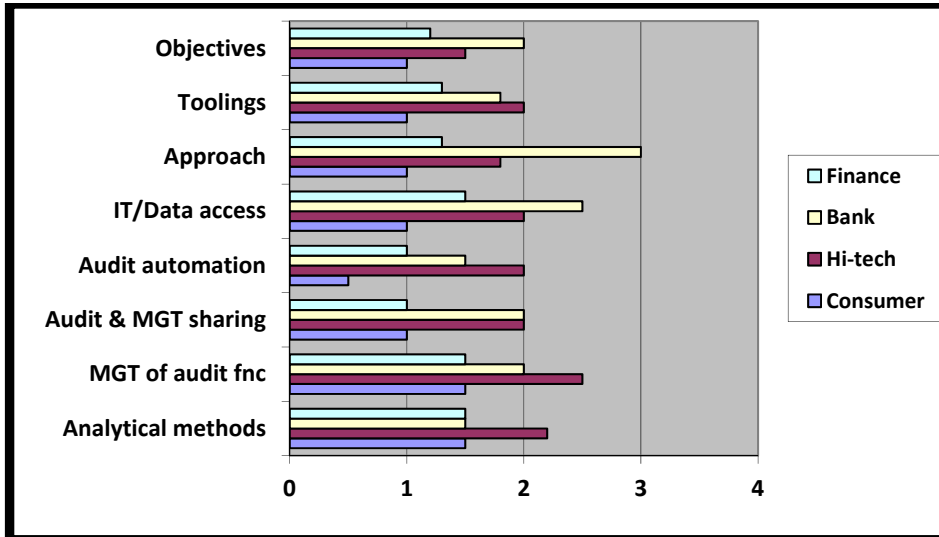
Figure 6: The current level of the adoption of Continuous Assurance and continuous monitoring of the companies

Figure 6 rates four different companies on a scale of IA maturity based on the Table 2Table 2 schema. Clearly companies are evolving progressively towards a substantial degree of maturity; however, with great differences among market players and industries. Financial companies were rated as the most mature while non-financial companies typically had substantive audit attention to core risk areas. It is noteworthy to observe the variables used to characterise the degree of maturity of an audit organisation. These variables could serve as the basis for developing objective analytics on audit maturity and a program of progress and self-assessment of the audit organisation.

It is worth asking how one should interpret the results of this study in the light of the credit crisis. The survey was conducted while the crisis was unfolding and as Figure 6 indicates, the financial services entity was among the leaders in Continuous Assurance adoption. This is hardly surprising since the nature of the transactions in that sector facilitate electronic controls and monitoring. Indeed, everyone is aware of how their credit card transactions are continuously monitored, leading to the occasional declined transaction because of the fear of fraud or a stolen card. But despite this head start, the fact that the crisis began and was centered on the financial services sector indicates that Continuous Assurance is no panacea for business failure. On the other hand, the adoption of continuous audit in the financial sector and other sectors is still incipient. Consequently it would be unreasonable to expect that a small degree of continuous audit adoption would have a large effect on the diffusion of the crisis.

There is a world of difference between issuing credit cards and credit default swaps, both in the scale and scope of the underlying risks and the complexity of the transactions that need monitoring. Most important of all, Continuous Assurance only works to the extent that its designers use it to monitor the correct sources of risk and provide it with the appropriate analytic engine to measure that risk. As we argue below, Continuous Assurance systems will need in the future to incorporate CRMA to dynamically adjust the scope of the Continuous Assurance system to emerging areas of entity risk, and ideally, will do so automatically with external sensing mechanisms, not subject to the human failure of assuming that the good times will continue forever, which is the handicap of any Continuous Assurance system subject to the need for manual adjustment to face new threats.

Formatted: Font: 10 pt, Complex Script Font: 10 pt

Continuous Assurance for the Now Economy

Measurement in the Now Economy (the accounting process)

In comparison to the changes that have been experienced in business, the fundamental practices of accounting have not changed for many decades. Thus, external accounting reports are presented quarterly and only audited annually; accounting standards are introduced in a reactive mode and are meant for purely manual application, with no directly formulated provision for tagging or automated referral; and auditing firms in general still retain billing practices developed for a highly manual audit process. In short, while businesses are moving on to the 'Now' economy, accounting and auditing remains in a 'traditional' mode.

This is only reinforced by the developments of the subprime crisis of 2007-2009. The financial institution crisis illustrates how the current accounting measurement methodologies fail to predict or detect serious crises. Many of the entities that failed during 2008, such as Bear Sterns, Lehman Brothers, Freddie Mac, Fannie Mae, and AIG had clean audit opinions with no going concern qualification issued just months prior to their failure. As we discussed above, Continuous Assurance by itself is only a technological / methodological tool and it is powerless to prevent catastrophic failures of this sort unless its designers have the imagination to foresee that such risks are present and need to be monitored. The key is to create a system of monitoring, external sensing and reporting rich enough that stakeholders, from investors, regulators and management to external auditors, receive advance warning of emerging threats to the entity's business and operating environment.

However, accounting researchers and innovative practitioners are beginning to look forward to how the technologies that are already in widespread use elsewhere in business can be used to transform accounting practice. Conceptually it is important to position accounting measurement in relation to assurance. The Now Economy organisation uses a wide range of business measurements, from those that are highly automated and formalised, to wide-level estimates and capricious assumptions. While in order to conduct its business it needs to capture thousands of data flows in the different processes of business, and through ERPs use hundreds of thousands of controls to generate tens of thousands of reports, its external financial report uses arbitrary asset lives, meaningless goodwill estimates, etc.

On the other hand, a real monitoring process needs both an objective (and frequent) measure and comparison standards for detecting anomalies. These objective measurements run the business on a day-to-day basis and eventually will be reported to the different stakeholders of business in a meaningful, less anachronistic manner. Vasarhelyi and Alles (2007)[14] propose a set of new aggregate external reports. The Enhanced Business Reporting Consortium[15] has attempted to create additional reporting models to satisfy a wider audience and bring up to current some of the obsolete aspects of reporting.

Current social and economic forces create a straitjacket for change in the business reporting process due to a series of factors:

- Reporting organisations must continue their day-to-day reporting so changes have to be evolutionary
- Business organisations consequently resist any serious attempt to change basic reporting guidelines
- The economics of the reporting tradeoffs (e.g. level of aggregation, disclosure and materiality) have changed completely with automation but their reflection in reporting is still traditional
- External audit firms have little motivation to substantially change things in order to not antagonise their clients

---

[14] http://raw.rutgers.edu/Galileo
[15] http://www.ebr360.org

- Governments, in particular in democratic countries, will be responsive to the grand public that, in general, does not understand the need for change.

While changing financial standards is necessary, their ineffectiveness does not stop IA organisations from innovating in order to provide better data quality and support to a trustworthy business organisation. Vasarhelyi and Kuenkaikaew (2009c) have documented some of these efforts. The particular focus of this monograph is on developments in the provision of assurance for business transactions, an area described by the general term of 'Continuous Assurance'. We typically will consider assurance an umbrella of services that may encompasswhile the traditional audit, WebTrust, SysTrust and an expandinged set of auditor services exists. The Elliott Committee[16] of the AICPA has proposed 148 of these services and has chosen to develop six. Among these services are the WebTrust and Systrust services. The AICPA's Assurance Services Executive Committee (ASEC)[17] is given the task to propose new services and create principles and criteria for these services. Under a wide umbrella of assurance services we find the 'traditional audit'. This monograph works on expanding the frame of the traditional audit towards a more timely and effective audit close to the event. While both the CICA/AICPA (1999) and the IIA (GTAG #3, 2005) have issued documents and some guidance in the United States, the state-of-the-art in audit is fluid and rapidly evolving.

The Australian Auditing and Assurance Standards Board (AUASB) continues to acknowledge the challenges created for auditors and standard setting in advancing the development of Continuous Assurance engagements. The AUASB will continue to monitor progress and develop guidance as necessary.[18]

Evolving toward a more continuous assurance

Early Continuous Assurance

One of the first recognisable examples of what we now call 'Continuous Assurance / Continuous Auditing' (CA) was a large scale auditing system developed in the late 1980s at Bell Laboratories, the research arm of the giant US telecom firm American Telephone & Telegraph (AT&T). That project relied on the ground-breaking IT of the day (PCs, databases, corporate networks, but not yet the internet) to assure the reliability of the entity's billing systems through the automated acquisition and analysis of data and the electronic communication of alarms – no mean task when the entity's customer base comprised over one hundred million users. The tools available at the time would be considered primitive today, and yet that pioneering system, known internally as the Continuous Process Auditing System (CPAS), and its successors, were in use even as late as a few years ago to detect anomalies in billing and possible fraudulent use of long distance calling.

The system intended to monitor and audit the large biller initiative of AT&T. This was part of AT&T's 'take back' strategy where the billing for long distance services would not be done through the regional companies (as for local calls) but by a separate bill issued to the client by AT&T. The system was enormous and highly sensitive data extraction was through semantic processing where electronic versions of reports were captured through a remote job entry system and its content pattern scanned for specific content. Report BIL173 would have next to the word 'total' the value of a particular variable and next to 'date' the actual chronology of the event. In Figure 15Figure 15 a symbolic view of this systems architecture shows the systems (four large data centres distributed throughout the United States) distributing electronic remote job entry (RJE) reports, these being filtered through the semantic extraction procedures discussed above, and placed in a relational database. This database was queried by screen-based reports that visually described the system in a 'flow-chart like' presentation comfortable to auditors.

Formatted: Font: 10 pt, Complex Script Font: 10 pt

---

[16] AICPA, 1997a, 'Special committee on assurance services report', available at: http://www.aicpa.org/assurance/index.htm. Accessed: March 2004.

[17] http://www.aicpa.org/Professional+Resources/Accounting+and+Auditing/BRAAS/Assurance_Services_Executive_Committee.html#Task_Forces

[18] www.charteredaccountants.com.au

Internal auditors who intensively participated in the effort were 'knowledge engineered' to acquire information about many parts of the system and to capture audit rules to be impounded in the system. Furthermore, past audit reports were used to identify sources of data (metrics), types of analysis performed (analytics), and standards (models to compare against), as well as when an alarm should be issued (Vasarhelyi and Halper, 1991).
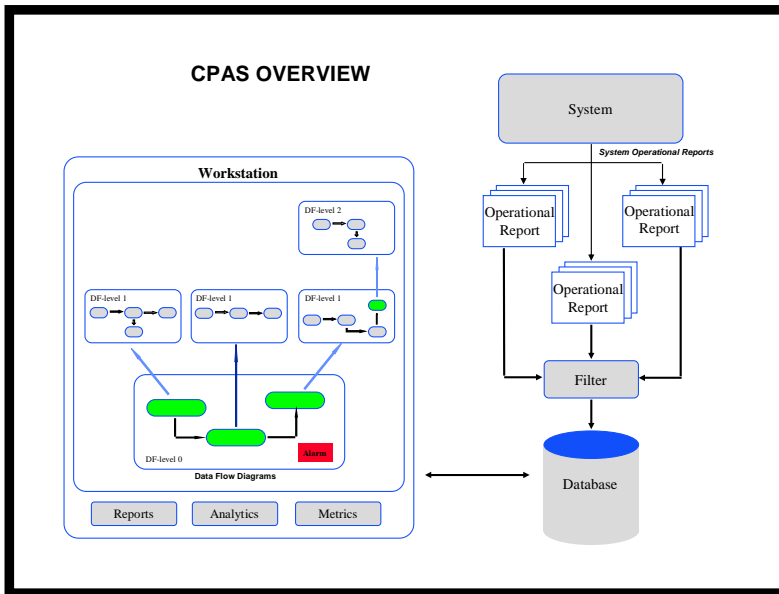
Figure 7: CPAS architecture

This effort in actual data monitoring to identify process flaws or data exceptions was termed 'continuous audit' but today would be known as 'continuous data audit'. Figure 8Figure 8 displays a system screen with an error analytic report overlaid. Note the buttons on the top of the screen with date specification, time period specification, ability for requesting recalculation (data could change too rapidly so it was frozen for the display) and specific comments. Each screen had its own documentation and could be used for auditor or user training.
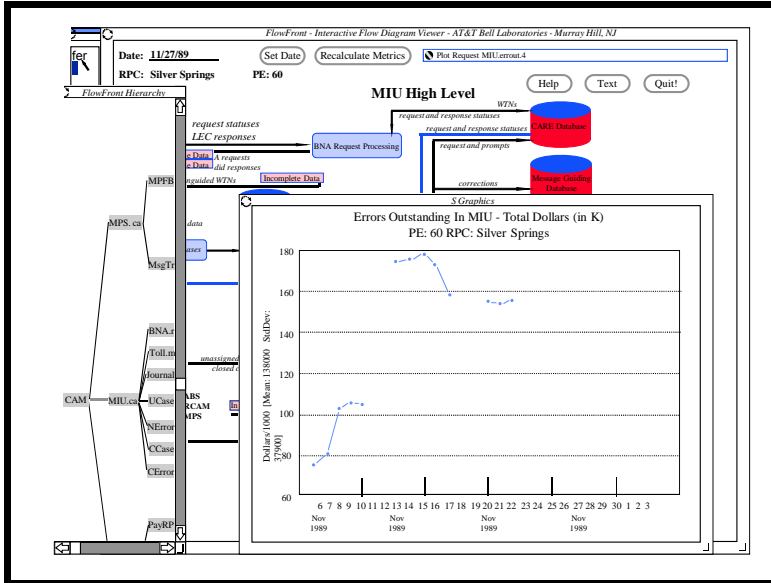
Figure 8: CPAS screen with live flowchart and analytic graphic

That first project clearly demonstrated that the ultimate point of Continuous Assurance is to bring auditing closer to the operational process, and away from the traditional backward looking annual examination of financial statements. The CPAS project was eventually paralleled by the 'Prometheus' project that used its infrastructure to deliver information to billing management analogous (but not identical) to the process monitoring features of CPAS.

Developments and the status of Continuous Assurance

Despite this working example of Continuous AssuranceCA, it took until 1999 before the accounting profession, in the form of a joint committee of the American Institute of Certified Public Accountants (AICPA) and the Canadian Institute of Chartered Accountants (CICA), took up the issue of Continuous Assurance and issued an often used definition of the term:

> *A continuous audit is a methodology that enables independent auditors to provide written assurance on a subject matter, for which an entity's management is responsible, using a series of auditors' reports issued virtually simultaneously with, or a short period of time after, the occurrence of events underlying the subject matter (CICA/AICPA, 1999).*

While parts of this definition, such as its emphasis on 'written assurance', have already been made obsolete by the progress of technology, the definition has helped jump start a thriving research and practice area in Continuous AssuranceCA.

A June 2006 PricewaterhouseCoopers survey[19] found that:

> *Eighty-one percent of 392 companies responding to questions about continuous auditing reported that they either had a continuous auditing or monitoring process in place or were*

---

[19] PricewaterhouseCoopers 2006, State of the internal audit profession study: Continuous auditing gains momentum, PWC Advisory, Internal Audit.

planning to develop one. From 2005 to 2006, the percentage of survey respondents saying they have some form of continuous auditing or monitoring process within their internal audit functions increased from 35% to 50% – a significant gain.[20]

A similar survey jointly undertaken by ACL and the Institute of Internal Auditors (2006) also showed that interest in Continuous Assurance was increasing rapidly, with 36 per cent of responding entities stating that they had adopted a Continuous Assurance approach across all of their business processes or within selected areas, and with another 39 per cent planning to do so in the near future.[21] The latter survey concluded:

Whatever the reasons organizations may have had for neglecting continuous auditing in the past, regulatory demands, the push for real time financial reporting and the drive to automate resource draining manual audits are nudging them to adopt it now.

Given the technological basis of Continuous AssuranceCA, perhaps the best metric of the 'mainstreaming' of Continuous Assurance is the over 40,000 hits that the term generates on Google (as of January 2009). Practitioners and software vendors (such as SAP, ACL, Caseware, Approva and Oversight Systems) now outnumber academic researchers as attendees at the biannual global Continuous Assurance conferences organised by Rutgers University in the United States and internationally. Among those practitioners are representatives of the major audit entities, most of whom have ongoing Continuous Assurance initiatives.

As befits a concept developed by academics, there is a large and dynamic research program into Continuous AssuranceCA. A recent review paper (Brown et al., 2007) surveyed the extant Continuous Assurance literature and classified over 60 papers discussing a wide range of topics and approaches into six major categories: 1) demand factors, meaning drivers of change; 2) theory and guidance; 3) enabling technologies; 4) applications; 5) cost benefit factors; and 6) case studies.

The issues discussed relative to the demand factors that are driving the creation of the emerging Continuous Assurance systems include: the increasing complexity and data-intensiveness of the business environment; the growing prevalence of electronic data interchange, etc.; the ever increasing usage of outsourcing; value chain integration; web-based reporting and the users' desire for reliable information to be disclosed more frequently, more timely and in more detail; XBRL-based reporting; and the fact that under Sarbanes Oxley (Section 409) companies must disclose certain information on a current basis.

As impediments, Brown et al. (2007) drew attention to Alles et al. (2002) who discussed independence issues such as who will pay for the large start-up costs and who owns work product. Under theory and guidance, Brown et al. (2007) cited articles describing Continuous Assurance concepts, proposing a framework and research agenda for the topic, and providing implementation guidance and discussing implementation challenges.

Vasarhelyi et al. (2004) discuss the enabling technologies including statistical methodologies such as belief functions, neural networks, as well as technologies from computer science such as database and expert systems, intelligent agents, and especially technologies for tagging data to facilitate transmission and comparison, most notably XBRL and XBRL/GL. In the applications domain, case studies now exist of Continuous Assurance implementations, such as the pilot implementation of the monitoring and control layers for continuous monitoring of business process controls (Alles et al. 2006), the formerly mentioned CPAS system developed at AT&T Bell Laboratories (Vasarhelyi and Halper, 1991), the Financial Reporting and Auditing Agent with Net Knowledge agent for finding accounting numbers in electronic

---

[20] http://www.pwcglobal.com/images/gx/eng/about/svcs/grms/06_IAState_Profession_Study.pdf
[21] August 2006, *Business Finance Magazine*:
 http://www.businessfinancemag.com/magazine/archives/article.html?articleID=14670&highlight=acl.

data-gathering, analysis and retrieval filings (Bovee et al. 2005), and advanced analytics at a major health services provider (Alles et al., 2006).

There is also an emerging literature of product descriptions in the application domain driven by the emergence of packaged commercial Continuous Assurance software solutions. Such solutions are now actively developed both by established computer assisted auditing techniques (CAAT) vendors such as ACL and CaseWare IDEA, and by new software vendors, such as Approva and Oversight Systems, who are quickly establishing themselves in this emerging market.

The final category of cost benefit issues deals with possible paths along which Continuous Assurance will evolve, long-run operating cost of running database audit, benefits of timely discovery of errors, omissions, defalcations, cost-effectiveness of automated, software-driven audit procedures, discussion of economic feasibility of continuous audit, an experimental market and laboratory experiment for continuous online audit, and nine benefits of continuous business assurance analytics.

While not yet an established technology, it is clear that Continuous Assurance is maturing both in practice and in the research arena, as lessons learned in implementations are used in refining the underlying conceptual model.

The scope of Continuous Assurance

As the technological drivers of Continuous Assurance continue to rapidly progress, it has proven difficult to reach consensus on what Continuous Assurance actually encompasses. What makes this problem of more than academic interest is that the perception of what Continuous Assurance can and cannot do significantly impacts the ease or difficultly of getting its usage accepted in practice. We have already discussed the need to update the AICPA/CICA definition of Continuous Assurance to do away with written audit reports, which are redundant in today's world of electronic communication. Even more importantly, the word 'continuous' undoubtedly would not be used today, because it implies a frequency of auditing that is both difficult to achieve technically without impacting the operations of the entity's IT systems, and probably beyond the needs of most users. The different elements of a corporate information system have different pulses and natural rhythms. The assurance process must be coherent with these rhythms to be useful and effective.

A narrow view

The difficulty of delineating the area of Continuous Assurance is manifested by the significant efforts made in the academic literature (Vasarhelyi and Halper, 1991; Vasarhelyi et al., 2004; Rezaee et al., 2002) on defining the distinction between Ccontinuous assurance Audit and Continuous Assurance and how both differ from the traditional audit. Alles et al. (2002) defined Continuous Assurance as the application of modern information technologies to the standard audit products, be they the mandated annual audit opinion or internal IT audit. In this view, Continuous Assurance is another step on the path of the evolution of financial audit from manual to systems-based methods. The literature on Continuous Assurance can restrict itself to technical matters, working under the assumptions that the demand for the mandated audit is a given and that the emerging technologies will be adopted because they are cheaper and more effective than the current audit methods.

A wider view

By contrast, Ccontinuous aassurance sees Continuous Auditssurance as only a subset of a much wider range of new, non-statutory products and services that will be made possible by these technologies. In particular, in this wider view, continuous assurance is seen as going hand-in-hand with continuous reporting, because more frequent assurance can obviously only have an impact when its availability is made known through some reporting mechanism that matches its timeliness. Elliott has been the most forceful proponent of this wide view of Continuous AssuranceCA, stating as long ago as 1997 (Elliott,

1997) that 'On-line reporting based on databases updated in real time will be less wedded to current protocols for periodicity, creating a parallel evolution toward continuous auditing. Continuous auditing may lead to continuous reporting that supplements and eventually replaces the annual audit report.' Subsequently, with the scope of such services expanded by the AICPA from auditing to assurance, Elliott (2002, p. 7) went on to say that 'The advantages of electronic business reporting will provide a market for – indeed, the necessity of – continuous assurance.'

Alles et al. (2002) subjected this view to an economic analysis, and recognised that assurance is driven by business necessity rather than being an inevitable outcome of technology. They postulated that the best way of thinking about the benefits of Continuous Assurance is that it enables 'audit on demand', which implies a continuous capability to audit, but not the continuous provision of assurance.

Shortly after the publication of this paper, the passage of the Sarbanes Oxley Act in the United States and especially its Section 404 requirements for assurance over financial reporting controls validated the view that demand would be the driver of Continuous AssuranceCA. However, what was not anticipated by Alles et al. (2002) and other writers prior to the passage of the Sarbanes Oxley Act was that it would be internal rather than external auditors who would be the main champions of Continuous AssuranceCA. The reasons were two-fold. First, external auditors were overwhelmed with doing 404 work and so had no time to spare for developing new Continuous Assurance methodologies, while internal auditors, who also had to find resources to take on new 404 responsibilities, saw in Continuous Assurance the means of reducing the headcount demands of their existing tasks. Second, Sarbanes Oxley Section 201 strengthened the independence standards on external auditors and there was great concern that Continuous Assurance would violate those constraints, while internal auditors obviously faced no such restrictions.

In particular, an important component of Continuous Assurance is what Alles et al. (2006) call 'Continuous Control Monitoring' (CCM) which is the application of technology to the continuous monitoring of internal controls of business processes. This is often driven by management needs, as opposed to the requirements of external auditors, and so typically it can only be carried out by internal auditors. However, in practice, the external auditor has a major influence on the design of these CCM systems. In all instances that we are familiar with, the internal auditor of the entity sought at least an implicit agreement beforehand with the entity's external auditor that the systems they use would be relied on by the external auditor in the their statutory auditor or (in the United States) SOX 404 certification. Otherwise, the cost and efficiency considerations would have made the CCM system economically unfeasible. Indeed, all the Big 4 audit firms are now developing Continuous Assurance technologies they are seeking to sell to non-audit client customers, and an important selling point of these products relative to those sold by third party vendors is the 'seal of approval' of an external auditor.

An evolutionary view

In the early days of the aforementioned CPAS effort and other examples, Continuous Assurance meant using close to the event data streams to identify faults or to give assurance of system / data reliability. The ensuing emphasis on controls, the requirement of independent assessment of controls, and the emergence of ubiquitous ERP systems (where controls cannot be directly observable) brought the expansion of the conceptualisation to bring in monitoring technology to observe adherence to controls in embedded software. This added CCM to CDA to make Continuous AssuranceCA.

We are currently at a stage of potential expansion of the scope of Continuous AssuranceCA. The subprime crisis of 2007-2009 made it obvious that the accounting measures in place did not accurately report economic health, the business model and risks to which entities were exposed. So the unforeseen series of trigger events was not considered or factored in. It is also obvious that corporate enterprise risk management (ERM) procedures were inaccurate and inadequate for a systemic set of problems and the complex business environment foreshadowed by financial engineering. At the planning stage of the audit, risks are assessed to the elements of the entity, and resources allocated for a 'risk-based audit'. If corporate ERM procedures were not adequate to assess business risk, obviously audit risk assessments

are limited too. Thus it is proposed that a new set of CRMA procedures be brought forward to take advantage of close to real-time monitoring and hopefully advancements in analytics and alerting technology.

A practice view

In contrast to the academic literature, practitioners attach less significance to what Continuous Assurance means, with definitions mattering less than the application of Continuous Assurance techniques and the value they create – but this only applies to those practitioners who are already convinced of the benefits of implementing Continuous Assurance within their organisations. For others, the term 'continuous' can still pose a conceptual problem that impedes acceptance and change management.

In the early days of Continuous AssuranceCA, the ultimate goal was the development of the 'push button audit', in which auditing functions somewhat analogously to the way in which virus protection software automatically protects a PC today with little intervention from the user. This overly optimistic vision of the potential of Continuous Assurance is due to the focus on the extraordinary possibilities of modern IT and its rapid rate of change. But business practices, let alone the mindsets of the people involved, change far more slowly, and only in response to proven value added. That makes pilot implementations and the role of academics in creating and disseminating the lessons learned essential to the development of Continuous AssuranceCA.

Implementing Continuous Assurance

By analogy with conventional auditing, we divide Continuous Assurance into three distinct but complementary components:

- Continuous controls monitoring (CCM) which consists of a set of procedures used for monitoring the functionality of internal controls
- Continuous data assurance (CDA) which verifies the integrity of data flowing through the information systems
- Continuous Risk Monitoring and Assessment (CRMA) which is used to dynamically measure risk and provide input for audit planning.
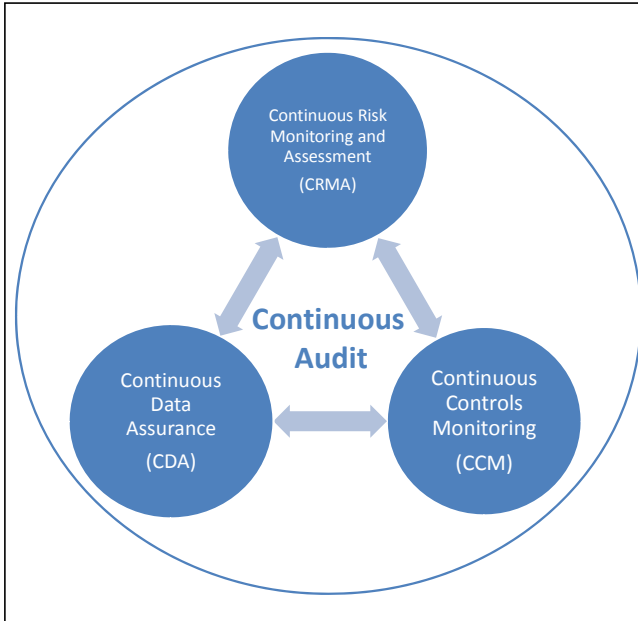
Figure 9: Three elements of Continuous Assurance

Examples of CCM include procedures for monitoring:

- Access control and authorisations
- System configuration
- Business process settings.

Examples of CDA include procedures for verifying:

- Master data
- Transactions
- Key process metrics using analytics (including continuity equations [CEs]).

CRMA includes processes that:

- Measure risk factors on a continuing basis
- Integrate different risk scenarios into some quantitative framework
- Provide inputs for audit planning.

While continuous monitoring of access controls and authorisations is well developed in computer security applications, monitoring enterprise system configuration and business process settings is an emerging area of development. At present entities are implementing these Continuous Assurance components individually, but not as an integrated system of Continuous Assurance. Over time, there will be a need for better integration across all assurance platforms, in much the same way that the proliferation of stand-alone functional software across the entities eventually led to the development of ERP systems.

More fundamentally, creating a fully integrated Continuous Assurance system would require rethinking the conceptual framework for both assurance – and more frequent assurance is irrelevant without

correspondingly timely reporting – and for reporting. There will be a need to re-engineer audit and reporting practices that were developed for a manual, annual procedure into ones that make sense for real-time, automated Continuous Assurance systems. Not only will new methodologies have to be created, along the lines of ones discussed in this paper, but new ways of thinking about such long accepted auditing and reporting principles as materiality, independence, recognition, measurement and disclosure will also have to be developed.

We now discuss implementation strategies of CCM and CDA. We also conceptually introduce CRMA and propose an integrated model.

Continuous Control Monitoring of business processes

Strategies for Continuous Control Monitoring

Continuous monitoring of business process (BP) controls relies on automatic procedures, and therefore presumes that both the controls themselves and the monitoring procedures are formal or are able to be formalised. Note that the latter is necessarily premised on the former. Formalisation of BP controls, while important in its own right, has been precipitated by ERP implementations and the ongoing Section 404 of Sarbanes Oxley compliance work. The verification of existence, suitability for purpose, and functioning of controls over BP can be accomplished in three different ways.

First, one can observe a BP and verify if the observations agree with the proposition that a control exists, is appropriate and functioning as intended. The benefit of this approach is that it can be applied even in those environments in which controls are not directly accessible by the auditor. The problem with this approach is that the observed behaviour of the BP may not completely cover the whole range of situations in which the control is expected to function, and therefore there is no assurance that this control will be functioning as expected under all circumstances.

Second, in the case of preventive controls, one can attempt to execute a prohibited BP behaviour (e.g. run a prohibited transaction such as recording a large purchase order without proper authorisation) to verify that such behaviour cannot happen. In the case of detective or compensating controls, the auditor can verify that the prohibited behaviour is detected and compensated for. While such control testing provides much stronger evidence than the previous approach, it is highly unlikely that an auditor (even an internal one) will be allowed to execute such 'penetration testing' on the entity's ERP system. Under most common circumstances, the best an auditor can count on is the read-only access to that system. Indeed, the most likely situation in our experience is that both internal and external auditors are reliant on the entity's IT personnel to install the interface which allows them to extract data from the ERP system on their behalf.

Finally, one can retrieve the control settings stored in the enterprise system and verify that they match the benchmark. The benefit of this approach is that it requires just read-only access to the enterprise system and provides very strong evidence since it actually confirms that the control is indeed what it has to be. The critical assumption in this approach is that the programming code of the control in the production enterprise system is correct, since what are verified in this approach are the control settings. This assumption seems to be reasonable with respect to the standard controls built into modern packaged ERP systems such as SAP R/3 or Oracle Business Suite. However, an ERP system can be customised, and in the case of customised controls, additional initial control verification work may be needed to complement the ongoing monitoring of BP control settings.

The analysis above implies that in the case of highly integrated and standardised enterprise system environments, the most appropriate approach to CCM is to implement continuous monitoring of BP control settings. Modern ERP systems make their automated BP control settings accessible online from the Continuous Assurance system. The process of monitoring itself falls within the general Continuous Assurance framework developed in Vasarhelyi et al. (2004) of obtaining assurance by continuously comparing the actual observations (in this case the control settings) against the benchmarks. Therefore,

the determination of the appropriate benchmarks for the acceptable BP control settings constitutes a critical part of implementing a Continuous Assurance system. Clearly, such benchmarks are often enterprise-dependent. In the case of large multinational companies certain control setting benchmarks may depend on the country or a particular unit of an enterprise, which will complicate the setup of the Continuous Assurance system.

A critical parameter in the Continuous Assurance system is the frequency (e.g. daily, hourly) of comparison of the actual BP control settings with the benchmarks. This is a generic issue in any Continuous Assurance system setup, and the optimal frequency may depend on many different features of the environment and the controls under consideration. Note that while higher frequency is indeed beneficial for achieving higher levels of assurance (since less time is available for undesirable adjustments or malfeasant transactions), the main problem with the excessive frequency is not the processing capability of the Continuous Assurance system, but rather the performance penalty imposed by such queries on the production enterprise system. While an hourly frequency will usually not present a problem, hitting a production system every second with a query to retrieve voluminous control settings may be problematic, especially during working hours.

The main task of a Continuous Assurance system is to take action in case the observed BP control values deviate from the benchmarks. We call such deviations 'exceptions'. A Continuous Assurance system has to automatically generate alarms in case of critical exceptions, such as individual accounts without passwords, or in case of numerous non-critical exceptions result in the aggregation of weaknesses in certain control areas (e.g. segregation of duties). The alarms are always sent to the (internal and maybe external) auditors, and can optionally be sent to responsible enterprise personnel and/or enterprise managers, as well as other relevant parties.

System architecture for Continuous Control Monitoring

Once an automated audit program for CCM has been created, it has to be implemented in audit software. This software can be categorised along its three dimensions: structure, access and platform.

In terms of structure, audit software can be either integrated or distributed. It is natural to mimic the structure of the enterprise software being audited: if it is tightly integrated, the auditing software can be a tightly integrated system as well, while in the case of loosely coupled enterprise applications, a distributed system consisting of multiple auditing software agents will be a better fit.

Auditing software's access to the enterprise system and data can be either direct or intermediated. As the word 'direct' suggests, in this case auditing software has access to the enterprise system implementing the business processes and containing source data being audited. Depending on the type of enterprise system, this interaction can be either with its database or the application layer. If the direct access is too cumbersome, expensive or unfeasible to set up, then intermediated access is in order, typically through a business data warehouse. This approach is usually the only option in the case of highly heterogeneous loosely coupled legacy enterprise system landscapes.

The platform of automated audit software can be either common with the enterprise system or completely separate. Modern integrated enterprise information systems have a three-tier architecture consisting of the presentation, application and database layers. While the database layer contains all the enterprise data, all the business logic is coded and executed in the application layer.

If the common enterprise platform hosts the audit software, the latter is usually referred to as an embedded audit module (EAM). Enterprise software vendors are naturally positioned to provide such software, even though until very recently they provided only rudimentary capabilities (Debreceny et al., 2005). If the audit software is hosted on a separate platform, it is usually referred to as monitoring and control layer (MCL), and this type of audit software is typically provided by third party vendors and audit firms. MCL can query the enterprise system through the application tier using its application program interfaces (e.g. business application programming interface in the case of SAP R/3). This approach is usually well-supported by system vendors and the APIs are well-documented. Analogously, an EAM can

be implemented as a sub-module of the application (e.g. coded in advanced business application programming in the case of SAP R/3).

MCL can query the enterprise database directly (using structured query language [SQL] through open database connectivity). While in principle this approach is more versatile than querying through the application tier since it is not constrained by the structure of the enterprise business objects, in reality the schemas of enterprise databases are so complex and enormous (they are highly normalised and contain upwards of 20,000 tables) that digging out anything which is a not a well-documented business object is close to impossible. Analogously, EAM can be implemented as a trigger (written in SQL) and stored in the database. However, using triggers in transactional databases will have an adverse effect on the database performance, in some cases slowing down the enterprise transaction processing system to a standstill.

While EAMs are usually permanently installed on the enterprise platform, one can also utilise an automated audit software architecture based on mobile code. In this architecture, the code implementing certain automated audit procedures is transported over the network to the enterprise platform on an as needed basis to execute its procedures there, and the code remains there for as long as needed. The primary reasons for executing audit procedures (whether in the form of EAMs or mobile agents) on the common enterprise platform follow.

First, they protect against network connectivity outages. Since remote code critically relies on the availability of connection to the enterprise system for access, it will be effectively disabled if the connectivity is lost (whether accidentally or intentionally). While modern networks are increasingly more reliable, sporadic connectivity outages still present a significant problem.

Second, the execution of resident code can be triggered by events in the enterprise system, while remote procedures can execute only after they retrieve information at a scheduled time. Event-triggered execution of audit procedures potentially reduces their latency to zero. Additionally, their latency is not affected by possible network congestion, which can significantly increase the latency of remote procedures.

Third, it is usually more efficient to process large volumes of enterprise data on site as compared with moving that data over the network for remote processing. The tradeoff here will depend on the processing capabilities of the enterprise system and on its load at the moment when processing is needed.

While the benefits described above seem to provide strong support for basing the architecture of automated audit on EAMs or mobile agents, there are extremely difficult problems associated with relying on the enterprise system for audit code execution.

On the one hand, there is legitimate concern on the part of the enterprise platform owner about the possibly adverse impact of the auditing code on the enterprise system itself. This impact can be caused by simply imposing a taxing computational load that can lead to the degradation of response time of routine enterprise transaction processing. To mitigate this issue, the enterprise platform can limit the amount of processing it provides to the auditing code, thus somewhat limiting its abilities. An even more serious concern on the part of enterprise system owners is the possible interference by the code (either accidental or malicious) in the workings of the enterprise system. This is the reason for protecting the enterprise platform against a (possibly malicious) EAM or mobile agent. Modern IT provides well-developed facilities for dealing with this problem in the form of a strictly controlled execution environment (known as a 'sand box' or a virtual machine) which enables the auditor to experiment with implementing Continuous Assurance on a replica of the entity's ERP system without actually affecting the operating system itself. Only when the Continuous Assurance system has been exhaustively validated will it be allowed to be implemented on the real ERP system.

The other side of the issues discussed above is the necessity to protect the EAM or mobile agent auditing code against possible manipulation by the enterprise platform. Given that the super-user privileges for the enterprise system are held by the enterprise IT personnel, the integrity of the audit code processing is

always in question since it is the objective of this code to check on the enterprise system and its personnel.

The extreme difficulty (if not impossibility) of protecting the EAM or mobile agent auditing code from possible manipulation by the enterprise platform puts in question the integrity of results provided by this auditing code. This lack of trust in the audit results outweighs the benefits of the resident code described above, and serves as one of the critical reasons for basing automated auditing architecture on remote monitoring of enterprise systems.

Formalisation of audit action plans for Continuous Control Monitoring

Having explored the strategy and system architecture of CCM, the steps in implementing the Continuous Assurance system can now be laid out. The key to implementing Continuous Assurance easily is to already have a clear and formally specified audit action plan that the CCM system attempts to automate. Otherwise, the change management problem becomes compounded as the audit team has to determine both how to carry out the audit in the first place, and then how to automate it. The steps are as follows:

1. Determine the best mode for the continuous monitoring of the chosen business process controls.
2. Develop the system architecture for this task, whether by using a monitoring and control layer or some sort of embedded audit module.
3. Determine the interaction and integration between the CCM software and the entity's IT system, such as it ERP system.
4. Develop guidelines for the formalisation of the audit action plan into a computer executable format. In particular, determine which aspects of the audit action plan are automatable and which require re-engineering.
5. Create processes for managing the alarms generated by the automated Continuous Assurance system and put in place the required set of audit trails.
6. Formulate a change management plan to move the project from the pilot stage to industrial strength software.

Of all these steps, the most critical is determining which aspects of the audit action plan are automatable. As Alles et al. (2006) indicated, before audit procedures can be automated, they must first be formalised:

> *Automation requires formalization of audit procedures. Approved audit programs are not highly formalized and most often reflect the legacy of the traditional manual audit/interview approach to auditing. Different human auditors interpret the same program somewhat differently. Our pilot study analysis of the approved internal IT audit program shows that certain parts of the program are formalizable while other parts are not.*

Indeed, since the audit programs are designed by human auditors for execution by human auditors who are presumed to largely share their own knowledge and judgment, audit procedures in these programs are not completely formal and as such, they leave open significant room for interpretation. This is extremely problematic for the audit automation process though, since, as confirmed by experience, even highly qualified human auditors will at times disagree about the precise interpretation of a particular procedure. Whether this results in uneven audit quality is an empirical issue, and one outside the scope of this paper. What is undeniable though is that the resulting lack of consistency is one of the key barriers towards audit automation.

While formalisation is a prerequisite of automation, formalising an audit program has wide ranging benefits not limited to automation. By eliminating possible inconsistencies in program interpretation, the scope, scale and exact nature of audit procedures will be assured. Consequently, it can lead to the improved quality of results, and increased confidence in the audit as a whole, as was previously found to be the case after limited scope audit automation projects. It should also decrease long-run audit costs due to the elimination of the ongoing labour intensive task of interpreting an ambiguous audit program. Additionally, it will drastically simplify and improve training of new auditors.

One argument is that an audit process should not be formalised because of the need to retain the flexibility to interpret it suitably in differing future circumstances. The counter argument to that is to better specify what such circumstances of concern are and to systematically develop formal procedures to deal with them when they arise, as opposed to risking audit failure by building in excessive flexibility. Indeed, in our experience, auditors would simply leave out entire parts of the required audit manual by stating something like 'Well, I know that this was only intended to apply to our operations in China and so it is not relevant at this site'. While it may be acceptable for a very senior and highly experienced lead auditor to make such a judgment, what happens when the audit is carried out by someone less qualified, as will inevitably occur at some point due to resource constraints? The purpose of audit automation is to have areas of flexibility planned for rather than inserted haphazardly.

Formalising an audit program is a difficult endeavour. It can be very laborious and costly because a formal procedure has to be very specific and detailed, and it has to describe the precise modifications to be used in various conditions. This problem is compounded by the difficulties that many humans (even properly educated and trained ones) experience with logical reasoning and formal thinking. To address this problem, the audit automation project can utilise the methodology of knowledge engineering, especially knowledge elicitation, developed originally for expert systems and further enhanced as those evolved into modern knowledge-based systems.

Since manual audit programs were not designed for automation, formalisable and judgmental procedures are often intermixed. To formalise and automate such a program, a redesign is usually required to separate out formalisable and automatable audit procedures from the others. Such a redesign amounts to re-engineering the audit program and should be done systematically (as opposed to ad-hoc) and based on the top-down analysis of enterprise risks to make sure that the redesigned procedures appropriately address all exposure areas.

The objective of re-engineering is not only to enable automation by separating out the formalised audit procedures but, more significantly, to maximise the proportion of automatable procedures in the audit program, and thus to reduce the reliance of audit procedures on informal judgmental techniques. An additional argument in favour of increasing the proportion of automated procedures in a re-engineered audit program is due to the fact that these automated procedures can be performed much more frequently than the eliminated manual methods they substitute.

However, not everything can be made completely formal. Certain complex judgments are not amenable to formalisation. Formalisation is particularly difficult (if not impossible at the current state of technology) whenever audit procedures have to deal with the analysis of complex modern business contracts. At the same time, the possibility of formalisation is often underestimated, and when an earnest effort is made to formalise audit procedures, the results often exceed the most optimistic expectations.

Example of Continuous Control Monitoring implementation: Siemens IT internal audit

In 2005, Siemens had over 460,000 employees and total global revenues exceeding US$95 billion. In the United States Siemens employs some 70,000 people in divisions spread throughout the country, generating in excess of US$20 billion in sales. We have been working with the US IT IA group to:

- Investigate the extent to which Continuous Assurance techniques can be applied to their existing audit process
- Help implement an automated Continuous Assurance system that frees up the IA workforce
- 'Continuous ~~Auditing~~Assurance-enable' established manual audit procedures by re-engineering them.

Siemens is one of the most SAP-enabled entities in the world. A downside as far as IA is concerned is that with over 60 SAP installations spread throughout the United States alone, each site can be audited no more than once every two years. The SAP IT audit process has to cover all the major SAP modules and is highly labour intensive. Each audit takes nearly 70 person days and requires a large audit team to travel to the site at great expense, both financial and personal.

Apart from the obvious desire to increase the efficiency of this process, another key driver of interest in Continuous Assurance by Siemens was the anticipated demands of implementing Section 404 of the then recently passed Sarbanes Oxley Act. The challenge IT internal audit was presented with by senior management was to cope with the additional burden of 404 while not adding to headcount. Continuous Assurance was seen as a promising tool for at least reducing the workload of the audit team when carrying out the existing tasks, which could then be redeployed to Section 404 work. Ideally, the Continuous Assurance methodology would itself be considered 404 compliant, thus leveraging the value added.

Siemens' IA methodology for SAP facilities involves carrying out the procedures prescribed by hundreds of 'audit action sheets' by internal auditors at the entity site. Initially it was estimated that about 25 per cent of the audit action sheets could be fully automated due to their deterministic nature. But this was always seen as a floor and not a ceiling as far as the scope of CCM was concerned because it presumed the use of a home-grown CCM software which was not industrial strength. More importantly, it was expected that far more audit action sheets would become automatable if they were rewritten on the presumption that they would be implemented by a computer rather than a human auditor; in other words, they would be formalised through re-engineering, removing ambiguity and missing instructions that would be filled by the judgment of the auditor.

In a more recent follow-up study of the Continuous Assurance initiative at Siemens based on its standard SAP platform and using Approva as an overlay control monitoring software (Teeter et al., 2008), it was concluded that about 68 per cent of the actions could be automated to some extent. Considering that some of these automated steps would be performed in a daily monitoring mode (as opposed to the 18- to 24-month cycle of SAP audits) the strength of its evidence would be much stronger and conceivably could replace much of the residual 32 per cent non-automated evidence.

As Siemens moves forward with extending CCM to all parts of their global operations, it is instructive to look back at the business case made by IT internal audit managers at the entity to senior management to justify the implementation of Continuous AssuranceCA. Figure 10Figure 10 is taken from a presentation prepared for internal and external audiences by Siemens' internal audit to explain why the project was undertaken. While the actual cost savings are difficult to determine, even achieving a fraction of these projections would give this project a very high return on investment.

Figure 10: Continuous Assurance value propositions at Siemens Continuous Data Assurance

Continuous Data Auditing

Strategies for CDA

Since its very inception, accounting has been shaped by the cost of obtaining and investigating data. Reports prepared and audited only once a year; sampling rather than examining the entire population; analysing at the trial balance level and using ratios: all these are outcomes of the fundamental constraint on the data accountants could gain access to and had the ability to analyse. What is common to all these responses to the constraint is the aggregation of data across time and space in order to reduce the data and analysis needs of the accountant. Moreover, aggregation at a level higher (often much higher) than the transactional level, has been a cost and capability-based limitation rather than the ideal process for assurance. Technology, auditor capabilities and the nature of auditee information have changed this constraint but accountants are still taught to follow these practices even though the underlying reason for them has not existed for some years now.

One area of accounting which has moved to exploit the capabilities of the new IT infrastructure of the entity is CDA, which uses powerful software to extract data from the entity's IT systems and then analyses it at the transactional level to provide more detailed assurance; and if the data extraction is done frequently enough, also on a more timely basis.

In developing a CDA system the assumption is that with access to transaction level data auditors will gain the ability to design expectation models for analytical procedures at the business process (BP) level, as opposed to the current practice of relying on ratio or trend analysis at a higher level of aggregation. Testing the content of an entity's data flow against such process level benchmarks focuses on examining both exceptional transactions and exceptional outcomes of expected transactions. With such benchmarks the Continuous Assurance software can continuously and automatically monitor company transactions, comparing their generic characteristics to observed/expected benchmarks, thus identifying anomalous situations. When significant discrepancies occur, alarms will be triggered and routed to the appropriate stakeholders.

An important innovation in the architecture of a CDA system is the utilisation of analytical monitoring as the second stage of data analysis, rather than the first one, as is the case in standard audit practice. Hence, the first component of the Continuous Assurance system utilises automatic transaction verification to filter out exceptions, which are transactions violating formal BP rules. The second component of the system creates and utilises benchmarks which model the fundamental business processes of an entity to serve as the expectation models for process-based analytical procedures.

Transaction verification will be found to be a necessity in most CDA implementations, especially in entities with disparate legacy IT systems rather than a single, integrated ERP system. When data is uploaded to the firm's data warehouse from the underlying legacy system the potential exists for errors to be introduced to the data set which have to be identified and removed before the data is suitable for automated testing, and that step is undertaken by the transaction verification component of a Continuous Assurance system. Potentially, in a very tightly integrated enterprise environment with automated BP controls, such data errors may be prevented by the client's ERP system.

Transaction verification is implemented by specifying data validity, consistency and referential integrity rules which are then used to filter the population of data. These rules are designed to detect and remove two types of data errors: first, data integrity violations which include, but are not limited to, invalid purchase quantities, receiving quantities and cheque numbers; and second, referential integrity violations which are largely caused by many unmatched records among different business processes. For example, a receiving transaction cannot be matched with any related ordering transaction. In other words, a payment was made for a non-existent purchase order.

While the verification of transactions relies on fairly straightforward business rules, entities implementing CDA often consider that just the exceptions identified at this stage are a major source of value added from the project. It is to be anticipated that as legacy systems are gradually superseded by the entity's

ERP system with stronger automated controls, the transaction verification component of the Continuous Assurance system will be catching fewer and fewer problems. Conversely, the fact that any are caught at all indicates the value of this element of automated Continuous AssuranceCA, since these transaction-level errors detected are only there because they have escaped detection by the standard manual practices being employed by the entity's internal auditors or control procedures.

The benchmarks for CDA can take a number of forms. The vendors of Continuous Assurance software all have proprietary tests of detail included in their packages, as well as (usually) the provision for the client to formulate their own tests. In addition, researchers are working on sophisticated statistical benchmarks called continuity equations (CEs) (Alles et al., 2010) that attempt to model the fundamental business processes of an entity to serve as the expectation models for process-based analytical procedures. Since those underlying business processes are probabilistic in nature, the CEs have to be data-driven statistical estimates. Once identified, CEs are applied to the transaction stream to detect statistical anomalies possibly indicating BP problems.

Recent research shows that for a given BP there is a variety of probabilistic models that differ in their statistical sophistication and ease of use. While these candidate CEs demonstrate differences in their predictive ability and anomaly detection performance, all models perform well and no single model performs better on all aspects. From this we can draw two important conclusions.

First, unlike in the traditional audit literature, the inability to clearly choose the 'best' across the candidate CE models is less important than the fact that all models yield efficient analytic procedure tests. Because of its automated and technology-driven nature, it is quite feasible and even desirable for the continuous data level audit system to use benchmarks based on multiple CE models instead of being forced to select only one, as would be necessary in a more manual system.

Second, the fact that all the CE models yield reasonably effective analytical procedures implies that it is the unconstrained data that matters the most. When auditors have access to transaction data, the richness of that disaggregate data makes error detection robust across a variety of expectations models. In other words, it is the nature of the data that serves as audit evidence which is the primary driver of audit effectiveness, with the selection of the specific analytical procedure a second order concern – not because the audit benchmark is not important, but because auditing at the process level makes errors stand out much more obviously in the data.

Thus the power of CDA comes from a variety of sources: the possibility of running automated tests closer to the event data; the ability of the auditor to access the population of data and to choose the level of aggregation for analytic procedures as opposed to being forced to accept constrained, highly aggregate and sample data; and the use of benchmarks for analytic procedure tests that model the business processes of the entity.

Example of CDA implementation at a major bank

This section describes the CDA implementation at Itau Unibanco, a major full service bank in Brazil, which has had a very active Continuous Assurance initiative since 2000. The Continuous Assurance program is part of the bank's Information Technology Internal Auditing and has over 10 people engaged in several roles. The CDA system currently monitors over five million customer accounts on a daily basis and sends out about six thousand alerts a month for detailed manual analysis by internal auditors.

The CDA program has as its motto achieving 'Productivity with Quality and Efficiency' and its mission statement includes:

- Mission
    – Automatically evaluate risks and controls on a continuous basis in order to identify exceptions and anomalies, trends and risk indicators.

    − Issue opinions about controls, risk assessment for top management, audit committee and other interested parties. Contribute to corporate Governance of the Conglomerate.

- Scope

    − All products, processes and services in the conglomerate that allow the systemic extraction and analysis of data generated by Information Technology.

- Approach

    − Use of existing products, processes and services information analysis to improve timeliness and scope of the Internal Auditing.
    − Inform resulting non-compliance events, generating new products necessary to minimise risks and unforeseen events.

There are currently about 18 procedures that cover the following scope:

- Detective: Routines to detect potential errors
- Deterrent: Routines to inhibit inappropriate events and behaviours
- Financial: Routines to reduce or avoid financial losses
- Compliance: Routines to help compliance with existing laws, policies, norms and procedures.

The CDA routines were created from the knowledge and experience of senior internal auditors and bank examiners as to likely indicators of fraud, or situations where fraud could easily arise. For instance, in Brazil, federal tax payments are paid in over the counter to bank clerks. In some cases the clerk may pocket the cash and the client will not realise this until the tax authorities issue a writ for non-payment many months later. Not only is this a serious situation for the client, but also a liability for the bank that is responsible for paying both the overdue taxes and late fees, as well as incurring a reputational cost. The CDA system monitors federal tax payment cancellations at each bank branch and alerts auditors if there is an anomalous low amount in any given time period.

Another CDA test examines the balances of bank employees to detect overdrafts, an indicator of possible financial difficulties facing the employees and hence, of susceptibility to commit fraud. This particular test illustrates that the kinds of transactional testing in Continuous Assurance systems that are feasible in some jurisdictions are not possible, or may not even be legal, in others such as Australia, which have stronger privacy protections. But this example shows that having the ability to continuously test transactions allows very innovative and powerful tests to be devised, though doing so ultimately depends on the experience, skill and imagination of those implementing the Continuous Assurance application.

Figure 11Figure 11 shows the scope of some of the CDA routines, while Figure 12Figure 12 shows the benefits achieved through the automation of these tests:

Daily Routines - Branches	Approach			
	Detective	Deterrent	Financial	Compliance
1. Check Advances or Excess in accounts or overdrafts	X	X	X	X
2. Returned checks	X	X	X	
3. Federal tax payment cancellations	X	X	X	
4. TED (ELETRONIC FUNDS TRANSFER) issue	X	X	X	X

Figure 11: Sample CDA routines

Daily Routines - Branches	Achieved Benefits				
	Time to Detect	Inform to Business Area	Inform to Audit Staff	Before	Today
1. Check Advances or Excess in accounts or overdrafts	1 DAY	1 DAY	1 DAY	15 DAYS	1 DAY
2. Returned checks	1 DAY	1 DAY	1 DAY	30 DAYS	1 DAY
3. Federal tax payment cancellations	1 DAY	1 DAY	1 DAY	AFTER GOVERNEMENT CLAIMS	1 DAY
4. TED (ELETRONIC FUNDS TRANSFER) issue	1 DAY	1 DAY	1 DAY	NEVER	1 DAY

Figure 12: Achieved benefits of sample CDA routines

Overall, the CDA program has enhanced the audit environment at the bank by increasing audit efficiency, detecting and reducing fraud incidence, and most important of all, creating a deterrence for future misbehaviour by bank employees who are aware that there is now continuous monitoring of transactions, combined with uncertainty about what the tests are looking at and how often they are carried out.

The tools used by the bank in creating its Continuous Assurance system include:

- Routines developed in FOCUS
- MS-Office (Access; Outlook; Word; Excel; Power Point; Visual Basic)
- Data Warehouse (SAS and BRIO)
- ACL
- Academic consultants.

The lessons from this CDA implementation are particularly pertinent in the light of the recent difficulties experienced by the banking sector worldwide. Continuous Assurance is closer to key bank controls, since it improves response time and risk management and increases IA involvement with the critical areas of the bank. In addition, it clearly improves audit effectiveness, efficiency and deterrence capability.

Continuous Risk Monitoring and Assessment

Strategies for CRMA

The focus so far in the development and implementation of Continuous Assurance has, understandably, been on creating initial Continuous Assurance systems. As audit automation matures, however, the focus will inevitably shift towards the question of how to keep the Continuous Assurance system relevant and efficient as the underlying audit environment changes. The audit planning process provides a template for how to make the Continuous Assurance system dynamic: by formally incorporating into it a risk assessment system that encompasses assessment of auditor perceptions of risks and allocation of audit resources to risky areas of the audit.

A recent PricewaterhouseCoopers study on the future audit of 2012 (Figure 13Figure 13) found that while the primary focus of internal auditors was Continuous Assurance and monitoring, a close second was auditing of the entity's enterprise risk management systems – a focus that surely has only increased after the experience of the ongoing credit crisis.[22] However, vital as auditing ERM is, it begs the question of how the entity's auditors, both internal and external, will apply such risk management practices to the audit itself, to reflect changes in the business and audit environment that are more rapid than anything ever envisaged. The aim of CRMA is to give Continuous Assurance systems the robustness to deal with shocks to the audit environment and thereby to make the Continuous Assurance system dynamic rather than static.

- Areas of greatest projected increases in internal audit's responsibility include:

  1. Continuous auditing or monitoring — 95%
  2. Auditing the ERM process — 77%
  3. Auditing outsourced or off-shored operations — 75%
  4. Fraud detection — 66%
  5. Fraud risk assessments — 66%
  6. Auditing executive comp and disclosures — 65%
  7. Auditing operational efficiency/effectiveness — 64%

Figure 13: Internal audit responsibility

Often entities focus their CCM and CDA resources on obvious but small-scale sources of risk (credit cards or employee fraud), while oblivious to the entity-destroying risks inherent in more glamorous parts of their operations. It is important to note that CRMA ≠ continuous enterprise risk management, meaning that CRMA is distinct from, and has a different focus than, the auditing of the entity's ERM systems, whether or not that takes place continuously; clearly the former must be aligned with the latter.

As it stands, there is concern that audit risk planning is too episodic and constrained to remain relevant, as epitomised by the Bear Stearns collapse, which occurred only six weeks after its auditor issued a clean audit opinion. The stated justification for this was that while the audit opinion was valid, changes in

---

[22] http://www.pwc.com/us/en/internal-audit/publications/future-internal-auditing.jhtml

that fortnight were beyond the scope of the audit. Whatever the merits of that argument, it only makes clear the need for a more dynamic, real-time risk management process for the Continuous Assurance audit system.

The good news is that just as continuous monitoring makes Continuous Assurance economically and politically feasible, the new emphasis on ERM will create the sensors and systems that will facilitate CRMA. But implementing CRMA will require that first the practice is formalised, for as we saw with CCM, only then can the degree to which it can be automated be meaningfully considered.

But can CRMA be automated? Does it need to be? A high degree of judgment will undoubtedly be called for when modifying Continuous Assurance systems. But key is to first have real-time information of changes in the business and audit environments, encompass new competitors and products, environmental and social impacts, new regulations and enforcement actions and so on. Again, as we saw with the credit crisis, it needs to be kept in mind that fundamental changes in an entity's risk profile can take place much faster than many expected. Even a Continuous Assurance system needs to adapt very rapidly while a manual audit system is bound to fail in the face of especially rapid changes in the risk environment. Thus, there is a need to think about different ways in which Continuous Assurance systems will have to change.

One useful analogy that can help illuminate the nature and scope of CRMA is to compare it to security software on a personal computer. In the latter setting there are different types of changes to the software possible, depending on changes in threat and technology. For example:

- Weekly updates of virus libraries
- New versions of the software
- New software altogether.

Similarly, Continuous Assurance systems will need continual updating as entity risks change, new CCM and CDA software and techniques are acquired or developed, and audit plans are changed. There is a clear requirement for auditors to create a formal model of CRMA and taxonomy of the stages and drivers of change in a Continuous Assurance system.

Analogous to CCM, risk assessment procedures have been an integral part of the traditional audit for many decades. The early audit planning process encompassed auditor perceptions of risks, and allocation of audit resources to areas of the audit. While there are many forms of guidance in the literature and statutes, this process is still vague and ad hoc. External audit firms have their own approaches and IA departments by and large use similar approaches, including:

- Divide the audit risk frame into manageable parts
- Understand the basic profile of risk of each of the parts
- Work on proposing joint risk profiles
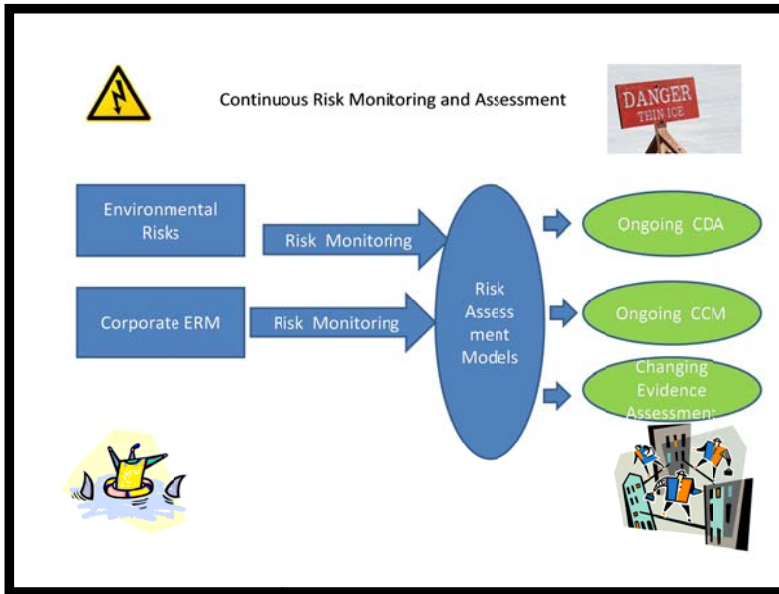- Create scenarios.

Figure 14: CDA, CCM, and CRMA

Continuous Assurance software

While it is certainly possible to design, develop and implement a custom-made automated auditing system in-house, the expense and expertise requirements of such a project make it prohibitively expensive, if not outright unfeasible, for the vast majority of cases. It is therefore not surprising that there is an emerging industry of packaged software developed to support audit automation or at least some of its aspects.

A convenient way of categorising the current software offerings is in accordance with the breakdown of Continuous Assurance as consisting of CCM and CDA. While vendors are attempting to integrate in their packages as many features as possible, they still typically exhibit strength in one of the two components. The well-established (CAAT) vendors ACL and CaseWare IDEA have extended their products to position them as continuous monitoring solutions.[23] ACL, in particular, has invested significant efforts into providing what they call 'continuous controls monitoring' solutions.[24] Despite the name, in the terminology of this paper these solutions should be categorised as CDA since the substance of their tests is transaction verification and analysis focused on making inference about the functioning of controls (as opposed to direct tests of controls through monitoring of their settings). A relative newcomer to this area is Oversight Systems which also focuses on CDA and puts emphasis on providing hosted monitoring solutions.[25]

The common feature of CDA offerings is their utilisation of internal common data models to which enterprise data is mapped by the extract, transfer and load (ETL) subroutines. This system architecture allows for a relatively easy accommodation of many different enterprise systems (or even home-grown

---

[23] CaseWare IDEA is distributed in Australia and New Zealand through Audit and Fraud Software Pty Limited (see http://www.auditsoft.com.au/) and Task Technology Pty Ltd (see http://www.task.com.au/).
[24] ACL services in Australia and New Zealand are provided through the partner firm Satori Group (see http://www.satoriassurance.com.au)
[25] http://www.oversightsystems.com/

solutions) through the development of additional ETL modules to accommodate additional systems. The test libraries and the main processing sub-routines usually do not have to be changed.

While the common data model architecture is utilised successfully in CDA solutions, the systems that implement CCM directly do not use it. The reason is the great diversity of business process automation in enterprise systems. The very significant differences in the types of business objects, process configurations and controls seem to make the common model too complex to be cost-effectively designed and implemented in CCM solutions. This is why these solutions develop special CCM sub-routines targeted at specific enterprise systems. Not surprisingly, the two pioneering offerings in this field – Approva and VIRSA – were targeted at SAP R/3 (mySAP ECC). Approva has since extended its offerings to target other ERP systems, most notably Oracle E-Business Suite. Such extensions are quite laborious since they require the re-implementation of the CCM test libraries and processing for each new enterprise system. On the other hand, VIRSA has since been acquired by SAP itself, and has become the core of SAP's GRC offering. To keep up in its competition with SAP, Oracle acquired in the latter half of 2007 a major GRC and CCM vendor, LogicalApps, whose offerings were naturally targeted at the Oracle E-Business Suite.

The area of GRC is still maturing and has a very large number of vendors, many of them small, though some major vendors such as IBM, with its Workplace for Business Controls and Reporting do have a presence. Among other notable offerings in this market are Paisley Enterprise GRC, OpenPages, AXENTIS Enterprise, BWise, and Protiviti Governance Portal. Many of the solutions in this market are not much more than customised document management systems with GRC-specific templates, though there is a pronounced trend to enhance these offerings with automatic control testing and monitoring functionality that would bring these solutions closer to the fully developed CCM and/or CDA systems.

Practical steps for implementing Continuous Assurance

The audit profession is inherently conservative given that its entire value added comes from the auditor's credible claims of professional independence, objectivity and reliability. As a consequence, auditing processes, even more so than other business processes, have a tremendous amount of inertia. It follows that any Continuous Assurance project, as with any major change initiative in such circumstances, will have numerous barriers to change and to overcome. As the large change management literature indicates, for a Continuous Assurance project to even get launched, let alone succeed, a senior executive has to champion the project, both at an IA level, and in their reporting level in top management or the audit committee. The fact that executives' positions with titles such as 'Associate Director, Continuous Assurance' (in the case of BD Corporation) are being created at entities indicates that such champions are becoming institutionalised as Continuous Assurance becomes mainstream.

The first critical task of audit automation champions will be to identify and engage project stakeholders. In addition to internal auditors, these stakeholders will include business process owners and IT personnel. Again, the use of such multifunctional teams is a standard recommendation of change management theory, but in the case of audit automation the problem is compounded by the need of internal auditors to be aware of the needs of the external auditor, while also balancing the demands of the IT process owners and line managers. The composition of audit automation teams must reflect the multifaceted nature of the task at hand.

The reason for having a high powered team with a senior level champion is obvious when considering the complexity inherent in automating audit processes initially designed to be done largely manually. In our experience, even very experienced auditors differ in how such procedures are carried out in practice, which translates into differences in how to transform the process into an automated one, what the objective of the process should be and how much weight should be placed on a particular process or on a possible compensating control.

Once a champion has been found and the project receives the go-ahead with assured senior management support, actual implementation can begin. Implementing a Continuous Assurance system, be it CCM or CDA, consists of six procedural steps[26]:

1. Establishing priority areas
2. Identifying monitoring and Continuous Assurance rules
3. Determining the process's frequency
4. Configuring Continuous Assurance parameters
5. Following up
6. Communicating results.
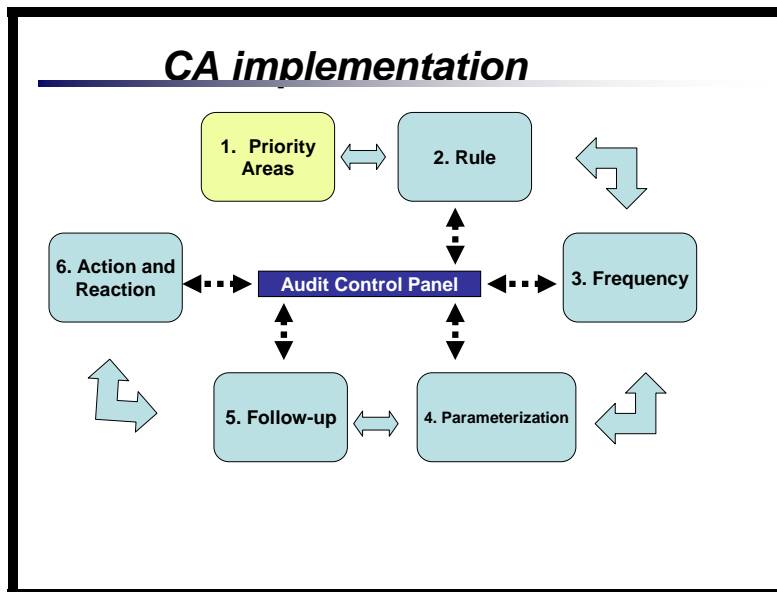
Figure 15: Steps in the Continuous Assurance implementation[27]

1. Establishing priority areas

The activity of choosing which organisational areas to audit should be integrated as part of the annual IA plan and the company's risk management program. Many IA departments also integrate and coordinate with other compliance plans and activities, if applicable. (The remaining steps below are applicable to all of the priority areas and processes being monitored as part of the continuous audit assurance program.)

Typically, while deciding priority areas to continuously audit, internal auditors and managers should:

- Identify the critical business processes that need to be audited by breaking down and rating risk areas.
- Understand the availability of Continuous Assurance data for those risk areas.
- Evaluate the costs and benefits of implementing a Continuous Assurance process for a particular risk area.

---

26 Adapted from Vasarhelyi et al., 2008.
27 From Vasarhelyi et al., 2008.

- Consider the corporate ramifications of continuously auditing the particular area or function.
- Choose early applications to audit where rapid demonstration of results might be of great value to the organisation. Long extended efforts tend to decrease support for Continuous AssuranceCA.
- Once a demonstration project is successfully completed, negotiate with different auditees and IA areas, if needed, so that a longer-term plan is implemented.

When performing the actions listed above, auditors need to consider the key objectives from each audit procedure. Objectives can be classified as one of four types: detective, deterrent (also known as preventive), financial and compliance. A particular audit priority area may satisfy any one of these four objectives. For instance, it is not uncommon for an audit procedure to be put in place for preventive purposes to be reconfigured as a detective control once the audited activity's incidence of compliance failure decreases.

2. Monitoring and Continuous Assurance rules

This second step consists of determining the rules or analytics that will guide the continuous audit Continuous Assurance activity, which need to be programmed, repeated frequently, and reconfigured when needed. For example, banks can monitor all chequing accounts nightly by extracting files that meet the criterion of having a debt balance that is 20 per cent larger than the loan threshold and in which the balance is more than US$1000.

In addition, monitoring and audit rules must take into consideration legal and environmental issues, as well as the objectives of the particular process. For instance, how quickly a management response is provided once an activity is flagged may depend on the speed of the clearance process (i.e. the environment) while the activity's overall monitoring approach may depend on the enforceability of legal actions and existing compliance requirements.

3. Determining the process frequency

Although the process is called 'Continuous Assurance', the word 'continuous' is open to interpretation. Auditors need to consider the natural rhythm of the process being audited, including the timing of computer and business processes as well as the timing and availability of auditors trained or with experience in Continuous AssuranceCA. For instance, although increased testing frequency has substantial benefits, extracting, processing and following up on testing results might increase the costs of the continuous audit continuous assurance activity. Therefore, the cost-benefit ratio of continuously auditing a particular area must be considered prior to its monitoring.

Furthermore, other tools used by the manager of the continuous audit continuous assurance function include an audit control panel in which frequency and parameter variations can be activated. Hence, the nature of other continuous audit continuous assurance objectives, such as deterrence or prevention, may determine their frequency and variation.

4. Configuring Continuous Assurance parameters

Rules used in each audit area need to be configured before the continuous audit continuous assurance procedure (CAP) is implemented. In addition, the frequency of each parameter might need to be changed after its initial set-up based on charges stemming from the activity being audited. Hence, rules, initial parameters, and the activity's frequency – also a special type of parameter – should be defined before the CAP begins and is reconfigured based on the activity's monitoring results.

When defining a CAP, auditors should consider the cost benefits of error detection and audit and management follow-up activities. The choice of a threshold of filtering implies a trade-off between false positives and false negatives, and consequently increases or decreases the follow-up effort. If the threshold is low it creates a larger number of false positives (items identified as problematic that after examination were found to be correct); however, if the threshold is high it allows more items that actually were incorrect not to be selected (false negatives). Because follow-up costs would go up as the number of false positives increases and the presence of false negatives may lead to high operational costs for the

organisation, internal auditors should regularly re-evaluate if error detection and follow-up activities need to be continued, reconfigured, temporarily halted or used on an ad hoc basis.

5. Following up

Another type of parameter relates to the treatment of alarms and detected errors. Questions such as who will receive the alarm (e.g. line managers, internal auditors, or both – usually the alarm is sent to the process manager, the manager's immediate supervisor or the auditor in charge of that CAP) and when the follow-up activity must be completed, need to be addressed when establishing the Continuous Assurance process.

Additional follow-up procedures that should be performed as part of the Continuous Assurance activity include reconciling the alarm prior to following up by looking at alternate sources of data and waiting for similar alarms to occur before following up or performing established escalation guidelines. For instance, the person receiving the alarm might wait to follow up on the issue if the alarm is purely educational (i.e. the alarm verifies compliance but has no adverse economic implications), there are no resources available for evaluation or the area identified is a low benefit area that is mainly targeted for deterrence.

6. Communicating results

The final item to be considered is how to communicate with auditees. When informing auditees of Continuous Assurance activity results, it is important for the exchange to be independent and consistent. For instance, if multiple system alarms are issued and distributed to several auditees, it is crucial that steps 1 to 5 take place prior to the communication exchange and that detailed guidelines for individual factor considerations exist. In addition, the development and implementation of communication guidelines and follow-up procedures must consider the risk of collusion. Much of the work on fraud indicates that the majority of fraud is collusive and can be performed by an internal or external party. For example, in the case of dormant accounts, both the clerk who moves the money and the manager who receives the follow-up money may be in collusion since the manager's key may have to be used for certain transactions.

Assurance in a changing world

The preceding sections focused on the progressive evolution towards the Now Economy and the body of research that is progressively showing ways to automate and accelerate the evolution toward a more frequent, more automatic and more close-to-the-event assurance process.

This section is even more speculative as it attempts to imagine a context of structural changes necessary to facilitate or allow the above changes. The context includes changes on: standards; standard setting; the structure of the audit professions; and the skills, behavioural attributes and competencies of the auditors.

A set of studies in the literature tries to anticipate the evolution of the assurance profession. Many of these use the Delphi method to anticipate, based on converging expert opinions, the future. The method utilises a set of questions provided to a panel of experts and shares their answers to obtain convergence. Delphi (Baldwin-Morgan [1993]; Brancheau et al. [20011996]; Rowe & Wright [1999]), is suited to assessing the likelihood of future events and trends, and has been suggested as an appropriate technological forecasting tool for predicting the effect of technological changes on auditing.

Delphi is deemed to be particularly useful when understanding the problem benefits from subjective judgements on a collective basis and the rationales given by the panelists for their predictions providing insight into the reasons for the predictions and their implications. Parente et al. (1984) claim that these consensus forecasts are more accurate than 95 per cent of individual forecasts, and iteration reveals more reflective opinions than single surveys. Mock et al. (1988), in a study for the Institute of Internal Auditors, also used the Delphi technique. Many of the considerations introduced in the ensuing discussion are based on Vasarhelyi & Lombardi (2010) who performed a 'modified' Delphi which aimed at creating a wider set of questions and inserting some flexibility into the methodology.

Changing external reporting and external auditing standards

Earlier we discussed the difficulties with traditional measurement and the assurance model. Here we present a few thoughts with illustrative tools to further this discussion. The basic problems around the existing standards and standard setting process are multiple. In general the standard setting process tends to be slow and rules stay in place much beyond their usefulness. This said, political and economic frames change but some basic rules that served society well are changed causing serious problems for the economy. For example, in the United States many argue that the rescission of the *Glass Steagall Act* (1933)[28] [29] was one of the accelerating factors in the subprime crisis creating a perverse motivation scheme for bank executives and placing banks in areas where they had little or no competence.

Two other stalwart legislations, the SEC's *FD rule* (2000)[30] and the Sarbanes Oxley Act of 2002 can cause major difficulties, or substantive social costs in the emerging Now Economy:

- The fair disclosure (FD) ruling aims at curbing selective information disclosure by management. However, in the progressive migration from paper to electronic reporting, whatever direction it may take, the essence of reporting will be not 'directed disclosure' but the provisioning of access and availability to large data stores and the ensuing discussion of competitive impairment. In essence 'selective disclosure' will be provisioned by necessity to the multiple stakeholders of business of information access (see the Galileo monograph database Figure 25).

- Sarbanes Oxley aims at auditor independence and forbids auditors to provide consulting services to their clients. One clear assurance product that could emerge, in addition to the traditional audit, is some form of continuous (evergreen) opinion issued by auditors where they provide assurance that filters are in place and certain types of transactions will be monitored; if alarms arise auditors will be immediately aware and will take appropriate action.

Figure 16Figure 16 and
Figure 17
Figure 17 present symbolic auditor opinions aimed at rethinking what auditors do and what they assert. These are probably in violation of Sarbanes Oxley and likely need clarification concerning FD. In essence they:

- Assume a yearly opinion a la current one
- Assume auditors also being independent monitors of their auditees
- Assume some commonality and disclosure of agreements concerning monitoring analytics
- Assume the possibility of 'paid reports or assurances' where stakeholders would pay extra for additional or different assurance
- Assume the co-existence of an 'evergreen opinion' with the more traditional opinion
- Assume parallel monitoring efforts by management and assurance (internal and external).

---

28 http://topics.nytimes.com/topics/reference/timestopics/subjects/g/glass_steagall_act_1933/index.html
29 http://seekingalpha.com/article/144581-should-we-reinstate-glass-steagall
30 http://www.sec.gov/answers/regfd.htm

Pseudo report 1

– We have examined the reliability and financial reports of ABC corporation and have been engaged on a continuous assurance engagement for the fiscal year of xxxx. We will monitor the organization's operations and strategic accomplishments using a wide set of analytics as described in http://www.ca.com/analytics and other analytics we deem appropriate and will report on an audit by exception basis when more than xx % variance is found in operational and strategic standards or when we deem it appropriate. This exception report will be issued to all customers registered (*paying*) at http://www.ca.com/analytics/customers.

Figure 16: An assurance opinion in a Continuous Assurance environment

These few assumptions depart substantively from the current model that has evolved for more than a century. It is difficult to imagine current entities and standard setters evolving easily to such a different schema. In essence, however, the schema is analogous but substantively expands the role of assurance; in essence it is also clear that the lack of observability in computer-based economic activity requires a dimensionally different assurance effort.

<div style="border:2px solid black; padding:1em;">

Pseudo report 2

We have been engaged on a continuous assurance engagement for the fiscal year of xxxx for the purpose of covenant monitoring. We will monitor the organization's covenants as described in our agreement with bank XYZ using a specified set of covenant figures and wide set of analytics as described in <u>http://www.ca.com/analytics</u> and other analytics we deem appropriate and will report on an audit by exception basis when more covenants are violated by more than xx % for a day or when we deem it appropriate. This exception report will be issued to bank XYZ immediately when the variance day is completed and to all customers registered (paying *) at <u>http://www.ca.com/analytics/customers</u>.*

</div>

Figure 17: Alternative assurance opinion with Continuous Assurance implying other assurance services

In addition to expanding the role of assurance to the above examples and to a much wider scope, it is important to expand the knowledge set and structure of the accounting profession.

Changing the structure of the external audit profession

Vasarhelyi and Romero (2009d) examined four engagements in external audit firms and Vasarhelyi and Kuenkaikaew (2009c) surveyed nine major leading IA organisations for their adoption and use of technology. Furthermore, Vasarhelyi and Lombardi (2009e) used a modified Delphi method to make some predictions concerning the future of audit[31]. These studies taken together suggest a series of communalities / trends / patterns / problems that together may point towards the need for structural changes in the assurance function.

First, internal audit organisations are taking the leadership on complex audits and external audit organisations are placing a much increased reliance on these audits. Second, industrial and consumer goods organisations present a substantively lower risk profile than financial entities, creating a very different set of emphases in internal and external audit procedures. Third, most large organisations, in particular those that often have limited interaction and synergy, have several audits. IA, fraud, compliance, Basel II, quality assurance and other organisations have similar functions, very different infrastructures, very different levels of technology adoption, and often do not share findings and process understanding. Rationalisation of audit-like functions, closer coordination and technology integration with external audit, and common platforms for audit / compliance, etc. support would create efficiencies and substantial improvement in the handling of risk.

Many IA organisations have extensive rotation programs. While these programs are greatly beneficial to staff training and individual growth, they come at a serious cost of professionalism and quality of IA programs. These trade-offs are not often at the forefront of the IA management's thinking. In addition, IA

---

31 http://www.thefutureofaudit.com.

organisations often have several levels of leaders who are not audit professionals but who bring in a set of specific concerns about the competence and quality of the audits. If the pattern of increased reliance on monitoring and audit of complex systems by IA continues, this may become a serious concern. The adoption of technology in external audit organisations has been heterogeneous across entities, audits and geography. While audit standards delve into minutiae of procedure it is pretty much up to the entity and the cooperating client as to the depth of audit, the technology to be adopted, the extent of sampling, etc. The more automated audit will require having these minutiae more formalised and attempt to clearly specify the context and nature of the related audit judgement. The comprehension of client systems, audit firm technology, risks of complex client systems has also become a major issue.

But the problem that offers the greatest concern for external audit engagements is the inability to acquire independent data. All the interviewees (Vasarhelyi & Romero, 2009d) report that when data is required for a process, the entity produces a script to retrieve the data, but it is the client who procures it and submits a file to the entity. Upon receiving the file, auditors perform checks for completeness of the data, mainly comparing trial balances, and control that the code was not modified, which gives them the assurance that they are working with the correct data. However, it would be clearly preferable to have immediate and direct access to the data. So, the adoption of electronic work papers to reduce the interchange of papers and files is a clearly desirable objective. Both external and internal auditors recognise this as a desirable route but of heterogeneous path. Finally, external auditors, of different entities, expect that when the crisis is over, companies will adopt Continuous Assurance / continuous monitoring, and that their entity will be able to offer additional services related to analysis of data or controls that they associate with the use of technology in auditing.

Based on the above considerations a few key changes regarding the structure of the external audit profession may happen or be desirable. Owing to the fact that auditor systems are progressively more complex and less human observable (e.g. SAP integrated with legacy systems and middleware) the assurance process will evolve away from the traditional audit to an evidence-based continuous systems monitoring, and opinions that cover: (1) assurance that monitoring of relevant ('material') events are being supervised by an independent third party; (2) evergreen opinion on the fairness of the financial statement; and (3) a grid measuring and explaining reliance and reliability of third-party processes outsourced. While the types of assurance issued by the external auditor need to be increased as described above, the complexities of understanding system structure and its monitoring requires substantive local specialisation and consequently much of the monitoring and audit work will be performed by internal auditors and relied upon by the external audit firm.

The current model of the client entity paying directly variable fees (often hour-based) to the external auditor will evolve towards some form of fixed fee size and complexity-based arrangement. This arrangement may entail mandatory auditor rotation and outside entity choice of auditor. In general the size of the audit and other assurance fees will increase in relation to the current compensation owing to the complexity and scope of the future audit. On the other hand, some form of audit firm risk reduction process will evolve as it is highly undesirable to have audit firms fail and have very limited sources of auditor services. The US public would be better served with a larger number of entities that can comfortably audit large multinationals. Most likely, a trade-off between tort reform to reduce auditor liability and some sort of supranational audit regulator / auditor choice will occur.

Internally companies will rationalise audit-like organisations by streamlining organisation charts, providing common infrastructures, keeping experienced IA management with audit training, and hiring specialised support as third party servicers for narrow complex tasks. The provisioning of this specialised support will probably come from consulting and/or audit support organisations, and depending on how the societal trade-offs evolve (corporate rights vs public rights) some of Sarbanes Oxley 404 independence requirements may be relaxed. Finally, audit firms have progressively moved to outsource labour intensive processes out of the United States to (mainly) India. While the scope and nature of outsourced work is unclear, it is obvious that this will be part of the emerging auditing frame of work. This raises an issue of great importance – quality control and monitoring of outsourced work.

Education

Vasarhelyi et al. (2009e) examine the issues concerning audit education and the Now Economy. They identify the motivation, skills (attitudes, behaviour and objective knowledge), and the necessary instructional artifacts.

Skills for the 21st century auditor

To be better prepared to face the demands of the real-time economy, entrants into the audit profession will need to possess skills that will help them understand not only the technology that will be required while conducting their audits, but also the dynamics that involve working in a team and integrating work between the audit firm and the client. These tools will help them work effectively with clients and maximise this relationship.

Audit automation challenges the way that auditors have traditionally done their jobs. This is illustrated in Figure 18Figure 18. The traditional auditor focuses on the past. Armed with an accounting (CA, CPS, etc.) credential, he works to extract data from legacy and heterogeneous information systems, becomes a master of the spreadsheet and basic analytical tools, and certifies the financial statement prepared by management. Much of what he does is solitary; the numbers must fit within the bounds of US GAAP or IFRS, and the constant fear of litigation keeps him risk averse and resistant to change. All of the work he and his team perform occurs several months after the occurrence of relevant events. Any material errors or fraud that have occurred in that period have had plenty of time to wreak havoc and create additional work (with the bonus of additional fees) for his client.
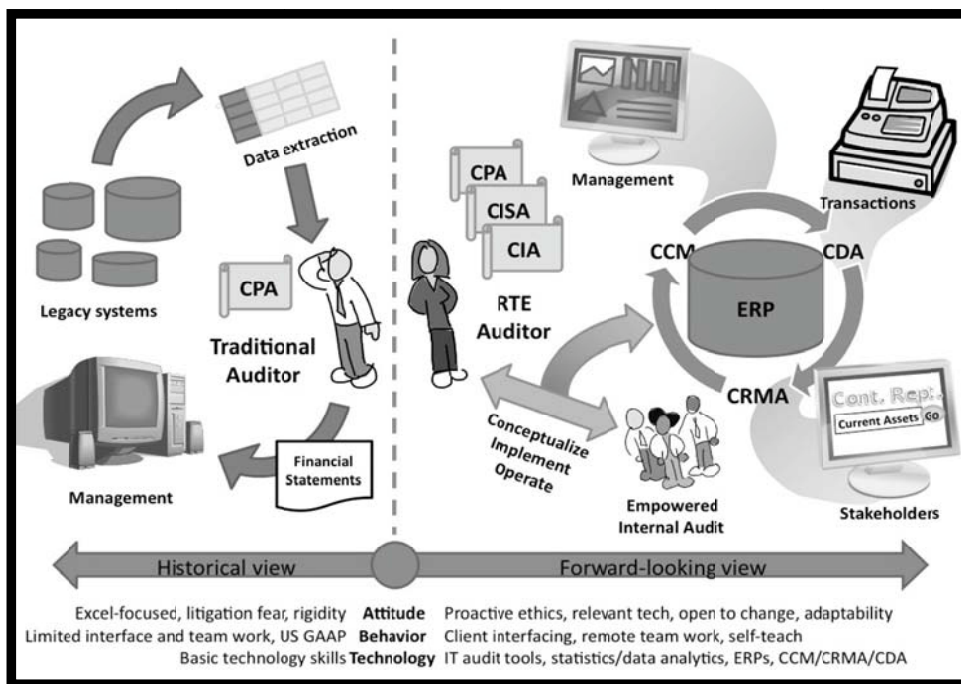
Figure 18: The traditional vs the Now Economy auditor[32]

---

[32] From Vasarhelyi et al., *op cit* p.13.

The Now Economy auditor, on the other hand, is ready to work with today's information. Certainly past data can help model the future, but the forward-looking view (A) allows her to react to problems as they occur and work with management to solve them (B). She may also possess a CPA / Continuous Assurance certification, but also chooses to become a Certified Information Systems Auditor (CISA), Certified Internal Auditor, Certified Fraud Examiner or any combination of these and other certifications. She realises that events occur in real time, so she is proactive in treating ethical dilemmas (B), open to change, and always searching for tools that will help her client remain a going concern. Working alongside an empowered IA team, she coordinates, delegates and evaluates the integrated ERP systems that ingest millions of transactions, ensure management knows that controls are working, and provides stakeholders with an accurate picture of her client's standing. In order to conceptualise, implement and operate these systems, the Now Economy auditor understands the technology and statistics that provide a ~~continuous audit~~ continuous assurance and assurance of the system. Finally, she has the ability to work remotely and to find solutions to problems if she is unsure in a situation.

The Now Economy auditor's skill set is the key to her success. These skills include the attitudes, behaviour and objective knowledge resources that differentiate her from the traditional auditor. They are discussed further in this section.

Attitudes
The following views and motivations will be the driving force behind the dynamic transition from traditional auditing to a Now Economy paradigm.

Ethics
While the literature on ethics is extensive, and as one of the most noteworthy recent evolutionary changes in accounting education has been the progressive incorporation of ethical considerations, the Now Economy brings in a wide set of new considerations relative to the rapidity of information provisioning, the automation of entire subprocesses, the global nature of business activities, and the emergence of faceless technological threats (viruses, denial of service attacks, etc.). For a well-documented list of resources on ethics in accounting, see the work of Thomas (2004). One key attitude for the future is being proactive about ethical issues: identifying ethical issues in advance in relation to themselves, to the client, and to the environment, and taking action in advance of events as opposed to detecting ethical problems ex-post facto.

Technology adoption
The acceleration of the introduction of technology into business requires auditors to have an attitude of constant learning towards technologies and their new features. Assisting this attitudinal posture is the rapid introduction of new devices (e.g. mobile phones) in daily life and the need to learn their features and adapt life to their capabilities.

Openness towards change
The popular perception is accountants are resistant to change, rigid and backward looking. But accountants and auditors must be receptive to changes in technology, social trends, business processes, accounting standards and accountant behaviour. Those who are not may survive by performing mundane tasks, but in order to prosper they will need to embrace change.

Adaptability
Adaptability relates not only to openness to societal change but also to the ability to rapidly change behaviour in this dynamic environment. It can be reflected on the auditors' ability to navigate auditees' rapidly changing technology and understand its capabilities and needs. The same adaptability is required in relation to progressively dynamic standards, business activities and, most of all, changes in risk profile.

Behaviour

Some key changes in underlying behaviour will go a long way to preparing students for the real-time economy. The primary focus should be on helping students foster an attitude of life-long learning. They should understand what the real-time economy is and how it will affect their function as an auditor.

Client interaction

This relates to the interface with the client in the Now Economy, which will typically involve substantially more remote interaction, data transfer and remote presence with less face-to-face interaction. The auditor will have to learn to balance the needs of audit deterrence with the decreasing auditor presence in the facility, more frequent audit interface, increased 'audit by exception' approach instead of programmed dates, and pre-established audit plans.

As remote audits become more feasible, future auditors will also need to know how to deal with clients and team members when they are separated geographically.

Working with a team

As is the case in many other business processes, virtual teams will turn from the exception to the norm aiming to explore narrow domain and scarce competencies (e.g. extensive experience with Approva, an IT-audit SOD-oriented software), diverse geographic locations, not coordinated and often not predictable (due to alarms / alerts) audit actions and plans. The remote audit associated with real-time analytics and alarms will change the face of auditing and make multi-located audits them virtually often with the client become the norm of assurance in large organizations.

Dealing with standard setting entities and regulators

Inevitably, there will be an increased set of regulations and a much more frequent need to interface with government entities and standard setters. These will also eventually adopt a wide range of knowledge management and information provisioning tools. For example, the SEC has been provisioning an XBRL instance reader during the deployment of the rule in the United States.

Managing the engagement

The virtual team, the virtual presence over a nearly continuous time set, and the existence of a large gamut of indigenous client technological tools all pose great audit engagement challenges. Furthermore, most audit entities will have engagement management tools that are expensive and complex and often not tailored to an individual auditor, company or client.

Learning technology on the job

The auditor, owing to the large set of potential indigenous tools, will have to be constantly on a technology learning role. This could also force longer client tenures and could work against auditor rotation programs.

Students need to spend less time memorising the minutiae of standards and procedures and focus more on understanding what they mean. They should know how and where to locate auditing and accounting standards on the internet and through various other sources and how to extract information to formulate integrative knowledge. At this level the student / auditor has enough basic accounting / auditing understanding / facts to knowledgeably search for information, but he is not overloaded with an over abundance of detail. Integrative knowledge uses basic and acquired information to formulate an integration of, for instance, accounting rules, audit evidence and relevant business facts to base judgement.

Objective knowledge – accounting and technology competence

Understanding the underlying technology, or at least its functionality, is an additional necessary skill for future auditors. While they need not be IT professionals, students should know more than basic computer skills. They need to conceptually know what the 'black box' is doing to produce the evidence they are evaluating. This will require a more comprehensive analytics and statistics application. At a minimum,

they should know what types of analytics are used. For example, many CCM procedures are rule-based. Understanding how monitoring of KPI provides insight into functioning controls is a critical skill.

Future auditors should possess the ability to keep up-to-date with the latest tools, and they need to be able to locate sources of information, such as professional association publications. Whether in auditing or accounting information system (AIS) courses, IT audit tools should be identified and implemented into the course instruction, identifying meta-controls, etc.

Basic understanding of technology
Corporate IT encompasses a much wider set than pure PC and telephone / PDA manipulation competences although these are highly related to attitudes vis-à-vis technology adoption and the ability to change. It basically involves a wide set of principles in hardware, software and business applications.

IT audit
This includes a set of audit automation tools and more advanced software aimed at data extraction, manipulation, control evaluation, sampling, exception reporting, separation of duties, fraud detection, etc.

Other audit-related tools
This encompasses software tools that are generic in nature and which are used in the audit. For example, software such as ACL and IDEA (IT audit packages) encompass sophisticated data extraction and statistical facilities. Auditors will often find the need to extract data from an ERP (e.g. some knowledge of SAP and BAAP), use, for example, a statistical analysis system (SAS) to analyse the data and provide the output on a website where audit supporting documents are placed.

Accounting
In general, accounting education in the Now Economy will de-emphasise factual details and emphasise principles and concepts that can be used to retrieve details in databases and knowledge bases that were not available in previous decades.

Certifications
Rather than focusing entirely on professional qualifications such as the Chartered Accountant qualification, students should be shown alternatives and complementary certifications that may more accurately match their interests. Exams provided by these other associations require a similar level of comprehension but may be more relevant. Furthermore, if some of the considerations in this paper are taken to heart the Continuous Assurance / CPA certificate will expand in scope to include IA, fraud examination and information audit certificates.

The role of universities in preparing the Now Economy auditor
Given the rise of Continuous Assurance and the Now Economy, universities have to fundamentally rethink the audit education process. As with all re-engineering projects, the question they have to ask is whether, if they began teaching auditing for the first time today, in the 21st century, would they use the same approach and cover the same topics as the courses they currently have? It is hard to believe that they would answer this question in the affirmative, and while changing coursework is a time consuming affair, it is essential that universities at least begin the process of thinking about the skills, knowledge and attitudes that their graduates will need to thrive in the Now Economy.

Universities will need to change the content of educational offerings and learning methodologies to satisfy learners' forward-looking information educational needs. In general, accounting students are sensitive to their credentialing needs and expect to acquire the necessary knowledge during their university years without needing to take external courses to pass certification exams. Unfortunately, the certification exam delves into minutiae of the standards that are of small value in this age of accessible databases, search engines and archival knowledge. In general there is a basic conflict between the backward-looking nature of accounting standards and education and the forward-looking needs of the accountants of the 21st century.

Knowledge is much deeper and wider than it used to be, it takes longer to acquire and encompasses a much wider scope of quantitative and judgemental structures. While much of the archival knowledge (e.g. codification of lease accounting) can be obtained over the internet, the utilisation of these queries, their efficiency and their availability has to be not only learned but kept current. It requires substantive actualisation and a dynamic learning attitude. In addition, learning of more quantitative techniques and their utilisation cannot be replaced by databases, as good as these may be. The learner must, to a certain degree, understand the analytic technology to be able to formulate the problem and choose key variables (e.g. ratios, variables in a regression, optimisation function). Furthermore, the learner must be able to interpret the obtained results for the good of the client. And while chartered accountants are performing useful functions for their employer they are actually forgetting a large amount of basic knowledge. During these activities they are focusing on current work where they are acquiring a more in-depth and practical knowledge. However, there is a major need for currency in their integrative knowledge.

Like many other fields, education is going through a major process of electronisation (Vasarhelyi & Greenstein, 2003) where computer support of the classroom, distance learning and substantive automation are totally changing the landscape. Finally, the fact that most major accounting firms have extensive internal training that overlaps or supplants what students learned in the universities is an indictment of both the entities and the universities. It wastes social resources and misleads students and faculties in their quest to learn.

The above points lead to some obvious and speculative steps that could be undertaken by universities. With the use of real-time technologies some innovative programs could be developed to actually support the chartered accountant on the job and at the same time provide educational credits and substantive learning. These would be equivalent to the old 'cooperative programs' where students alternate between the job and the university but in this case would be less disruptive and more valuable to the employer. Universities would also have to redesign their curricula with the view that education is a lifelong process and that diplomas and certificates should be revalued if education is not continued. This same issue has implications for professional bodies.

Universities must rapidly improve their technological infrastructure to provide for this educational channel. They must understand that educational content requires substantive investment in development and updating. It is not clear if the university, or publishers, or major accounting firms, or suppliers of software and analytic technology or professional associations have the competitive advantage in developing knowledge packages. However, it is clear that major educational knowledge packages will exist and many educational institutions will become more content deliverers and administrators of the lifelong educational process.

Furthermore, universities must change the nature of their educational staff along the lines of modern knowledge structures. It is not clear that the traditional mix of teaching, research, service and external relationships that is currently required from faculties will make sense in the future. For a university to remain reputable it will have to establish narrow domain competencies that will be superior to others' and will enable it to provide the knowledge for knowledge packages.

Finally, universities should join the business of knowledge consulting where their lifelong learning partners can avail themselves of faculty knowledge to help them in their day-to-day jobs. The separation of the learning stage of life from the professional stage is now artificial. Companies and universities need to create knowledge support partnerships that are fully compensated. These of course would present a feed-forward effect where faculty would be more relevant but probably less independent and forward-looking.

The role of professional bodies in preparing the Now Economy auditor

Professional bodies are a very important element of the mix for progress in the Now Economy. No other type of entity can drive the profession in a more positive way. While the government can enact laws and

regulations that force activity, these rules do not respond well to the needs of the profession and/or for the proper advance of the state-of-the-art of accounting practice. Professional accounting organisations have the pulse of the profession and understand on-the-job needs as well as the shortcomings of instruction and professional knowledge. The following recommendations are closely related to the justifications and recommendations for universities.

First, professional bodies should tighten up and expand their continuous professional education (CPE) efforts and requirements. Education is a lifelong process and it must recognised as such. Furthermore, accountants at different stages of their career should have different CPE requirements and restrictions on what education satisfies a CPE requirement. The body should develop a service of education counselling and direction. Second, professional societies, standard setters, governments and universities must work together on curriculum, certification requirements and learning monitoring efforts. While there may be some competition among these entities the old stovepipes of separate and artificially separated efforts cause substantive harm to society Third, professional societies need to work together with international entities to facilitate the globalisation of accounting and auditing standards and recognise the fact that there will be differences in local practice, local tax considerations and implementation of standards. Finally, on a wider scope, professional bodies should take into consideration the multiple convergences described in the next section where currencies, economies, stock exchanges and standards will converge but not fully merge and will require a nimble professional, above the local specialisation, to help clients in a rapidly changing world. A profession that tightly holds on to its current turf will see this domain shrink into irrelevancy. However, a profession that holds on to the present will tend to keep current gains but shrink towards the future.

The effects of globalisation

Over the last 50 years technology has enabled major advances towards a global economy. Consequently it has set into motion social change, economic re-balancing and an unprecedented degree of cross-country cooperation. However, this phenomenon of ubiquitous consequence has created a wave of challenges to the socio-technical structure of business and corporate policy making.

Friedman[33] has extensively discussed the effects of globalisation and what he calls the flattening of the world. He talks about triple convergence where hardware and software multifunctionality, the availability of a large set of software and infrastructure tools of cooperation, and three billion new people joining the markets (in India, China and Eastern Europe) have substantively changed the way we live. Symbolising these changes are political change (the falling of the Berlin Wall in 1989), change in fund raising and equity markets (Netscape went public in 1995), and structural change he labels 'flatteners' (work flow software, open sourcing, outsourcing and offshoring among several items).

These major structural changes will also drive what we call the 10 major convergences or flatteners of the financial reporting and assurance world. These are discussed in Vasarhelyi and Alles (2009e). To understand these one must place them into the following wider context frames:

- One man gets richer and the other gets poorer; it is a zero sum game
- The eco-system is highly taxed with its exploration
- More technological 'glue' brings all together
- There will be more change in the next 10 years than in the last century.

Financial convergences:

- Financial markets are interlinked and that is good and bad
- Substantial reduction on the number of currencies
- Development of real global stock exchanges
- International Accounting Standards, common but with some differences

---

33 Friedman, T., *The World is Flat*, 2005, Farrar, Strauss & Giroux.

- International Auditing Standards, common and similar
- Workforces will blend across market and countries
- A wider set of assurance products
- Accounting work outsourcing
- Closer to supranational real-time reporting
- A wider set of reporting products?

Friedman's view sees a wider flat world, with double its current economic population working more efficiently and harmoniously through the 21st century with substantial gains in quality of life and longevity for a larger sector of the world. Accountants can have a substantive and positive contribution in this vision. Substantive opportunities for the expansion of scope of services (e.g. carbon audits), size of the economic pie and contributions to the good management of the enterprise (e.g. monitoring) lay ahead for the profession.

The effect of the financial crisis

The subprime market precipitated the most serious crisis in the United States since the Great Depression. But it is hard to characterise this solely as a crisis of the real estate markets. Since the Reagan era[34] an economic bubble has been brewing. Since the 1970s the relationship between the market valuation of companies and the financial reports measuring them has been deteriorating. In simple term this means that financial reports do not explain the value of companies perceived by the markets[35]. Confirming this perception, interviews with financial analysts reveal a much wider examination of information and events and financial analyst reports that are grandly uncorrelated with actual corporate outcomes.

Any shakeup in the dynamics of the situation would have sooner or later burst the bubble. It could have been the subprime or the failure of a large company driving uncontrolled swap betting or a crisis of confidence on some of the intermediate markets.

The initial burst of the bubble created a major misbalance in highly stretched markets. Investment banks at untenable leverage levels (between 30 to 50 to one) would go into negative equity with a bare 2 or 3 per cent decrease in asset values. While the bubble kept growing, the equilibrium was maintained but the bad news created a crisis of confidence melting the intermediate markets. To summarise:

- Freezing of intermediate markets changed the short values of derivative financial assets
- These changes forced ill-capitalised investment banks to dump assets bellow their ongoing value
- Hedge funds and other parallel banking entities had abandoned strict hedging or hedges did not work when counterparties reneged or markets for the hedges did not exist
- Substantive de-leveraging aggravated the lack of credit
- The disappearance of the large US investment houses in the form we know them was a foregone conclusion
- The crisis can be represented by six waves (see Figure 19).

---

34 Paul Krugman, 'Reagan did it', *New York Times, 31 May 2009*,
35 A set of meaningless financial reports makes the value of their assurance dubious for the financial market's purposes. Still these assurances have some value as they assert that the actual entities exist and perform transactions of economic value. Consequently to increase the social value of assurance much of this work has to revert to focusing on essential economic transactions not their meaningless obsolete aggregation.
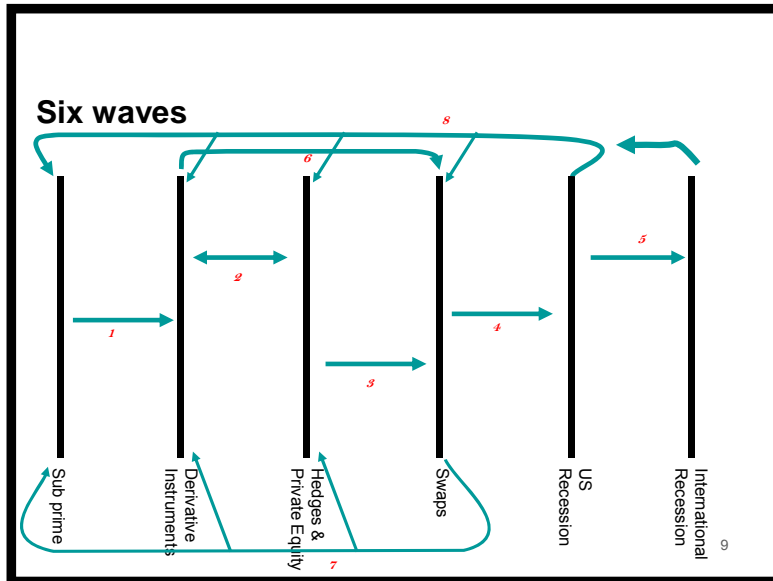
Six waves

Sub prime — Derivative Instruments — Hedges & Private Equity — Swaps — US Recession — International Recession

1 2 3 4 5 6 7 8 9

Figure 19: The cycles of the 'subprime' crisis

Effects of the six waves

Wave 1: Subprime

Over the last two decades interest rates have been low in many countries propitiating a substantial increase in home ownership. Buyers tended to be totally cash-flow oriented and bought what they could afford to pay on a monthly basis. Over the last decade low interest rates allowed higher housing prices to be paid and a separation between loan origination (entity who sells the loan) and loan ownership (entity who carries the loan) created perverse incentives. The incentive to sell loans to those who could not afford it, the incentives by the government to increase home ownership without underlying wealth, and the incentives to the borrowers to buy above their means assumed an eternal growth in real estate values. With or without other factors such as swaps and derivatives eventually this would have led to a crisis. However, any of these three factors (and others) could have been the needle that pricked the bubble.

Wave 2: Derivatives

Once the bubble is pricked all derivative assets that are stretched start giving way and it is only a matter of time before it bursts. The investment banks operating at very high leverages (over 30 times) have very little play when assets decrease in value. The Now Economy just accelerates this factor and 'panic' occurs unless there are 'fire breakers' in place to deal with rapid decreases in value as those instituted in the US stock markets. Real-time monitoring of hedging structures needs to be in place to rapidly detect waves of change and help in the prevention or attenuation of crises.

Wave 3: Hedges and private equity

Hedge funds have become a large part of the 'shadow banking system', largely unregulated and the prime clients of investment banks. Over 20 per cent of these 'shadow bank institutions' have been dissolved or failed but due to their smaller sizes have had less repercussion. If the US government had not stepped in to salvage the swap market and consequently salvage the large investment banks (e.g. Goldman Sachs) the hedge funds would have been even further affected. In general hedge positions work well in well-behaved markets but with catastrophic change hedges are inoperative. While much of accountants' work has involved trying to measure the value of derivative positions and then the hedging

63

strategies, a ~~continuous audit~~ continuous assurance would constantly map hedges and present aggregate positions measured under different scenarios. Purists would say that this is the role of management, but in a world of nanosecond transactions and rapidly changing economics, unless there is some continuous awareness of the matching of positions their actual hedge validity is questionable. A Now Economy will need substantial reigning in of these positions, shaded disclosure of all details of these positions, and rapidly functioning valuation dashboards with many alternative strategies available.

Private equity entities are another part of the 'shadow banking system' that have to be reigned in, placed in substantive disclosure, and subject to new rules of the game. In reality it is very difficult to assure a particular entity if their closely related party (private equity) is not publicly reporting and is privately held. Many European countries apply rules to a much wider set of organisations, many privately held, regarding disclosures. The emerging assurance and reporting environment must be aware of these issues and of the rapid set of regulation changes currently evolving.

Wave 4: Swaps

There are many types of swaps. But in essence, as they are a form of barter transaction where, for example, an insurance company promises to pay another party the value of a bond if it fails, they have been kept out of the recording system. No economic transfer, except fees, occurs in most instances. Consequently this is a later event in most crises as it has to be caused by the original failure of the bond. The value of the swap markets, measured at face value, is in the 40 to 70 trillion dollars range but it cannot really be compared as it is low probability contingency compared with actual GNP numbers or bond being traded. Investors can't tell whether the people selling the swaps – known as counterparties – have the money to honour their promises. This clearly substantive market grew in the shadows and benefited from the difficulties and opacity of measuring and disclosing contracts.

On 8 May 2008 American International Group Inc. wrote down US$9.1 billion on the value of its certificates of deposit holdings. The world's largest insurer by assets sold credit protection on collateralised debt obligations (CDOs) that declined in value. In 2007, New York-based AIG reported US$11.5 billion in write downs on CDO credit default swaps. Ultimately the US government that intervened provided over US$130 billion to AIG in a bid to protect AIG's counterparties including Goldman Sachs and Morgan Stanley.

Once the marked liquidity diminished the probability of likely payout exploded and the US authorities felt obliged to rescue AIG which, in most of its areas, was a solid and profitable entity. Actually, the United States government was rescuing the investment banks that had not failed and their clients the hedge funds. The rapidly unfolding events was a consequence of absolute fear, investors, the government and financial entities not really understanding the reality of the situation. There were no overall maps that could give any of the main entities an aggregate view and an understanding of where the risks really were. If the modern world doesn't want to be the site of frequent and rapid meltdowns, measurement for all entities of their derivative and hedge positions is a must and its disclosure at least to a technologically enabled government must be full. Alternatively, an assured set of disclosure dashboards could be very useful in the monitoring and management of instruments and positions. Unless a real-time dashboarding and analytics framework exists, most likely the current mélange of risk instruments is unsustainable.

Supporting this view, billionaire investor George Soros indicated that a chain reaction of failures in the swaps market could trigger the next global financial crisis. The swap market is unregulated, and there are no public records showing whether sellers have the assets to pay out if a bond defaults.

Wave 5: US recession

The United States moved into recession faster than the rest of the word in an ever increasing spiral. The government, remembering the Great Depression, worked very hard to stimulate the economy but these measures have been slow to take root in basic economic activity. On the other hand, by and large, the measures adopted to restore liquidity and calm the markets have worked and there has been a slow reignition of activity that has progressively slowed job losses and restarted sectors of the economy.

From measurement and assurance views the basic problems have not been addressed. Very much on the contrary the standard setting authorities have been forced into poor regulation by skittish financial markets.

Wave 6: Selective international recession
The interconnectivity of markets, a basis for their increased efficiency, becomes a compounding / accelerating factor. Different countries reacted different ways to the crisis but most of them eventually printed money (a symbolic expression) to stimulate the economy and increase liquidity. Again, even more than in the United States, the basic problems have not been addressed or resolved.

The interesting question is how would a Now Economy technology help in this situation? Clearly socio-technical systems cannot be modelled around technological innovation. Systems, with their human being components, are slow to adapt and follow economic motivation schema.

How can Continuous Assurance and/or continuous monitoring help?

A Continuous Assurance environment can generate a forward looking environment in the following ways:

- By establishing a set of rules requiring all entities to report. Private, public, small, large, government, not-for-profit, all organisations must use their internal measurement tools (accounting packages) to prepare disclosures. Symbolic representation of all economic activity must be developed and to a certain degree monitored and assured.
- The government or audit firms or independent internal auditors must monitor companies close to real time and this will identify and prevent potential problems (i.e. defaults in subprime).
- By using analytic CEs to create linkage.
- By publishing process relationships and forward-looking metrics.
- By considering the other technologies discussed in this monograph.

Transparent monitoring can create additional instability in the markets just like fair value regulations can be blamed for increased instabilities (clearly true but probably desirable in the long term) as it will reduce counterparty opacity and is necessary for long-term regulation and stability. Stabilising mechanisms must also be developed.

While monitoring and assurance can help reduce the size and consequences of bubbles they are not sufficient. Perverse incentives as described next must be reduced:
:
- Loan originators exploiting uneducated consumers. They do not careing if the loans fail as they are not the ones that carry the loan. Once the commission is received the loan becomes the problem of the entity that took it over.

- Derivative instruments that are too complex for client understanding
- Rating agencies being paid directly by the rated entities. If the rating is not good enough the issuer will not issue the title and the rating agency will not get income

- Accounting rules allowing 'off balance sheet entities' where entities may offload obligations for short or long periods of time. Consequently these allow to even further increase the already stretched leverage ratios.
- Fair value valuations precipitating unintended consequences where frozen markets create temporary dramatic price drops … a cooling period with double or triple reporting using different valuation bases would help

The credit crisis has choked off many of the markets that banks in recent years relied on to take assets off their balance sheets. Issuance of mortgage-backed securities has dropped sharply, while demand for more complex instruments such as collateralised debt obligations – packages of loans that have been sliced to create new securities – has dried up completely. Many bankers think it will be months, if not years, before they can start issuing these securities again. If and when they do, investors are bound to demand higher returns than before and are likely to require banks to demonstrate confidence in the

65

securities by keeping a greater proportion to themselves. In short, this means that banks will be forced to fund more of their future loans from their own balance sheet resources. And it also means that Continuous Assurance / Continuous Assurance could have helped but would not have, by any stretch of the imagination, avoided the subprime crisis of 2007/ 2009.

Conclusions

This monograph first introduced an analogy to automotive inspections to stress the need for a fundamental reconstruction of the audit process. Then it defined and conceptualised the main elements of the Now Economy. The main driver towards the Now Economy is the need to reduce the latency within BPs or, in other words, to make the BP faster and more efficient. Any consumption of time costs money in a competitive framework may lead to competitive disadvantage.

A set of views on Continuous Assurance served to build a composite model where continuous data audit is complemented by continuous control monitoring, and a new view that we called continuous risk monitoring and assessment. Practice of the evolutionary audit field, and standard setting entities, will progressively consolidate practices that are experimental today.

The first recorded Continuous Assurance initiative was at AT&T (Vasarhelyi & Halper, 1991) and aimed to assure and monitor a large corporate customer relationship management system. There, high level monitoring of data led to increased system reliability and the detection of faults. Late in the 1990s and early 2000s first the CICA/AICPA and then the IIA issued guidelines on a more continuous audit continuous assurance. Surveys by ACL (a leading audit software vendor) and PriceWaterhouseCoopers indicate that many companies have embraced some form of continuous audit continuous assurance. These definitions of 'continuous audit continuous assurance' are varied but the reality is that few companies are monitoring and assuring their processes in a timely fashion.

Some experiences and some evolving questions

The Siemens effort described earlier is a leading edge experiment to expand the frame of Continuous Assurance. This effort is mainly aimed at assurance of large ERPs and their portion of audit automation. For this purpose the definition of Continuous Assurance was expanded to include CCM. ERPs encompass a large number of configurable and controls which may be active or inactive at a certain point in time. The Siemens project proposes a methodology to monitor and evaluate through base lining the actual configuration of controls day by day. The second part of the Siemens project allowed for a wider evaluation of automation of Siemens' Audit Action Sheets and led to the conclusion that about 68 per cent of the actions could be automated. Consequently instead of an 18- to 24-month cycle of internal audit evaluation of an SAP facility, daily, weekly and monthly evidence could be gathered automatically and fed to an audit evidence assessment mechanism. This rebalancing of audit evidence leads to the need to re-engineer the assurance function. Furthermore, the Siemens work raises interesting questions that must eventually be addressed. First, the current set of prescribed audit evidence is surely anachronistic. What is the type of evidence of the audit of the future? Second, the audit of the future can be heavily performed by automated means. Of the Siemens' audit actions only 32 per cent could not be automated and the others would be provided automatically and frequently. In question was the need of the residual 32 per cent, very often about existence of documentation, the execution of certain processes, the nature of certain facilities, etc. This type of 'soft' evidence, often just of perfunctory performance in traditional audits, may potentially be replaced or eliminated in the future. The question that arises is what evidence would be required in a new audit, of highly automated systems, if a new audit methodology is designed from scratch? Third, auditor presence, and the rituals of the repetitive audit, is clearly a deterrent for fraud and a mechanism whereby organisations increase data integrity. What are the effects of a (visible or invisible) remote audit?

The modelling work performed at HCA (Vasarhelyi et al., 2004) modelled the supply chain of a major health organisation and aimed to improve the state-of-the-art in establishing the baseline against which to

compare real-time data. Experience has shown that using static budget or estimates does not provide adequate comparison models. Consequently if we use sophisticated real-time data flows, we also need to improve the models against which we compare these streams of data. These models must incorporate provisions to account for seasonality, details in the value chain, special events and the inherent time delays in the process. Questions raised in this work include:

- Should monitoring be performed and at what level of aggregation? At the financial statement account level, at the general ledger level or at the individual transaction level?
- What kinds of faults do we find in streams of data? How can they be classified? How do these faults relate to weaknesses in internal controls?
- What are the intrinsic latencies in the value chain? How does one model the value chain integrating these latencies? For example, in average it takes 17 days to receive a delivery, three days to post a receivable, 29 days on average to collect a receivable (50 per cent of events), and 60 days to collect (25 per cent of events), etc.
- Can we automatically correct transactions that are estimated to be in error?

Several of the Itau Unibanco steps towards Continuous Assurance have helped understand the future of audit. The bank, as described above, created a monitoring of mechanism for its more than 1400 branches. Furthermore, it created a set of filters that brought up alarms in the areas of human resources, branch management, credit, etc. In its Continuous Assurance effort the bank proposed 56 potential Continuous Assurance projects, ranked these projects and made selections on their priority based on management perceptions for needs, the bank's corporate culture and expediency considerations. The 'low hanging fruit' approach, whereby the easiest projects take priority ahead of larger and more complex efforts, was considered vital. These efforts provide learning and questions related to continuous assurance including:.

- Auditor presence could be enhanced by constant monitoring (as at Itau-Unibanco) to replace the more extended presence of the auditor in the engagement. Itau-Unibanco replaced 160 audit hours annually for a 40-hour surprise audit driven by continuous monitoring-driven alerts, and a system of KPIs. What is the ideal mix of audit presence, remote human-manned auditing and automated auditing?
- This experience clearly indicates that Continuous Assurance can be applied across many areas of organisations. Also, the experience seems to indicate that banks and other financial organisations are particularly good potential ~~continuous audit~~ continuous assurance users as their main product is easily abscondable cash. What are the areas of non-financial institutions that will become the best targets for continuous assurance?

Itau Unibanco chose to examine and monitor transitory accounts (Kim et al., 2009) in order to decrease their transaction risk and to create an infrastructure of enhanced data assurance. For this purpose it created an audit structure of four levels which encompassed: 1) analytical account review; 2) real-time monitoring for key events at the mainframe level; 3) detailed analysis of high risk accounts at daily cycles; and 4) business modelling of critical accounts using CE (Alles et al., 2010) analytic technology. At the same time Itau Unibanco hired IBM to create the necessary infrastructure to support these analytical processes, migrate the earlier mentioned branch monitoring and create the necessary audit dashboard for alarm and ~~continuous audit~~ continuous assurance management.

The Itau-Unibanco effort raises a series of important questions:

- What should be the methodology to choose Continuous Assurance applications?
- How should these be assigned priorities?
- What processes are to be monitored online, at the mainframe level, and at what level of detail?
- What is the depth of detail that account filters are to be developed to extract fallacious transactions? How does one make decisions at thresholds of filtering levels that would result in trading off false positives for false negatives?

- How should a Continuous Assurance dashboard be designed? Should the focus be on financial statements, processes or on particular variables, events, etc?

Understanding some Continuous Assurance realities

The above discussion and examples of Continuous Assurance at several organisations indicate some commonalities that should serve as additional guidelines to establish a ~~continuous audit~~ continuous assurance effort. Our predictions include:

- Traditional auditing will give way to a progressive form of close to the event auditing without the need for special regulation. However, first professional organisations and then governments will need to identify the need for this and issue guidelines for a kit of progressively real-time assurance procedures
- Organisations must look in the domain of their processes to applications that are time sensitive and have material effects on their financial statements.
- Organisations must balance application choices between their importance and ease of implementation.
- Continuous Assurance implementation will happen over a range of companies but initially to companies that are highly sensitive to environmental change, have very liquid assets or must for legal reasons show high control in processes.
- Financial organisations and corporate financial processes will have early priority but over time most industries will evolve towards real-time control and assurance basically to reduce latency and to improve data / product quality.
- Advances in IT must be matched by advances in analytic modelling to bring Continuous Assurance to its full maturity.
- The advent of XML, XBRL and other interoperability standards will accelerate Continuous Assurance and will allow for cooperative inter-organisational assurance processes. For example, a company and its banks will have automatic verification (confirmation) procedures for transactions and account balances. These will be established and regulated at the contractual date and follow eventually promulgated database-to-database confirmation standards.
- The academic community has led the thinking in CA, and a small industry of software to support ~~continuous audit~~ continuous assurance has emerged. While external auditors have been very supportive of CA's development it is the IA community that can invest in systems in loco, which is driving the development of CA.
- While many of the Continuous Assurance solutions at large organisations will be ad hoc, it will take the integration of Continuous Assurance facilities in integrated software (ERPs) that will allow some of the benefits to flow to smaller organisations.

Further reading

ACL / Institute of Internal Auditors. 2006. *New Demands, New Priorities: The Evolving Role of Internal Audit*, The Institute of Inernal Auditors, Vancouver, Canada.

Alles, M.A., A. Kogan, and M.A. Vasarhelyi. 2002. Feasibility and economics of continuous assurance. *Auditing: A Journal of Practice and Theory* 21 (1): 125-138.

Alles, M.A., G. Brennan, A. Kogan, and M.A. Vasarhelyi. 2006. Continuous monitoring of business process controls: A pilot implementation of a continuous auditing system at Siemens. *International Journal of Accounting Information Systems* (June): 137-161.

Alles, M.A., A. Kogan, M.A. Vasarhelyi, and J. Wu. 2010. Continuous data level auditing using continuity equations. *Working paper*, Rutgers Business School.

Baldwin-Morgan, A. 1993. The impact of expert system audit tools on auditing firms in the year 2001: A Delphi investigation. *Journal of Information Systems* 7, (1) (Spring 93): 16-34.

Bovee, M., A. Kogan, K. Nelson, R.P. Srivastava, and M.A. Vasarhelyi. 2005. Financial reporting and auditing agent with net knowledge (FRAANK) and Extensible Business Reporting Language (XBRL). *Journal of Information Systems* 19 (1): 19-41.

Brancheau, J.C., B.D. Janz, and J.C. Wetherbe. 1996. Key issues in Information Systems Management: 1994-95 SIM Delphi results. *MIS Quarterly* 20 (2) (06): 225-42.

Brown, C.E., J.A. Wong, and A.A. Baldwin. 2007. A review and analysis of the existing research streams in Continuous Auditing. *Journal of Emerging Technologies in Accounting*, 4 (1): 1-28.

Burg, Harm Jan van. 2009. Advantages of the cross domain standardization of financial data: Standard Business Reporting in the Netherlands, Update March 2009, Standard Business Reporting Programme NL.

CICA/AICPA. 1999. *Continuous Auditing*. Research Report, Toronto, Canada: The Canadian Institute of Chartered Accountants.

Davenport, T.H., and J.E. Short. 1990. The new industrial engineering: Information technology and business process redesign. *Sloan Management Review*, 11-27, Summer.

Debreceny, R.S., G.L. Gray, J.J.-J. Ng, K.S.-P. Lee, and W.-F. Yau. 2005. Embedded audit modules in Enterprise Resource Planning Systems: Implementation and functionality. *Journal of Information Systems*, 19, (2) (Fall), 7-27.

Elliott, R. 1997. Assurance service opportunities: Implications for academia. *Accounting Horizons* 11 (4): 61-74.

Elliott, R. 2002. 21st century assurance. *Auditing: A Journal of Practice and Theory* 21 (Spring): 129-46.

Fingar, P. and J. Bellini. 2004. *The Real Time Enterprise*. Tampa, Florida: Meghan Kiffer Press.

Kim, Y.B., C.E. Aquino, W.L. Silva, and M.A. Vasarhelyi. 2009. An architecture to manage and continuous audit a complex set of transitory bank accounts. *Working Paper*, CarLab.

Mock, T. J., G. Holtrum, and R.N. West.1988. *The Impact of Technology on Auditing: Moving Into the 21st Century*. Research monograph, Institute of Internal Auditors Research Foundation.

Parente´, F.J., J.K. Anderson, P. Myers, and T. O'Brien. 1984. Validity of judgment in forecasting. *International Journal of Forecasting* 12: 1-8.

PricewaterhouseCoopers LLP. 2002. *Internal Audit at a Crossroads: Leveraging Opportunities in the Post-Enron Era*. PricewaterhouseCoopers LLP: New York.

Rezaee, A., R. Elam, and A. Sharbatoghlie. 2002. Continuous auditing: Building automated auditing capability. *Auditing: A Journal of Practice and Theory* 21 (Spring): 147-163.

Rowe, G., and G. Wright. 1999. The Delphi technique as a forecasting tool: Issues and analysis. *International Journal of Forecasting* 15 (4) (10): 353-75.

Sikka, P. 2009. Financial crisis and the silence of the auditors. *Accounting, Organizations and Society*, doi:10.1016/j.aos.2009.01.004.

Teeter, R.A., G. Brennan, M.G. Alles, and M.A. Vasarhelyi. 2008. Aiding the audit: Using the IT audit as a springboard for Continuous Controls Monitoring. *Working paper*, CarLab, Rutgers Business School.

The Economist. 2002. 'The real time economy', 31 January.

The Institute of Internal auditors, Continuous Auditing: Implications for Assurance, Monitoring, and Risk Assessment, GTAG # 3, Altamonte Springs, Florida, 2005.

Thomas, C. W. 2004. An inventory of support materials for teaching ethics in the post-Enron era. *Issues in Accounting Education* 19 (1) (02): 27-52.

Vasarhelyi, M.A., and D. Lombardi. 2010. The future of audit: A Modified Delphi Approach, *Working paper*, Rutgers Accounting Research Center.

Vasarhelyi, M.A., A. Kogan, M.G. Alles, and D.J. Warren D. 2009a. Audit automation as the foundation to continuous auditing. *Working paper*, Rutgers Accounting Research Center, Rutgers Business School.

Vasarhelyi, M. 2009b. Illustrations of real time economy business applications. *Working paper*, Rutgers Accounting Research Center, Rutgers Business School.

Vasarhelyi, M. and S. Kuenkaikaew. 2009c. Continuous Auditing and Continuous Control Monitoring: Case studies from leading organizations. *Working paper*, Rutgers Accounting Research Center, Rutgers Business School.

Vasarhelyi, M.A., A. Kogan, M.G. Alles, and R.A. Teeter. 2009d. Audit automation. *Working paper*, Rutgers Accounting Research Center, Rutgers Business School.

Vasarhelyi, M.A., R.A. Teeter, and J.P. Krahel. 2009e. Audit education and the Now Economy. *Working paper*, Rutgers Accounting Research Center, Rutgers Business School.

Vasarhelyi, M.A., Carlos Elder Maciel De Aquino, and Washington Lopes Da Silva. 2008. On the road to Continuous Auditing. *Internal Auditor.* August: 27-29.

Vasarhelyi, M.A., Carlos Elder Maciel De Aquino, Nilton Sigolo, and Washington Lopes Da Silva. 2008. Six steps to an effective Continuous Audit process. *The Tech Forum, Institute of Internal Auditors.* July.

Vasarhelyi, M.A., M.A. Alles, and A. Kogan. 2004. Principles of analytic monitoring for continuous assurance. *Journal of Emerging Technologies in Accounting* 1: 1-21.

Vasarhelyi, M.A and M.L. Greenstein. 2003. Underlying principles of the electronization of business: A research agend*a. International Journal of Accounting Information Systems* (March): 1-25.

Vasarhelyi, M.A. and F. Halper. 1991. The continuous audit of online systems. *Auditing: A Journal of Practice and Theory* 10 (1): 110-125.

Wiseman, C. 1988. *Strategic Information Sy*stems. Richard D. Irwin, Homewood IL.