Towards an Intelligent Audit: online reporting, online audit, and other assurance services

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Abstract

This paper examines the evolving scenarios of data processing, networking, financial reporting, assurance services and electronic commerce. Integrating some of these points it advocates a view of atomistic progressive intelligence in systems. This view uses new technologies, and an aggregation of simple and more complex algorithms to provide some form of intelligence.

Within this scope it proposes a series of new views on corporate reporting and assurance within the focus of the basic intelligence function and increasing complexity of data rich and overlaid processes.

Introduction

Over the last five years we have witnessed critical change in technology and financial practices that will substantively change our view-of-the-world. While technological change does not per-se change financial practices and the need for verification, some forms of technological evolution require changes in audit processes. Technological tools create, change, and eliminate audit risks and opportunities, from very pedestrian issues to complex new audit exposures. Most of all new technological capabilities change the feasibility of certain reporting practices and the ensuing cost x benefit tradeoffs.

Prawitt and Romney[i] state a series of new and increased risks evolving from emerging business technologies. These are listed in Table 1.

Insert Table 1 here

Some of these risks are old risks with new facades (2, 3, 6, 7, 10, 11, 12, 13, 16) and others are a direct product of new types of services and environments (4, 5, 8, 9, 14, 15). Clearly however, the nature of the risks is changing and the need for new methods and technologies in security, reporting, and auditing are arising.

While practice has been slow to understand these changes the leadership of the accounting profession has started a major process of reconsideration of the assurance process. The Elliott Committee[ii] has issued its report and created a series of task forces to

define needed change and to accelerate this process. Its emphasis in the early stages is six task forces[iii] to focus on: Risk Assessment, Business Performance Measurement, Information Systems Reliability, Electronic Commerce, Health Care Performance Measurement, ElderCare Plus and other opportunities (seven other assurance services were described and over hundred other opportunities mentioned).

Next section examines changes in the scenarios of technology and financial practices leading to the ensuing sections that focus on intelligence in data processing and financial systems.

The State of the Art

Computer Technology

Over the last fifteen years we have witnessed major changes in the data processing environment. Overall we witnessed a phenomenon where cycles became worthless by itself and storage cost went down in a trajectory similar to dollars per cycle. Consequently we observed a migration of many manual office function to data processing and the progressive inclusion of the desktop into the corporate data processing cycle.

Furthermore, a more remarkable feature of the evolution of data processing is the democratization of applications. A mainly mainframed world mutated into a hybrid of mainframe and workstation-based world. Consequent of this democratization many

manual processes became semi-automated with many data processes performed at the desktop with the inherent strengths and frailties of PC-based processes.

This migration has transported the locus of corporate knowledge in direction of the desktop, creating semi-intelligent processes on the desktop and formalizing knowledge structures at this level.

Networking Capabilities

The corporate information processing scenario has not been so much revolutionized since the introduction of the PCs in the early 1980s. Internet based processes are changing business processes faster and more radically than the introduction of PCs did. The tcp/ip protocol while simple in nature provided a platform for network intelligence that allows progressive distribution of processes over a common set of communication arteries. This structure expanded the paradigm of distributed computing into a paradigm of common-shared communication network for corporate processes and processes of cooperating business entities.

A very important phenomenon is the emergence of Intranets and Extranets in the corporate environment. While internal corporate networks have been in existence for nearly two decades they basically were build around applications and as a fringe benefit provided some voice and data communications for users. The emergence of the tcp/ip world brought a degree of linkage prior unknown within the corporation. Aggregate

information, often only assembled manually or later in corporate PCs now can be made available company-wide and placed in corporate directories of information resources. Consequently, while corporate cultures change, their Intranets change the balance of power and dissemination of information. Of major importance in the financial world is the emergence of Intranet-based financial services from the raw data preparation function (e.g. online preparation of vouchers) to report dissemination and selective disclosure of aggregate proprietary data.

Extranets, where a firm selectively shares its data with outside audiences (such as volume suppliers, distribution networks, and maybe certain shareholders) change further the scenario of corporate data dissemination. For example J.C. Penney has opened their inventory applications over an Extranet to over 3000 of their distributors and large clients. This process, prior only possible through proprietary EDI networks, now became possible to a wide audience of customers. This clearly opens the doors of substantive competitive information to third parties and indubitably will allow for new information to reach the markets. The benefits however, improving information to customers, provisioning, and logistics now change the cost x benefit tradeoffs of this disclosure.

Extranets and reengineering also provide a step towards new views of corporate applications. For example one company's accounts payable is other company's receivables, one company's inventories provision other firm's JIT production processes, many companies supply chains feed a single process of major manufacturers. It is likely that companies will progressively share applications and draw their reports from different

views of the same relational database or replicated versions of the same table. It is even conceivable that some applications will be pooled commodities, where many firms share facilities, data structures and report types with transactions packetized over the public /private network and processed by a common utility.

Consequently, we are finding increasing levels of embedded intelligence in the communications infrastructure leading to re-balance the tradeoffs between processing, communication and application processes.

Financial Reporting

While change has been very rapid in data processing and networking, change in the financial reporting world has been slow. Corporations are progressively using the World Wide Web and other electronic media to divulge their traditional disclosures but the essence of these disclosures (and information therein) has not changed very much. This reticence to change can be mainly explained by statutory requirements and litigation risk avoidance by corporations.

On the other hand internal corporate information in changing in nature. Several processes that traditionally were batch processes gathered together at reporting time are turning into online real time applications, to support and improve on business activities. For example most large firms now keep their cash management applications close to online as they need to invest overnight their floats. They also keep close track of payables to be able to take advantage of discounts and to respond to questions by suppliers. Just-In-time (JIT)

production processes require updated work in process, inventory and production level information to survive. All these could be provided online to third parties thorough Extranets, and in different industries and circumstances this is a reality.

The natural question that arises is the value of providing this information to stockholders through online-real time reporting, or the appropriateness of selective disclosure to third parties. If information is just disclosed to selected parties, with need to know or shared purposes, it is just a question of time that information aggregating entities would be created to provide this information to the market. Also, litigation relative of the fairness of selective disclosure a wider issue than inside trading will arise.

Furthermore, while extant practices present a static unique model of financial reporting for outsiders, corporate communication with stock analysis, news pieces, investigative reporting pieces, and others present an expanded information set.

It is probable that corporations will eventually start to sell additional information about themselves, and intelligent information disclosure products will arise. Some of these issues are discussed later in this paper.

Auditing / Assurance Services

Accountants are focusing on expanding their roles in assurance and other areas. Elliott and Pallais[iv] state:

> "The special committee found clear evidence that financial statement audits are a mature product. Accounting and auditing revenue, adjusted for inflation, has remained flat for the last seven years. The traditional audit of financial statements adds value to both users and clients, is widely appreciated for its effect on the integrity of the capital markets, contributes to the CPA's reputation for objectivity and integrity and will continue to be in demand in the future. But the greatest opportunity for growth lies in assurance services. …. The need for information services is exploding and in those needs lie opportunities for the CPA profession. The core benefit of the audit-attest tradition – information improvement – provides a foundation for new value-added services" (p. 47)

They continue by stating three major effects that support their view:

- decision –making in progressively and increasingly based on "knowledge work"

- information technology I radically changing the availability and type of information

- accountability is playing an increasing role in social, economic, and political life

This scenario is rapidly emerging as a strong motivation. The AICPA has moved with unusual speed in setting up task forces to propose and advocate this new set of products.

While the focus has been on an enhanced set of assurance services, much thought will continue in changes in the reporting process and the consequent assurance processes.

Six major products were emphasized:

Risk Assessment

Entities are subjected to greater risks and more precipitous changes in fortune than ever before. Managers and investors are concerned about whether entities have identified the full scope of these risks and taken precautions to mitigate them. This service assures that an entity's profile of business risks is comprehensive and evaluates whether the entity has appropriate systems in place to effectively manage those risks.

This product reflects the progressive distancing of the audit profession from detail testing and the increased focus on analytical review and risk assessment.

Business Performance Measurement

Investors and managers demand a more comprehensive information base than just financial statements; they need a "balanced scorecard." This service evaluates whether an entity's performance measurement system contains relevant and reliable measures for assessing the degree to which

the entity's goals and objectives are achieved or how its performance compares to its competitors.

Information Systems Reliability

Managers and other employees are more dependent on good information than ever and are increasingly demanding it on-line. It must be right in real time. The focus must be on systems that are reliable by design, not correcting the data after the fact. This service assesses whether an entity's internal information systems (financial and non-financial) provide reliable information for operating and financial decisions.

This product reflects the progressive preoccupation of auditors with the very fast turnover of certain processes and exposures due to system integration.

Electronic Commerce

The growth of electronic commerce has been retarded by a lack of confidence in the systems. This service assesses whether systems and tools used in electronic commerce provide appropriate data integrity, security, privacy, and reliability.

In mid September 1997 the AICPA stepped in virgin territory by proposing ***WebTrust*** *a seal of assurance by the auditor on the Web site. As part of this paradigm change auditors would have some continuing review*

obligations in relation of the maintenance of the seal. Three principles were focused on the initial announcement: business practice disclosure, transaction integrity, and information protection.

Health Care Performance Measurement

The motivations in the $1 trillion health care industry have flipped 180 degrees in the last few years. The old system (fee for service) rewarded those who delivered the most services; the new system (managed care) rewards those who deliver the fewest services. As a result, health-care recipients and their employers are increasingly concerned about the quality and availability of health care services. This service provides assurance about the effectiveness of health care services provided by HMOs, hospitals, doctors, and other providers.

ElderCare Plus

Older Americans prefer to live independently in their own homes. But as their capabilities decline, they require an increasingly broad range of services to do so. They and their loved ones are concerned about the comprehensiveness and quality of these services. ElderCare Plus assesses whether specified goals regarding care for the elderly are being met by various care givers.

Other Opportunities

Seven other assurance services are described in a common format dealing with the source of demand for the services, the benefits to users, the market potential for CPAs, and the competencies required. (**Comments in Italics added to the AICPA text**)

Electronic Commerce

Kalakota and Whinston[v] define *electronic commerce* as " .. a modern business methodology that addresses the needs of organizations, merchants, and consumers to cut costs while improving the quality of goods and services and increasing the speed of service delivery. The term also applies to the use of computer networks to search and retrieve information in support if human and corporate decision making."

They expand the concept by stating ".. e-commerce is associated with the buying and selling of information, products , and services via computer networks today and in the future via any one of the myriad of networks that make up the Information Superhighway (I-way)."

More encompassing is the view that e-commerce is an expansion of traditional commerce, using electronically enhanced means and where eventually a large portion of business processes will be performed. Kogan, Sudit & Vasarhelyi[vi] expand the basic view of e-commerce focusing on the value added elements of e-commerce in the value chain.

> "While technology is important to integration, human resources are indispensable. Electronic Commerce principles require co-workers, customers, and even former competitors to work together to solve problems, improve services, create new products, and pursue new markets. The essence of Electronic Commerce is data continuity, which is the concept of having data created, modified, and saved in such a way that it can be used throughout the life cycle of a manufactured product, as well as through the value chain[vii] of complementary products. The understanding of the value chain, and the increased connectivity of the value chain facilitated by inter-networking can provide substantive competitive advantage. **Error! Reference source not found.** displays a visualization of how the value chain can benefit from partners sharing Intranets, the corporation with its own Intranet, and the buyers from access through the Internet." (p.127)

Insert Figure 1 here

Error! Reference source not found. stresses the role of the Internet in the value chain as a tool of infrastructure as well as a direct tool in the corporation's primary activities. Figure 2 explains the progressive role of the electronic infrastructure in corporate processes.

Insert Figure 2 here

The WWW greatly facilitated the growth of electronic commerce (EC) over the Internet by bringing point-and-click usage and a simple publishing language (HTML) to the Internet, so that millions of users with only basic computer literacy could conduct business on the Internet easily and with low cost. But more interestingly, while e-commerce is often mentioned as an entity it is its progressive invasion of components of traditional commerce that will make most of *traditional commerce* become *e-commerce*. This phenomenon that we define as *progressive electronization* of commerce components.

For example, e-care (a mix of e-mail, VRS, Web support, and traditional care) is evolving to be a major efficiency in the support of advanced technological products and services, in particular when a physical storefront can not be placed next to the client. Furthermore, in certain cases, such as the support of software it is also less expensive and more practical. We will find progressive companies adopting e-care even in traditional processes like the location of express mail packages, balances of checking accounts, etc. Also, ubiquitous EDI (common carrier general protocol EDI , or enhanced-EDI) will clearly be a mode of transaction distribution that will supplant rapidly paper form based processes. With our progressive learning about improved ways of providing e-care this

will not be an option any more but a competitive necessity where companies will have to use it to be competitive.

The same line of thinking will be applicable to the many aspects of electronic processes which in the case of bitable[viii] (not hard goods) products or commodities (in the e-commerce sense) prevail over the entire commerce process. Furthermore, the links between the product cycles, and the processes themselves will undergo a process of *progressive intelligence* whereby pieces of intelligence will be inserted to improve and expand processes. This view of *progressive intelligence* in the modules and linkages of business processes is the core of the ensuing discussion.

A New View of Intelligent Systems

Vasarhelyi[ix] modified Dreyfus schema to classify traditional Artificial Intelligence (**AI**) work into four main areas: game playing, problem solving, language translation, and pattern recognition. In the early sixties Feigenbaum reoriented the work in AI by focusing not on basic paradigms and pure logical development but on the identification and formalization of human expertise often represented in the form of software systems. This led to the area of Expert Systems (**ES**) which became one of the five[x] main areas of AI. These areas are: Natural Languages, Expert Systems, Cognition and Learning, Computer Vision and Automatic Deduction. Expert Systems became the most popular area of AI and eventually the basis of many commercial, semi-commercial and prototype systems. The financial and accounting area became a major field of application[xi]. Expert systems are often built around architectures encompassing the elements displayed in Figure 3.

Comment [U1]: Insert Dreyfus reference here.

Comment [U2]: Insert Feingenbaum's series in AI reference.

Insert Figure 3 here

While traditional expert systems encompassed extensive data gathering and preparation the knowledge acquisition system can double in the performance of other functions. Let us imagine the development of a dynamic workpaper structure whereby, a la Executive Information Systems, particular data fields and structures are tied to specific audit tests and procedures like reconciliation, transaction tracing and relationships to other fields of data. Facts necessary for a rule-based system would be progressively gathered and kept as part of the knowledge base.

The Continuous Process Audit System (**CPAS**) system [xii] [xiii] displayed in Figure 5 was designed as an alternative methodology to discrete year-end audits. It focused on the need for constant surveillance of large distributed data systems that in this case collected paperless information from telephone switches for telephone billing purposes. The system, gathered information from client (monitored) systems simply by receiving through telecommunications links copies of management reports of the different modules of the biller. This information was scanned and pattern recognized electronically and data extracted to be placed in a relational database. Each of these **metrics**, initially identified by knowledge engineering of the systems and heuristics gathering from systems experts, was stored and used in the form of **analytics** relative to the system. Analytics could be complex relationship between metrics that represented the flows of the system, to simple comparisons with standards for a particular variable and **standards of acceptable**

variance for that process. If metrics differed from standards plus allowable variances **alarms** would be fired to warn of systems irregularities.

Insert Figure 4 here

The CPAS system consequently used a large number of embedded heuristics, logical relationships, and simple computations to ascertain the quality of the process being monitored. The CPAS systems did not have the classic characteristics of an expert system, however it possessed many of its main elements, some learning (not automatic but part of the process) ability, and some degree of intelligence.

Let us now return to the 'dynamic working paper' example being viewed as a Internet-based type of CPAS where basic metrics, annotations, and supporting electronic documents, in a standardized format are used as knowledge classification tools. Consequently a database of corporate process descriptions, actuals from transaction summaries, rules of integrity, standards for processes and a progressive database relating symptoms and problems can be constructed.

This 'dynamic working paper' (**DWP**) now has the characteristics of a knowledge acquisition system, its documentation has the basis for an explanation system, and its cells has actual data to drive the system. Progressive usage and indexing of the DWP will provide a basis for monitoring and alarming the system a la CPAS. Continuing the reasoning two other capabilities may be of great use to a system of this type. Improved

diagnostic ability in process problems and the ability of relating certain variable cues to actual potential outcomes of the system.

These two capabilities, with the data enriched environment can be provided by technologies like Case Based Reasoning and Neural Networks. This fictitious example attempts to demonstrate the argument for progressive intelligence to be embedded in systems. The key argument is that just the provisioning of 'intelligence atoms' encompassing simple items as key ratios, standards, relationships, reconciliation equations and giving them capabilities together with networks and databases provides some degree of intelligence, even if not such in traditional terms. This same infrastructure can be enhanced by other analytical tools, based on a wider set of data, and use a more traditional AI toolset. This view of progressive intelligence with basic nodes of competence (atoms) is not unlike Minsky's[xiv] agents, structures, frames of attention, hierarchies, heterarchies, etc.

Emerging Enabling Services

The roles of financial and managerial accountants are merging rapidly. There is increasing concern for non-financial data in corporate measurement and accountants will progressively position themselves as **corporate measurement specialists** as opposed to financial measurement specialists. Many cues and comprehension of business performance are going to emerge from non-dollar (or yen) measures but by the correlation of say human resources data and production.

- permission by organizations of limited access by certain parties to corporate databases
- progressive availability of corporate reports of non-financial nature
- changing role of 'independence' in attestation

The increasing speed, larger integration, and electronic nature of many business processes make traditional financial statements to have much lesser a value than in the past. This more likely will lead to:

- financial statement of alternate formats
- financial statements of incremental nature, being sold as a commodity, but available for purchase by anyone
- continuous financial statements disclosing certain fields of data to the last minute
- some safe harbor ruling must be issued to shelter businesses from litigation due to increased information disclosure

Progressive Levels of Intelligence

With the development of systems of increasing complexity, based on simple intelligent features, rich databases and network access we will eventually see software agents (not

unlike Minsky's agents) increasingly intelligent as explained by Sareen & Vasarhelyi[xv] for fraud detection.

A set of simple tools could be developed to:

- find documents without electronic signatures
- flag transactions from a particular (suspect) account
- identify foreign transfers larger than US $10,000
- identify transactions of repetitive nature and very small dollar impact (salami technique fraud)
- random sample for manual audit

These tools could be linked to a higher level of intelligence analytic engine that would:

- link master files to transaction files and identify unusual patterns
- flag accounts with market potential
- offer services/products to clients with unusually low turnover related to their regular pattern
- agent for the entity with customer's buying agents

These tools could be linked to an even higher level of intelligence analytic engine that would:

- create a program of “audit by exception”
- negotiate with suppliers and banks for automatic confirmations
- issue system assurance certificates based on indices of financial performance and control measurements a la “continuous control monitoring”
- perform accounting services for third parties at the same system that performs such internally
- perform joint accounting for joint processes of a supplier and its dowstream corespondent

These tools could be linked to an even higher level of intelligence analytic engine that would:

- issue audit attestation to systems and clients
- resolve issues with discrepancies in confirmations
- issue automatic consolidated statements

Consequently, intelligence in financial systems can be viewed as a pyramid of increasingly complex services that can be mounted one on the top of another. While a generic model can be built of an hierarchy of agentiation, different industries, cost structures, needs, states of development of systems, security, and corporate cultures will inevitably develop focuses and heterogeneities.

Opportunities for Research

The increasingly rapid change on the pace of technological change creates new and urgent needs for research. On the area of basic research questions arise concerning:

- areas of attestation that can provide new potential domains of CPA action
- acceptance and methods developed for the new assurance services
- audit problems generated by new technologies
- cognitive and decision effects of continuous information provisioning

On a more applied oriented frame we find among many:

- information structures for continuous financial reporting. The structures for continuous reporting balance sheets, income statements, and other new types of financial accounting reports
- reporting agents adequate for particular decision functions

- stochastic measurements for information systems reliability

- measurements of the system development process and the quality of resulting systems

- accounting methods and measures focused for electronic commerce

- methods for the performance of remote accounting services over the Internet

- indicators of fraud for “black box” transaction auditing

- taxation methods over the Internet facilitated value chain

These potential research topics are just a few of the wide set of needs generated by the advancement of technology and its application to business measurement processes.

Conclusions

A new set of contingencies is emerging in the arena of technology and financial reporting that is changing needs, importance of tools, and tradeoffs between different countervailing motivations. Many of these technological tools allow for very powerful functionality to emerge from some rather basic algorithms and functions. Consequently, intelligent systems can be built with basic atoms of intelligence and increasing

functionality. Furthermore, their construction is much less risky and costly than their older counterparts.

Researchers in the accounting and financial areas should aims to further understand the future impact of more timely reporting, different forms of reporting, non-financial reporting, new attestation services, and other problems of attestation arising from more difficult technologies to audit. Substantive attention should be given to the potential development of simpler systems that progressively compound intelligence.**

[i] Prawitt, D. F. & Romney, M. B., "Emerging Business Technologies," **Internal Auditor,** February 1997, pp.25-32.

[ii] http://www.aicpa.org/assurance/.

[iii] the Committee developed business plans for six assurance services with potential revenues of over $1 billion each.

[iv] Elliott, R.K. and Pallais, D. M., "Are you Ready for New Assurance Services?', **Journal of Accountancy,** June 1997, pp. 47-51.

[v] Kalakota, R. & Whinston, A. B., **Frontiers of Electronic Commerce**, Addison Wesley Publishing Co., 1996.

[vi] Kogan, A., Sudit E. F. & Vasarhelyi, M. A. , **The Internet Guide for Accountants**, Prentice Hall, Upper Saddle River, NJ, 1998.

[vii] Michael E. Porter & Victor E. Millar, "How Information Gives You Competitive Advantage," HBR, July-August 1985.

[viii] See Kogan et. All, Op. Cit. p. 125 for a discussion of bitable and non-bitable goods and well as the routes of commodization of an item.

[ix] Vasarhelyi, M. A. "**Expert Systems in Accounting and Auditing,"** in Artificial Intelligence in Accounting and Auditing, Vol. 1 (M. A. Vasarhelyi ed.), Markus wiener Publishing Inc., New York, 1989.

[x] Vasarhelyi, op. Cit. 1989, p. xv.

[xi] See Vasarhelyi op. cit 1989, and the subsequent Vols. 2, 3 (1993) and Vol. 4 (1998).

[xii] Vasarhelyi, M. A. & Halper, F. B., "The Continuous Audit on Online Systems," **Auditing: A Journal of Practice & Theory**, Vol. 10, No. 1, Spring 1991, pp. 11-125.

[xiii] Vasarhelyi, M. A. , Halper, F. B. & Ezawa, K. J., "The Continuous Process Audit Systems: A UNIX-based Auditing Tool," **The EDP Auditor Journal**, Vol. 3, pp. 85-91, 1991.

[xiv] Minsky, M., **The Society of Mind,** Simon & Schuster, Upper Saddle River, NJ, 1988.

[xv] Sareen, V. and Vasarhelyi, M. A.., Towards Intelligent Agents in Accounting: background and potential,' in Artificial Intelligence in Accounting and Auditing, Vol. 4. (Kogan & Vasarhelyi, Eds.), Markus Wiener Publishing, Princeton NJ, 1998.

Table 1: Emerging Audit Exposures

1. More exposure Points and Errors	7. Theft of Laptops Information	13. Vandalism
2. Industrial Espionage	8. False Store fronts	14. ISP Linkage Alterations
3. Viruses	9. Theft of Cellular Services	15. E-mail risks
4. Cyberloafing	10. Unauthorized Use of Computer Resources	16. Disclosure of Confidential Information
5. Home Page Risks	11. User Ignorance and Perceptions	
6. Use of Outdated Software and Data	12. System Incompatibilities	

Figure Error! Main Document Only.**: Internet Enhanced Value Chain**

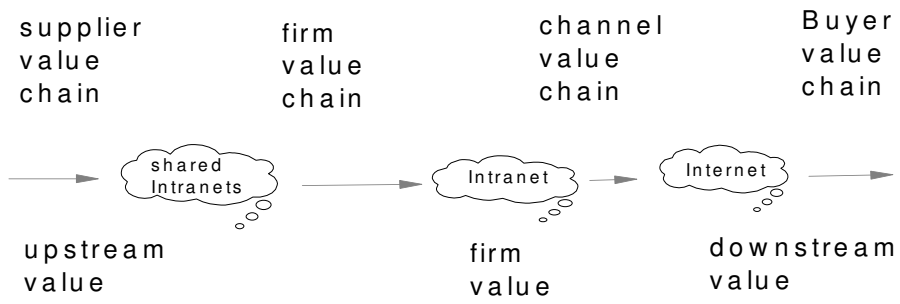


Figure 2: Internet / Intranet role in Corporate Activities in the value Chain

Support Activities					
Infrastructure	planning models	Intranet	Shared Intranets	Internet Presence	E-customer care
HR management	automated personnel scheduling				
Technology development	CAD	electronic mkt. research			remote servicing of equipment
Procurement	online procurement, automated warehouse	flexible manufacturing	automated order processing	telemarketing, remote terminal for sales	computer scheduling and routing
	Inbound Logistic	**Operations**	**Outbound Logistics**	**Marketing & sales**	**Service**
	Primary Activities				

Figure 3

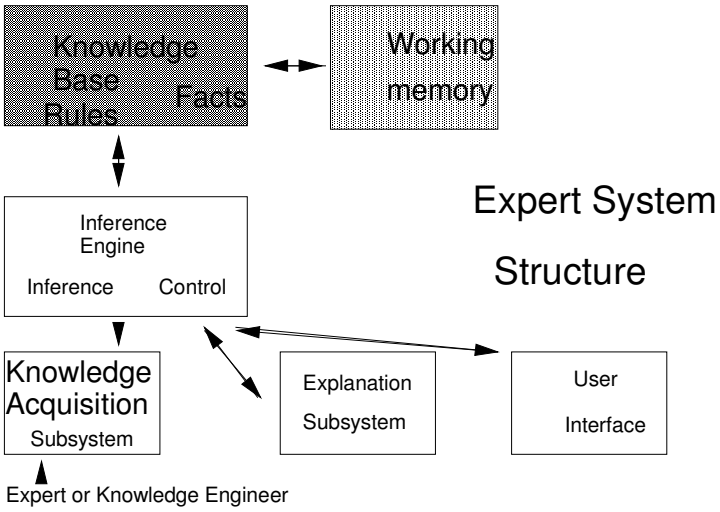
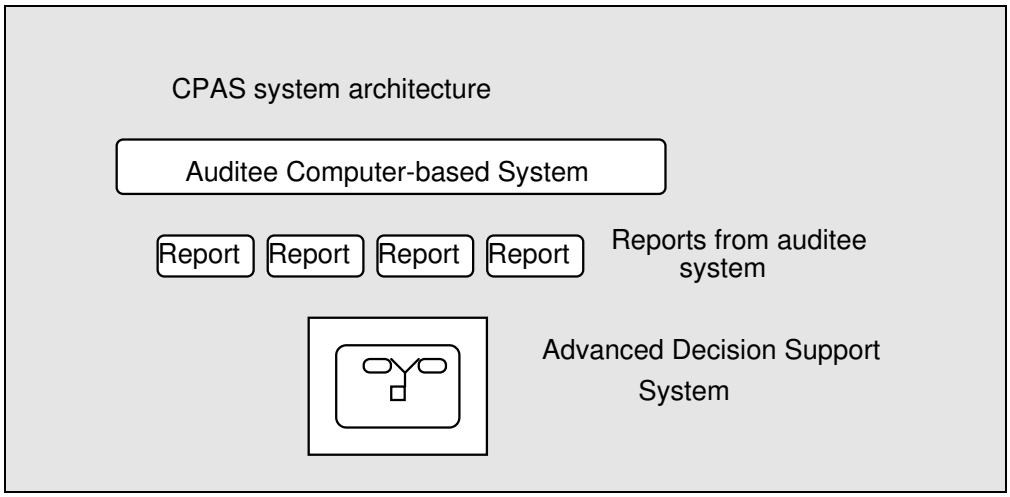

Knowledge Base
Facts
Rules
Working memory
Inference Engine
Inference
Control
Expert System
Structure
Knowledge Acquisition
Subsystem
Explanation
Subsystem
User
Interface
Expert or Knowledge Engineer

Figure 4


CPAS system architecture
Auditee Computer-based System
Report
Report
Report
Report
Reports from auditee system
Advanced Decision Support System