AUDITING: A DAY IN THE LIFE OF IVAN AUDITORVICH IN THE FUTURE,:

A View of Future Technology

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IVAN AUDITORVICH in the 21st Century

1. A Fable

A view of a far fetched environment in the future for the day to day audit procedure. It entails the audit environment, the audit industry, auditor tooling, and the process of auditing.

1.1 A Day In the Life of Ivan Auditorvich in the 1990s

Ivan calls in to his computer early in the morning and finds out that the automated assignment system has sent him electronic mail requesting an audit of a new AT&T venture that manufactures word recognition devices (WRD Inc.). In addition he browses through his mail and finds a series of messages some of which relayed through electronic mail and others through a voice messaging system.

Directly from home, using internal audit's audit support system, he finds out how to get to the client, polls a news service for any outstanding news items that may affect that line of business, and gets down to work initially by scanning a description of all systems that process information for WRD. Furthermore, Ivan pulls two active files, one with an up-to-date financial statement on WRD and a second with a confidential just-generated report straight out of the different monitoring devices impounded into WRD's systems. He scans through these files, requests a detailed monitoring scheme to be placed into effect for a couple of hours and while waiting for this to go into effect runs a series of analytic reports on WRD.

These analytic reports will compare WRD's performance with others in the industry, examine the day by time series of WRD's sales and costs and extract incidents of variance that may be worth examination. Financial ratios and key indices are drawn and analyzed. The firm's time-series data is scrutinized for seasonal and unaccountable variations through detailed decomposition techniques. Furthermore, a coarser set of time-series data on WRD is analyzed in a cross-section comparison with other firms from the industry and virtual company aggregates that have the same product mix as WRD. In addition, the software assesses qualitative issues related to the business. These charts and indicators, are summarized into a report that suggests key areas needing further examination by the auditor.

By this time, detailed monitoring is in place and churning. He returns to the monitoring module, sets up a window for such a purpose in his terminal and scans a flow of transactions. After some familiarization with the flow he sets up a few traps to call his attention if certain events occur. He also examines a library of traps that other auditors developed looking for appropriate exceptions to search. This procedure allows for the incorporation of expert audit experience into his work.

He now moves away from that window in the terminal. He queries for the last auditor's evaluation on the system and examines the workpapers, auditor letters and recommendations to the client. With this information he calls up the client and asks his permission to browse through recent system changes once these are identified. In addition he sets up an appointment for several interviews with key client personnel that afternoon.

It is time for lunch and he picks up a sandwich at the nearby MacDonald's in the way to the client. With his car phone he calls up his office and receives any additional messages through the voice forwarding system. He does not take a notebook computer with himself as last year's report indicates the availability of a series of remote communication and processing devices for the asking at the client's location. However, just before leaving home he had loaded the log (automatically prepared for him by his auditor's workbench) of critical issues on to a CD and carries it with himself to avoid client access to this key information. This method is often used also to carry workpapers around if no high-

speed communications are available.

At the client's site he sets himself up in a local computer and connects into his audit support system. There he chooses key items to be set up in the local machine and while the downloading is being performed he reads over the materials he brought with himself.

The first client arrives at his location and he proceeds with the interview by calling up the relevant ICQ (Internal Control Questionnaire) and asking the questions that arise in the screen. The system has examined the current system and spotted some changes from the prior-year. These are scrutinized and annotated. Once the interviews finish he runs the results and the operational software through the "Internal Control Analytical Review Evaluator" and obtains a detailed flow chart of key systems and points to evaluate for compliance.

He calls the compliance routines for the generation of fictitious data streams in a procedure that nostalgically reminds him of the old ITF days. Also he uses some of the monitoring features of the systems for additional compliance testing and comes to a rating of compliance in some key systems. His overall rating of the internal control system has not changed too much from the former year but notices with satisfaction improvements in control based on last year's comments.

Now he gets down to substantive testing by statistically pulling transactions using a "dollar-unit sampling" method and electronically verifying the paperless transactions. Some of these are also marked for independent verification by electronic mail confirmation and others for mailing and manual verification.

The results of many of these procedures are brought back into the standardized working paper management package which automatically indexes and ties its different components. Some manipulation and tying must be performed by Ivan that uses the word-processing and spreadsheet like features of the package to prepare a trial-balance for WRD. Key accounts and balances are marked for examination and a direct database access module used for such purpose. The auditor foots key fields, extracts partial balances and examines changes in the database structure that should be noted in the workpapers. With key fields footed and compared to the book balances presented he focuses down on a series of accounting treatment issues and variances spotted. He calls in through the terminal into internal audit files and looks for similar accounting treatments found in the lease of a second hand computer shared with a client. Several comparisons pop-up but none to his satisfaction. He looks for the lease expert in the dictionary of experts and sends him electronic mail placing a note in his working papers. In addition, he prepares a few adjustments to be made by the client and mails these to the client's controller.

Using the word-processing feature and many boilerplates he prepares the audit report and the management letter for review by his supervisor. These are noted as still waiting for the resolution of a series of open items contingent on results from the monitoring tests, confirmations, adjustments, expert opinion, etc.

Its late in the afternoon and time for Burger King and home. Next day will be another chapter in this "auditssey".

1.2 A Day in the life of Ivan Auditorvich in the year 2000 after he makes partner

Ivan's career has greatly developed since the old days of the Tech audit. He was made partner of now one of the big two Tanaka, Mitsubishi, Datsun, Young, Gorbachev & Delloite.
The audit business has hit the skids for about a decade and a frenetic pace of consolidation had set in under a multinational setting. This served as the basis for substantial improvement in the servicing of multinational audit firm needs as well as provided the economies of scale necessary for providing capital for the development of the technology necessary for modern day auditing.

Some economies of scale have however disappeared, under the prodding of Senator Dingle, now a nonagenarian. The firms were forced to practically divest the MAS practices to avoid conflict of interest. This forced the firms to consistently separate their audit work, research and pricing from the consulting/development practices and therefore not to be able to leverage on specific technical knowledge and competencies that were available.

Transnational limitations molded much of the limitations of the audit work. Audit mentality and government rules made the role and task of auditors quite diverse across countries with greater or lesser influence of the IAC (International Audit Committee). Political factors and telecommunication policies made certain countries much closer than others and audit technique very varied across countries. Audit risk now encompasses country risk and the nature of audit procedures as well as audit technologies. Poor telecommunications force auditors to visit and perform scheduled audits in the LDC countries as opposed to the more prevalent "audit by exception" that is allowed by the "continuous process audit methodology."[1]

Much of Ivan's work these day is performed using groupware[2] [3] where the different media are linked into an audit's "living record" encompassing computer data records, voice messages, records of remote distance teleconferences and a large set of computer monitoring reports indexed and organized automatically.

The place, timing and process of audit work has changed substantially while auditing standards continue to evolve at a very slow pace.

Most of the auditor's work these days is at his desk or home if he/she telecommutes. Virtually no paper documents remain in the major corporations and if such exists they are stored in imaging systems that can be accessed from the corporate network. The physical manipulation of paper became a too expensive endeavor as well as ecologically undesirable. Consequently, any records needed can be accessed from a computer with he appropriate security precautions respected.

Embedded audit modules have now improved to the point that there is automatic error correction and process impeachment if major problems occur. Long are gone the days where Ivan prepared workpapers. As part of the client investigation process and audit[4] startup (the most expensive part of the process) the workpapers were designed and they are constantly updated by the continuous control monitoring process.

The laborious part of the audit has been substantially reduced. The AICPA gave up on the 5 year rule of partner rotation when they noticed that it took more than 5 years for an auditor to understand client-systems to the point where he/she was effective in dealing with soft issues like privacy[5], ethics and going concern in the modern world.

Ivan now works with a multidisciplinary team where auditing (if an old fashioned person as Ivan can call it such), litigation damage estimation, pension accruals and management, tax services and system design work together to deliver a series of services being subcontracted by the corporation. Due to independence rules, and Dingle's fuss the system design team belongs to Sears, Roebuck, Bloomingdales, Touche & Avis their major international competitor. (Ivan feels that this is like sleeping with the enemy but he is getting used to it)

Ivan notices from his buzzing Dick Tracy watch (which also serves as a terminal, a telephone and a toilet) that today he must issue the Monthly audit report and the internal control rating. Considering that these are the result of a continuous process and that no major alarm has happened that was not automatically self-corrected and adjusted Ivan is ready for issuing the statement and this is done electronically with a second and third layers of the report with significant events and explanations. The report is automatically distributed electronically to all significant players and placed on a bulletin board for access by any

interested party. The access to the different layers of the report is controlled by security access and need-to-know considerations.

It is noon, and the audit is out, Ivan decides to meet the new Sears partner, Natalia Systematova and take her out to lunch. He wonders if she is going to enjoy Burger King. Old habits die hard!

2. Nature and Technology in Corporate MIS's

The shape and technology[6] to be used in delivering corporate information in the next decades will major determining effect on audit technology and procedure. These include the shape and format of the Management Information System, hardware developments, software developments[7] and the EDP industry.

2.1 Shape and format of MIS's

The nature, shape and medium of Management Information Systems[8] is most likely to change substantially over the next decade due to changes in technology and competitive needs of organizations.

Information systems will be a mix of different type of records encompassing linked elements of recorded audio (voice), images and more traditional data processing records[9] [10]. Object-oriented structures[11] [12] will serve to link disjoint, heterogeneous elements into coherent objects and classes of elements.

Of great import in this type of environment is the ability of conversion from one medium to the other. Optical Character Recognition (OCR)[13], voice recognition[14] (generic and trained), voice synthesis, computer vision and computer representation are fields of varied domain of progress which in due time allow for the increasing transitivity among media.

Figure 1 illustrates the media and the conversion processes necessary for interfacing prevalent media.

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Substantial expertise[15] is to be found in the different elements of the corporate information system. Of particular impact is the impounding of intelligence in the front-end part of corporate systems in the data collection stage. There substantial labor savings are to be found and increased audit risk from intense dependency on a process where the combinatorics are astounding making comprehensive testing impossible.

Overall system architectures will mainly:

- become much more decentralized[16]
- be substantially paperless
- capture data automatically at the moment of the economic transaction
- perform daily closing of the books and keep running balances of many accounts
- perform one edit at the moment of transaction entry using intelligent data evaluation
- have inbuilt continuous monitoring[17] systems
- be representable analytically[18] [19] and rely on this representation for analytic checks-and-balances on its controls
- use a variety of man-machine interfaces in different modules
- rely heavily on local station power for user display and decision support computing power.

2.2 MIS, DSS[20] [21], EIS[22], ES & AI

Bailey et al [23] [24] discuss the nature of corporate systems attempting to create a taxonomization of systems of increasing complexity and intelligence. Their classification entails: (1) decision aids, (2)

non-expert decision support systems and (3) expert systems.

A more comprehensive view of data processing systems incorporates Alter's framework, Bailey et al's classification as well as the EIS layer of modern systems.

This view is presented in Figure 2 where a financial systems architecture serves as the backbone of forms of information and decision usage.

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The natural general ledger feeders such as accounting payable, accounts receivable, production, billing and inventory feed transactions of the general ledger system that can be viewed as the main database (data store) of the system. This main data store feeds the preparation of corporate financial reports and a management information system with managerial accounting reports under a wide-range of forms of delivery and information support.

Current Systems offer a large degree of rigidity leading to great difficulties in the support of executive decisions. This has led to the concept of Executive Information Systems and the architecture of a staging area to support this approach. This human seam, cumbersome in nature, seems to be an intermediate step to more advanced architectures. The more traditional distinction (Alter, 1977) between the Data Processing System (DPS) and the Decision Support System (DSS) now seems to be related to the nature of the particular interaction and use of the system. For example, the general ledger system provides a series of classic DPS functions but may feed the MIS a series of critical files to be used in a DSS mode.

Five dimensions of Corporate Information Systems (CIS) may shed some further light on the evolution of financial systems and the comprehension of their nature. Figure 2 presented an application layer surrounded by DSS, DPS and linked to an EIS. This schema is valid for the current limitations of technology and evolution of systems. Figure 3 presents a more complex and continuous characterization of CISs along the:

Level of expertise: passive, decision aids, expert decision making and expert

Level of decision implementation: passive, recommending, decision making and decision taking25

Form of Information Service: data processing, decision support, executive support

Type of Usage: passive data entry, user-interface data entry, decision usage interface, personal computing usage.

Application Layer: feeder module, main database and data presentation modules.

A loose illustration of a system view of this type is presented in Figure 3. Such a view may be more desirable for the purposes of evaluation and consideration of technological progress and audit impact.

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Nolan[26] characterized four and then six[27] stages of system evolution process. The characterization of systems along those stages is not, in most instances, appropriate as a corporate-wide characterization of DP development in large corporations. Their characterization is appropriate for the early stages of development (initiation, contagion) but at the later stages of evolution corporate development is heterogeneous being better described by the five particular dimensions of CISs.

2.2 Major hardware developments

2.2.1 The **Basic technology to be used** in the support of the forthcoming systems encompasses a wide range of traditional solutions, improved in capabilities and major change in some islands of technology of major impact. Among the areas to be marginally improved are the cost effectiveness of storage in magnetic medium (higher storage densities in all media from magnetic tape, through floppy disks, through magnetic disks to semiconductor based static storage), power and throughput of chips[28] (with eventual usage of gallium-arsenide and more in the future optical computing[29]).

2.2.2 The **Telecommunications** technology will have major effect on system architecture as well on mode of usage of data processing. Projections for the computer and telecommunication market merge for the residential[30] and business markets[31] as the progressive availability of broad-band services to the home expand the work-at-home feasibility.

The advent of the "smart house" and the home use of artificial intelligence and expert systems over the later part of the next 25 years will further dull the boundaries of the home and the office. The natural delays of the house building/rehabilitation cycle as well as the very large investment requirements to ultimately wire the "loop" (communication wiring from the substation to the home) in fiber optics will make these phenomena take some time.

On the other hand the telecommunication front will have a substantive change in nature with the increasing deployment of cellular telecommunications, the advent of the personal communications networks (PCN) and the concept of the personal telephone number. These services initially geared to the voice market will rapidly be followed by an expansion of data, image and personal service offerings.

While the market has been rich in business oriented new telecommunications services such as optional calling plans, 800, 700 and 900 numbers the basic technology of the software defined network has not fully been explored nor integrated with image and service features. These features do not require basic technological breakthroughs to be offered but require substantive improvement in TELCO (telephone company) billing capabilities. Some of these features will only be implementable if the TELCOs can offer improved efficiencies in their billing, control and delivery capabilities.

The local-area network and networking[32] areas will allow nearly universal interconnection into hybrid arrays of software and hardware and costs that ultimately will equal somewhat less that one third of the hardware/software investment.

2.2.3 **Man-Machine Interfaces**: a wide set of forms of man-machine interfaces will be found in the computer environment of the next decades. "Smart Home" computing will heavily rely on voice for interaction using probably limited-vocabulary, trained voice devices. This medium of interaction, natural for the home use will also probably serve for high executive computer interaction as well as for hands-free operation in the factory.

On the other hand, programmers and computer professionals may choose for an efficient keyboard/mouse combination enhanced by some voice input. Voice output is often substantially slower and less effective than a printed screen.

2.2.4 **Other factors in Hardware** will affect to great extent the forthcoming decades. With the evolution of technology and the increasing reliance of corporations on Online Transaction Processing (OLTP) technologies developed for critical systems such as strategic air command, hospital information systems, life-support, telephone switching, turned into fault-tolerant systems[33 34 35] allowing for high degree of continuous operations reliability. Current levels of fault-tolerance are obtained by building redundancy into hardware items such as more than one CPU, repetitive storage banks and redundant data channels. A promising line of research, which most

likely will be commercialized over the next five years is chips with redundancies that diagnose defective parts and self-heal by rerouting and reorganizing its logic. These devices, sounding very exotic to today standards probably are not too complex and will allow substantive inexpensive redundancy to by built into chips.

The next major step in dimensional gains in processor performance is coming from massive parallelism. These chips that may encompass over a thousand processors are slowly arriving in the market subject mainly to the limits presented by the lack of software to take full advantage of its characteristics. In a time frame of about ten years some of these softwares will become operational allowing for probably a hundredfold gain of processing power in a period of five years (instead of the ten-fold observed in five years intervals).

2.3 Major features of software[36]

Software can be divided into five main categories; operating systems, utilities, languages & interpreters, applications and specialized softwares.

Operating Systems[37] have a high degree of stability. IBM's mainframes still run under a OS-like operating environment maintaining vertical compatibility and UNIX, the emerging software of the nineties was developed in the early seventies. The major operating system development for the next decades is a new generation of systems able to: deal with massive parallelism and able to operate in a distributed environment with intelligent database[38 39 40 41 42] behavior.

New operating system versions typically incorporate extensions made available as **utilities** earlier. For example, many of the accounting features available in IBM MVS environment were originally issued by independent companies as add-ons to an OS/370 or VS/2 environment.

Computer languages are facing a major change in nature whereby high level application construction systems are slowly replacing more traditional construction environments. However, the traditional COBOL environment is very resilient and presents a substantive customers in the established computer application base. The large majority of mainframe computer applications are still being built in COBOL now however with relational database Interfaces and intensive usage of productivity enhancing software. The next two decades will see the proliferation of productivity enhancement tools with traditional programming languages being extremely resilient and lasting. The economics of system development and maintenance are such that even if great efficiencies in reengineering and construction can be shown still the capital necessary for the reconstruction of application and the disruption caused generates enormous static behavior.

Consequently the movement towards the CASE[43] type methodologies as a form of systematization and improvement in design will be slow. Currently, 10 % of major US firms use the CASE methodology with a savings of about 10% in the first 5 years. It is estimated that by 1995 about 50% of all firms will have formalized CASE as part of their system development methodology. The startling factor of the above numbers is the fact that the savings are found to be very low in such a labor intensive endeavor. The conclusion that can be drawn is that these softwares are still in a very immature stage with very weak, if existent at all linkages, in between lower and upper CASE modules.

Application Systems continue to be developed with a very slow migration towards the purchase of pre-programmed software as predicted by many analysts. the reasons are multiple but primarily economic. Despite the fact that the process of custom-design and implementation of software is very primitive, hand-crafted method its implementation is not very disruptive and allows for continuous flow of the production activities of the organization. Considering that the main cost of computers in organizations is not the hardware, nor the facilities, nor the custom-made software but the labor-time employed by users of the

system by a factor of 3 to 5 over a period of 5 years is natural that companies will bite the bullet and pay for the less disruptive crafting of their programs.

In the area of software confection and manufacture, in addition to the CASE methodology the concepts of software factory [44], and software reuse [45] are of great promise.

All of the above areas of software and software construction are to be substantively affected by the increasing level of intelligence (either rule-based [46], new axiomatic computing-model (e.g. Neural networks [47] construction or AI-based) in all of its functions. Also, the advent of expert-systems has increased the pressure for substantive consideration of the concurrent development model (including prototyping) instead of the more formal and traditional waterfall model. This is counterbalanced by the increasing complexity of large systems and consequence need for formal controls.

Of more immediate effect but also of great importance is the key-role that database systems have assumed. Much of current design and application thinking is slowly evolving from the hierarchical to the relational models and slowly strong interest is emerging in the so-called object-oriented databases [48]. Most likely, basic structural paradigms, are a natural function of the nature of problem and data being stored. Therefore, it is probably that the relational model will assume full leadership in the analytical support function while the hierarchical model will remain resilient as a component of large mainframe-based applications. databases are a microcosms of technological developments and it fuels today an industry estimated at 10 billion dollars. Many models for future database development have been evolving [49] [50]

The auditing/monitoring function, which relative cost is to unavoidably rise, will probably help tilt the balance of cost factors towards more formalized development methodologies and towards further acquisitions of software elements.

2.4 Aspects of the EDP industry

Over the last decade Datamation [51] surveyed the computer industry and list the "Datamation 100," largest companies in the industry. These companies are today a substantial portion of the economy of the US and the recent 3 years has shown an increasing participation of large (particularly Japanese) conglomerates in the leadership of the industry. We do not observe the "computer industry" but a mix of office services, data processing and telecommunication firms difficult to untangle and understand. Actually, one computer industry has given way to a series of smaller markets which are industries by themselves and even the larger market players are now smaller in the overall context. These smaller emerging markets offer a cadre of high-growth, high-mortality firms with the scions of the industry entering late into the fray and often acquiring substantive portions of the market through acquisition (particularly in the software domain) and development.

Once the computer sub market is more mature (growth rates down to the 20% range) a wave of consolidation occurs such as it is occurring in the workstation market leaving only the leaders independent and now striving to enter in other high growth markets.

These patterns of subdivision, failure, growth, consolidation and internationalization are likely to continue for the next decades with Japanese and International mega-concerns occupying the more mature markets while high profitability and growth to occur on the new technologies and market sectors.

3. Accounting, Auditing, and Technology in Information Rich processes

Auditing, in our current form, was initially an Anglo-Saxon endeavor with the UK and the US developing its methodologies and processes. Even in the nineties still only a handful of countries has a mature and well established audit practice as the one found in the US. On the other hand many forms of meta-verification and government oversight

can be found that conform to more or less extent to local cultures.

Observing auditing practices in European countries a model of the US first and then a lag can be developed. Many countries as well as the International Auditing Standards Committee present a series of audit guidelines that are close to direct translations of the AICPA SASs. Some countries, have simplified out of these standards the idiosyncrasies that compromises among interest groups forced on to the US standards.

3.1 Major Technological Barriers

Observing the history of major technological barriers found by auditors with the evolution of computers presented in Figure 4 some conclusions may be drawn.

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While in many areas audit thinking led the installation of controls and architectural considerations in the advent of computers into corporate systems auditors have lagged development of technology in their thinking about controls and auditability of emerging technologies. Often auditors have attempted to eliminate technological features for their reported uncontrollability or corporate risks. These attempts tended to fail due to the inherent economic benefits of the new technology but allowed some delays where a more mature (and controllable) technology had arrived.

3.2 Controls and Standards vis-a-vis Emerging Technology

A recent study[52] pointed the main areas for audit concern in the scope of three to five years: development methodology, (CASE, object-oriented), storage technology (CD-ROM, WORM, WMRM), Processing Technology (cooperative, fault-tolerant), communications technology (fast-packet X.25, ISDN), database technology (distributed, object-oriented), interface technology(voice, biometrics, image processing, vision) and knowledge-based systems (natural languages, learning systems & robotics). Each of these areas were discussed in terms of its technology and an incipient discussion of risk, controls and audit considerations was presented. This effort is an example that the audit profession is taking a more forward-looking approach to technological advancement.

The advent of expert systems in the corporate information systems domain[53] created opportunities and problems for the auditor. The opportunities involved the usage of ES tools[54] [55] in the performance of an audit. The audit domain being rich in judgment and very ambiguous in nature provides and excellent domain for this work. the problems are multiple from the position of a new technology[56] being impounded into critical corporate processes to the more intrinsic problems of the nature of the knowledge[57] impounded into the systems, their validation and the risks inherent to this process.

The issue of the posture and potential standards to be issued by the AICPA in relation to expert systems is of particular interest. Holstrum[58] argues for the need of standards an interesting variance to the current approach whereby no SAS have been issued having specifically a technology in mind. SAS # 3, dealing with the generic topic of EDP audits was deleted and its guidance impounded into the more generic section 320. Most likely, in one or two few decades, when knowledge rich systems are frequent, they will warrant a special SAS as the problems are such that generic statements may not be applicable.

3.3 Accounting as an Information Function

Accounting has over the last decades been a relatively narrow field with strong specific domain context. Audit researchers and practitioners have shoed serious concern with the evolution of technology and forthcoming audit practices[59] [60]. The recent years have made accountants to reach out to many fields of endeavor such as actuaries (pensions), engineers (fixed-assets), lawyers (contingencies), etc. as a form of improvement of the quality of

measurement. Such factor and the consolidation of the public accounting industry and its relative lack of profitability is bound to change substantially the sociology of the profession. The three more dramatic changes will probably be:

1. the dramatic change in the nature of the initial apprenticeship with probable delay consequence of the change of the CPA exam.
2. the opening of the ranks of the profession to either non-accounting (non-certified, specific skill personnel) and
3. the change of the leading oligopolistic firms that control the industry to potentially a smaller number, international-based corporations.

3.4 The Role of Attestation

Our current litigious environment, the demise of a major accounting firm due to this litigation, and the natural conservatism of accountants has further and further narrowed and standardized the nature of the attestation function into a very narrow and often meaningless opinion.

Economic arguments would argue for a large set of products of the attestation nature ranging from opinions on financial statements to opinions on the quality of forecasts, of the management of pension fund assets, of the soundness of engineering structures, of the market value of assets and of the quality of the workforce.

Furthermore, in addition to these attests, auditors would get involved as contractors to fiscal audits (working for state and IRS), subcontract performing internal audit functions and work for GAO like social audits for interest groups.

However, the balance that exists today will have to change for these events to happen and only major disruption in a turbulent environment will make them happen.

4. Auditing as a Process

4.1 Changes in the audit process

Modern audits will rely to a much larger extent on analytical procedures. The arguments for these procedures have been extended for many years with substantive resistance by many in the profession. The economics of test of details are changing and with it the ability of auditors to get to large amounts of paper. Actually paper is disappearing and retrieval of magnetic information allows for larger samples and more formalized examination however of a different nature.

Also, the nature of sampling in paperless processes is to be reviewed. Sampling allows populational representation at a much smaller cost while yelding stochastic results. With the elimination of paper records, and assurances in the form of continuous control monitoring[61] if doubt arises the costs of full population polling may not be prohibitive considering information retention policies of the organization. On the other hand, economics are such that a much more frequent set of samples can been drawn as a part of the control monitoring process.

4.2 Evolution of audit technology

Audit technology may be potentially traced/projected through three major stages:

I. **manual audits**: where by system procedures and audits are manual
II. **hybrid audits**: whereby computerized systems exist in the organization and also manual processes interface frequently with the first. the auditor audits around-the computer and with the computer as well as places substantial emphasis on the substantive part of the audit.
III. **advanced audits**: where continuous system monitoring exists and systems are mainly integrated and paperless, forcing most of the audit to be automatic and continuous.

Obviously the third stage is still not here but its visualization may help in the consideration of long range audit strategy and in the planning of audit tools.

Holstrum et el.[62] performed a DELPHI survey of auditing moving into the 21st century. They did not find evaluating technology of great use for predicting trends and relied principally on experts visioning of the world. among their principal conclusions they stressed: (1) the importance of economic factors (transaction volume, internationalization & increased competition), (2) the changing nature of reported information (online databases, broader information sets), (3) changing professional standards (, (4) enhanced need for corporate control (congressional and regulatory pressures), (5) evaluating policies - not just compliance, (6) boundaryless auditing (when other entities are part of the audit), (7) novel approaches to auditing (using the computer) and multidisciplinary auditing.

Holstrum's et al. suggest an "Auditor's Future Tool Kit" along the following areas: integrated audit networks, micro-to-mainframe interconnectivity, interconnection with large databases, audit software embedded in the operating system, expert systems along functional audit lines, multiple input modes and natural language programming.

Such a tool-kit would be a good start for the second major stage of auditing but still does not offer the level of hands-free integration that may be achieved to support stage three.

4.3 Other factors and Risks in Future Audits

4.3.1 The role of OLTP: online transaction processing, increases the exposures to systematic problems but, in a well controlled system, also reduces risks of casual and human error. Embedded audit modules and considerable attention to control are essential for these type of systems. Actually, the advent of OTLP made systems virtually impossible to audit in a manual process.

4.3.2 Manual vs automated processes: the elimination of manual portions of a document flow is usually viewed as a way to improve control over an operation. Unfortunately, the lack of human system surveillance also creates exposures of the nature of absurd outcomes not being observed unless specifically tested for. The usage of well designed knowledge structures associated with machine learning technology[63] and deductive processes may lead ultimately for devices that detect absurd patterns and outcomes without specific warning.

4.3.3 Proximity and expert boxes in the transaction flow: processes that at entry have no manual processing, at processing are purely computerized and at output go directly to an outside entity are delicate and must be considered of different nature. An ATM (automated teller machine) allows for fully automated disbursement of cash under a very controlled environment. Control weaknesses and risks are numerous and some cannot be predicted until a loss occurs.

On the wider and more complex processes that occur in an organization proximity to the process of a controlled human seemed to be desirable. On the other hand manpower limitations do not allow for manual supervision of each transaction. Consequently the impounding of expert software to search for anomalies, replicate auditor/supervision transaction review as well as the recognition of anomalous patterns[64] [65] boxes in the flow may be desirable.

4.3.4 Audit by exception: extant audit processes are procedure driven and are performed on data from a limited period on the audit year. Vasarhelyi & Halper (1991) proposed the concept of audit by exception hereby system standards are used to be compared with actuals and alarms are fired if the variance exceeds a particular method. Once the audit procedure is defined and wired into the application the auditor's role changes to only monitoring the alarms and designing increasingly complex set of audit heuristics that could also be called meta-controls.

4.3.5 Multidimensional audit: audit as one of many dimensional processes. System activities revolve around its accounting

(history), its business actions (present) and its plans[66] (future). the comparison of plans and outcomes is the activity of control leading potentially to other actions. In a CPASlike system a control mechanism triggers an alarm which calls the attention of an individual to a discrepancy. This type of activity could be called a "meta-control" and conceptually is the same as an audit (the control of a control). The key differences between a traditional and a continuous audit are displayed in Figure 5.

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Insert Figure 5
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4.3.6 **Audit as a strategic effort in the organization**: an extensive literature[67 68] discusses the usage of Information Technology (IT) as a strategic corporate tool.
Effective auditing may also be seen in the same way whereby control and process-monitoring would give super insight on the corporation and a superior ability to control costs or to create quality products and error-free data processing.
This view o audit as a strategic tool is probably one of the key changes in audit thinking for the next decades.

5. Conclusions

This paper introduced two fables of auditing in the near future and in a farther future as a way to introduce issues of change in audit process and technology. A day in the life of Ivan Auditorivitch examines auditor tooling in this decade while Ivan in the 21st century focuses on the changing environment and a direction for the future.

This paper described a blueprint for future corporate information systems, discussed what technology will evolve in the next decades (hardware and software), discussed the changes in the information process in auditing as a process, and presented a view of continuous control monitoring as the desirable methodology of meta-control.

Many important questions can and must be raised about the future of technology, the legal environment and specially of the changes in the state-of-mind of auditors in the future. Unfortunately, no hard methodologies are available for such endeavors.

Figure 1

Media and Conversion

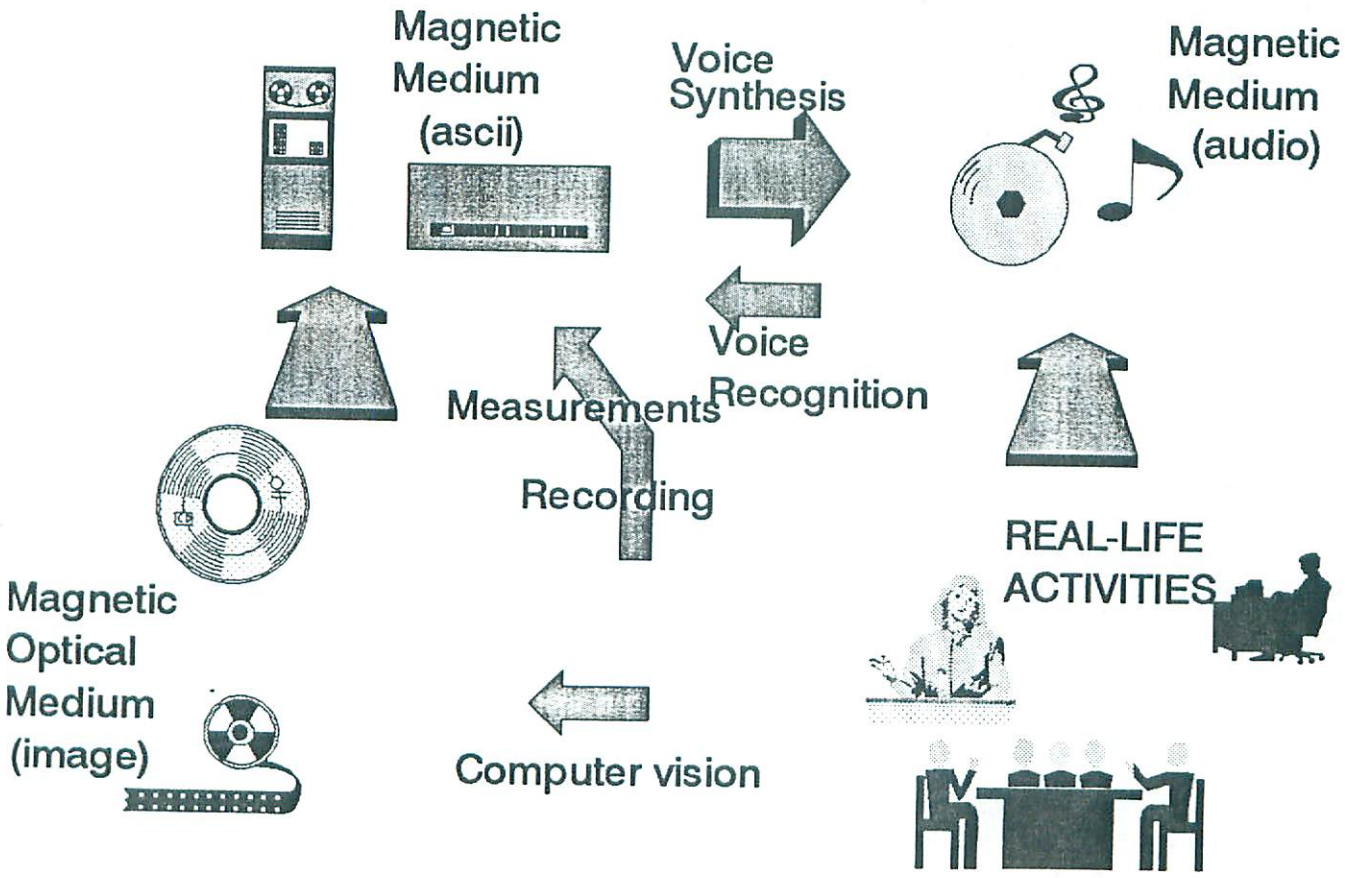

Figure 2

DPS, DSS, EIS & Financial Architecture

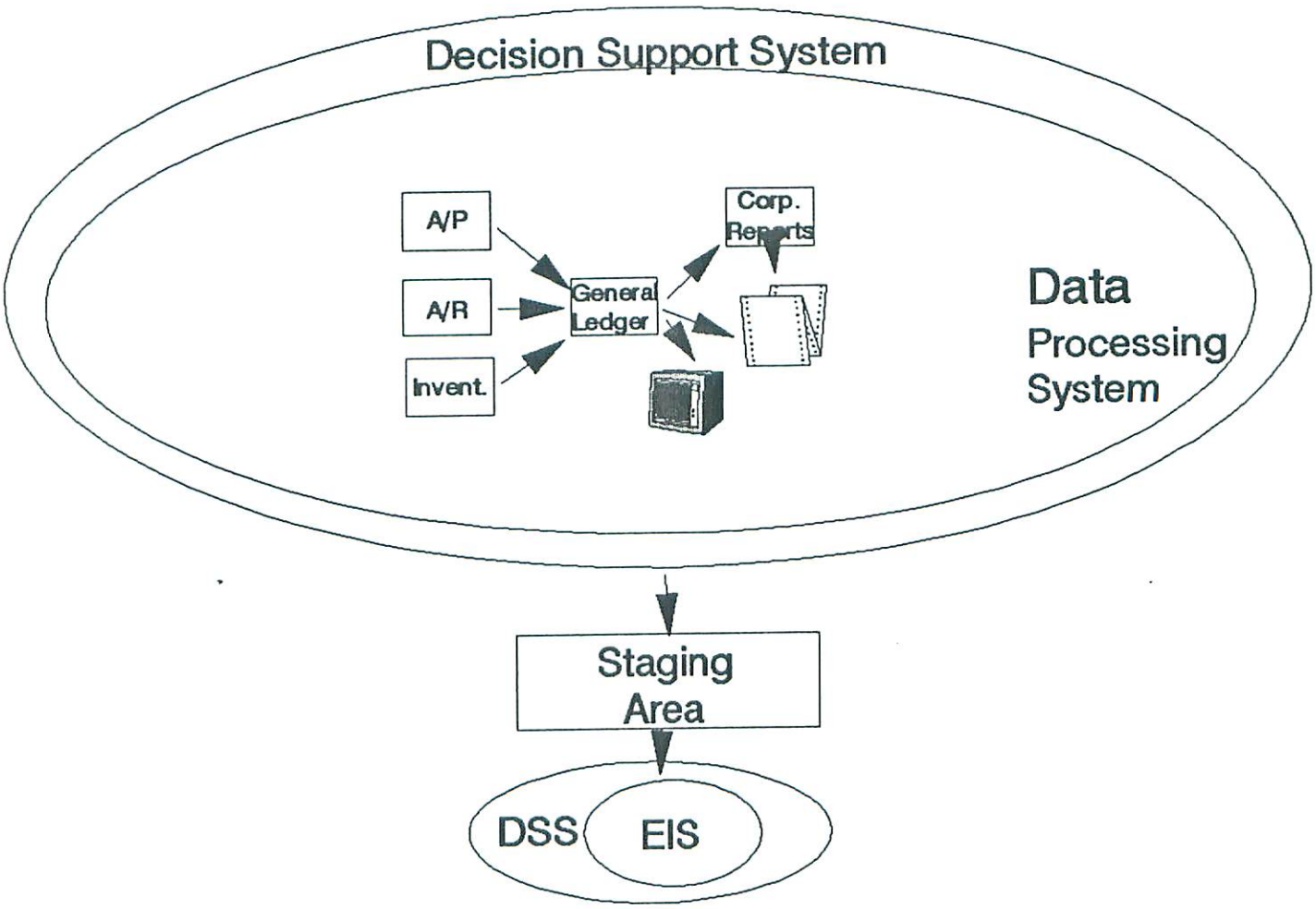

Figure 3
The Five Dimensions of CISs

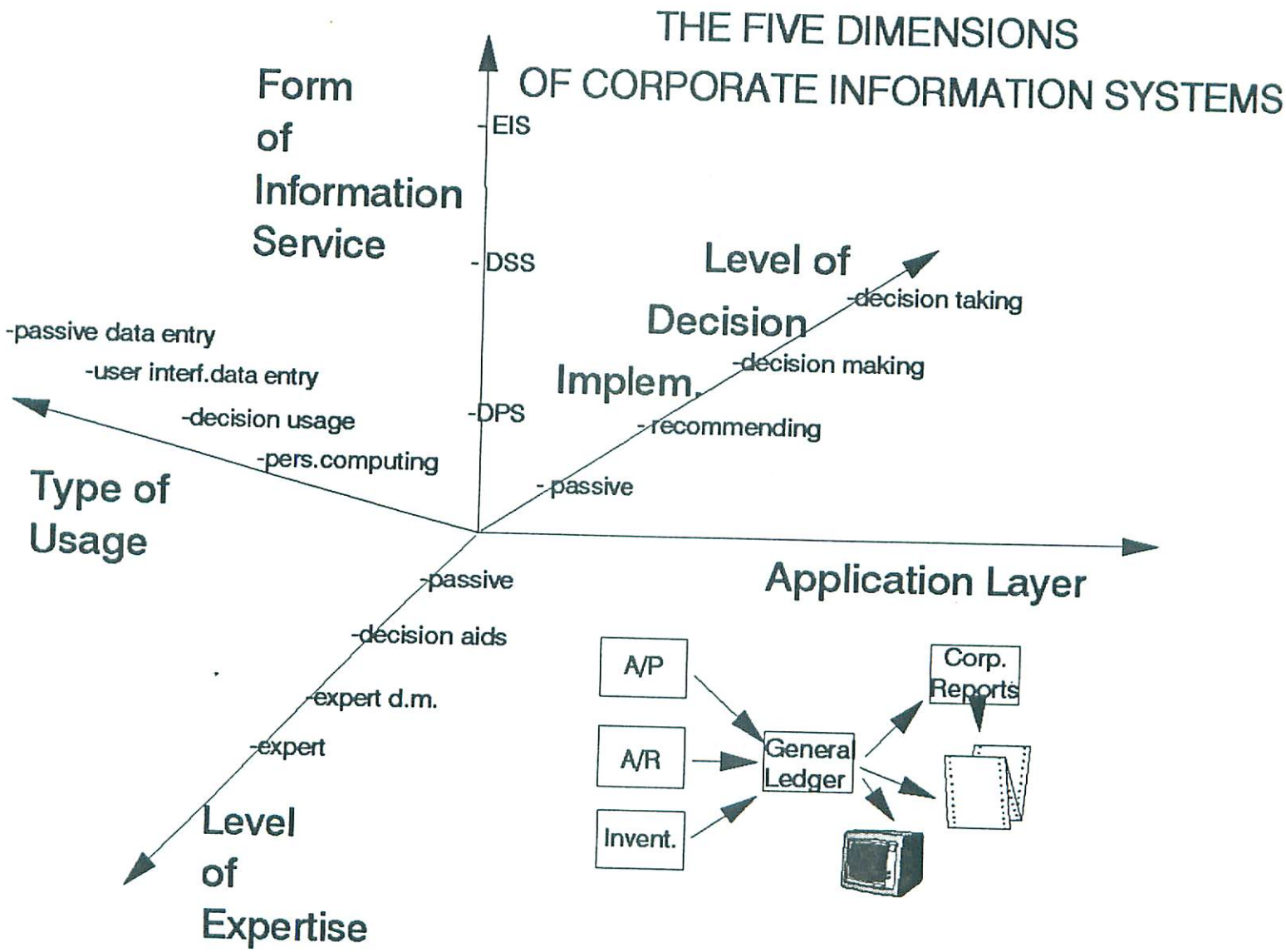

Figure 4
Data Processing and Audit Problems

Period	Technological Innovation	Audit Problem
1945-55	Computers	Data transcription Repetitive processing
1955-65	Magnetic tapes	Data not visually readable Data may be changed without traces
1965-75	Data Communication Time-sharing systs.	Access to data without physical access
1975-85	Databases(D)	Integrated databases Different physical and logical data layouts New complexity (DBMS)
	Dec.Support Systs. (decision aids)	Formalization of decision
1985-1995	Expert Systems Distributed systems Workstations (W) DSS(with expertise) Mass optical storage. Paperless sources Interconnected sys.	Across-area applics Decisions impounded into soft. Distributed data and DP Large quantities of data No human contact No clear boundaries
1995-2005	Massive parallelism Parallel Software Super-CASE Distributed intell.	Variable data paths Semi-automatic devmt.

FIGURE 5
A Comparison of Traditional Auditing with Continuous Process Auditing

Dimension	Traditional Audit	Continuous Process Audit
Emphasis	Past	Near past
Measurement of	Levels	Flows
Data gathering	Traditional	Receptacles
Timing	After-the-fact	Less-after-the fact
Record select.	Archival	Choice into receptacles
Source docs.	Paper	Magnetic
Frequency	Interim & year-end	Near continuous
Auditor involvement	At audit time	At operation time
Search-of -evidence	Aggregation & disaggr.	Through heuristics

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