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An Assertion Based Approach To Auditing

Donald A. Leslie
Stephen J. Aldersley
Donald J. Cockburn
Carolyn J. Reiter
Clarkson Gordon

1. Some History And Introductory Comments

It is our contention that there is a theory of auditing, that there exist a number of basic assumptions and a body of integrated ideas, the understanding of which will be of direct assistance in the development and practice of the art of auditing. Further, it is our belief, which we attempt to support in the following pages, that an understanding of auditing theory can lead us to reasonable solutions of some of the most vexing problems facing auditors today.

*Mautz and Sharaf
The Philosophy of Auditing, p. 1
American Accounting Association, 1961*

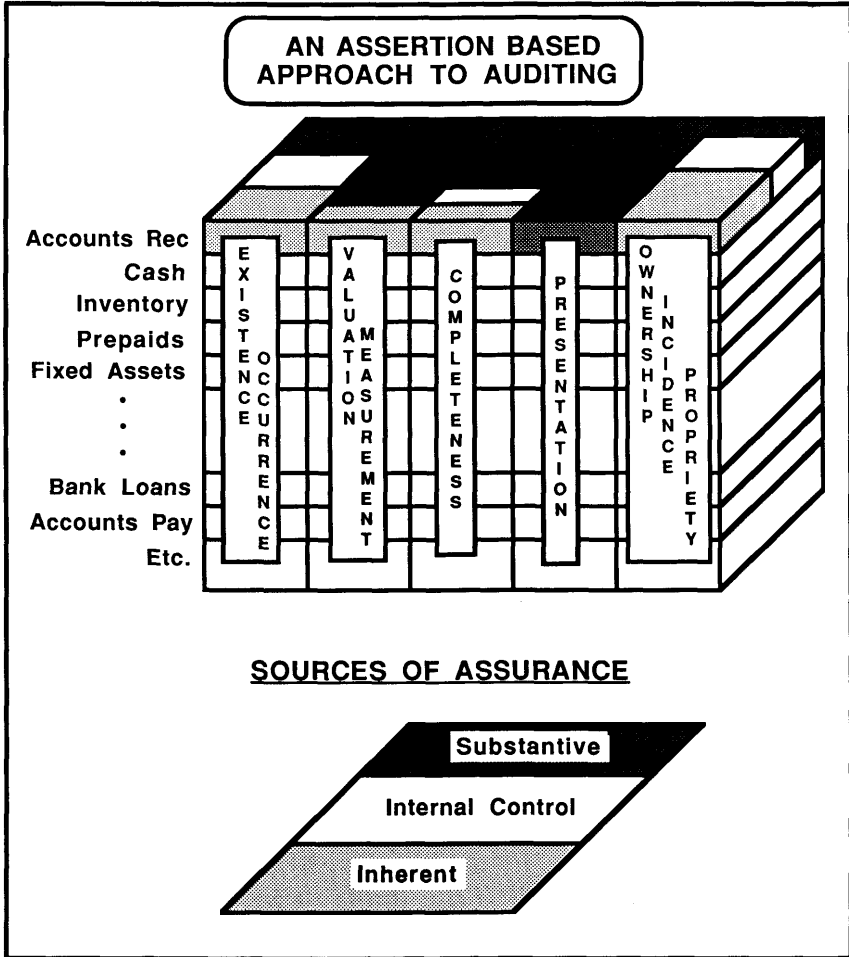
It is interesting to note that this is the Silver Anniversary of what is probably the most recognized pioneering work on auditing theory. It is a pleasure to have Bob Mautz with us today as a participant in Auditing Symposium VIII.

The earliest reference to the concept of **assertions** that we could locate in the auditing literature can be found in Chapter 5 of Mautz and Sharaf. After publication of *The Philosophy of Auditing* by the American Accounting Association in 1961, the concept of assertions appears to have gone into hibernation until 1973 when it made a brief appearance in *A Statement of BASIC AUDITING CONCEPTS* [ASOBAC]. The definition of auditing provided in ASOBAC was:

Auditing is a systematic process of objectively obtaining and evaluating evidence regarding **assertions** about economic actions and events to ascertain the degree of correspondence between those **assertions** and established criteria and communicating the results to interested users.

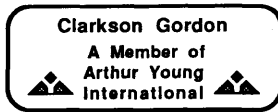
In the early 1970s R.J. Anderson recognized the merits of the assertion concept described by Mautz and Sharaf and he organized the assertions by financial statement component¹ [assets, liabilities and income]. Figure 1, taken

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Donald A. Leslie

Stephen J. Aldersley



Donald J. Cockburn

Carolyn J. Reiter

Figure 1

Components of the Objective of Substantive Verification		
Assets	Liabilities	Income Components
To provide reasonable assurance as to whether or not:	To provide reasonable assurance as to whether or not:	To provide reasonable assurance as to whether or not:
1. the reported assets really exist (<i>existence</i>);	the reported liabilities really exist (<i>existence</i>);	the reported transactions really occurred (<i>occurrence</i>);
2. there are not other undisclosed assets (<i>completeness</i>);	there are not other undisclosed liabilities (<i>completeness</i>);	there were not other, undisclosed transactions (<i>completeness</i>);
3. the enterprise really owns and has clear title to the reported assets (<i>ownership</i>);	the reported liabilities really incide on the enterprise and not on some other entity or person instead (<i>incidence</i>);	the enterprise, and not some other entity or person instead, was really a party to the reported transactions (<i>propriety</i>);
4. the assets are valued appropriately and accurately (<i>valuation</i>);	the liabilities are valued appropriately and accurately (<i>valuation</i>);	the income components are measured appropriately and accurately (<i>measurement</i>);
5. the assets are appropriately described and disclosed (<i>presentation</i>).	the liabilities are appropriately described and disclosed (<i>presentation</i>).	the income components are appropriately described and disclosed (<i>presentation</i>).

from *The External Audit* [Anderson, 1977], illustrates this structure. As the first Chairman of the CICA Auditing Standards Committee, Anderson was also instrumental in the CICA's decision to formally recognize the assertion concept in its Handbook [Sections 5300.16-.21]. The commentary in Section 5300.17 immediately following a description of the assertions states:

The auditor seeks evidence with respect to these **assertions** primarily through the performance of substantive procedures. Obtaining evidence relevant to one **assertion**, for example, existence of inventory, will not compensate for failure to do so for another, for example, its valuation. Some **assertions** will be virtually self-evident to the auditor, for example, the "valuation" of cash, while others, such as the "completeness" of accounts payable, may require extensive procedures.

Section 5300.21 concludes the discussion of assertions with the italicized statement:

*The auditor should evaluate all the evidence he has obtained and assess its sufficiency and appropriateness. He should consider evidence supporting and evidence refuting an **assertion** and should be alert for evidence supporting one **assertion** but inconsistent with that supporting another.*
[Jan. 1978]

The AICPA addressed financial statement assertions in August 1980 when it issued SAS 31 on Evidential Matter [AU § 326.03 - .13]. Included in this statement is a section on "Use of Assertions in Developing Audit Objectives and Designing Substantive Tests" which includes the following sentence:

In obtaining evidential matter in support of financial statement **assertions**, the auditor develops specific audit objectives in the light of those **assertions**.

In the concluding paragraph of SAS 31 under the heading “Evaluation of Evidential Matter” the Auditing Standards Board stated:

In developing his opinion, the auditor should give consideration to relevant evidential matter regardless of whether it appears to corroborate or to contradict the **assertions** in the financial statements. To the extent the auditor remains in substantial doubt about any **assertion** of material significance, he must refrain from forming an opinion until he has obtained sufficient competent evidential matter to remove such substantial doubt, or he must express a qualified opinion or a disclaimer of opinion.

In January 1982, the International Auditing Practices Committee of the International Federation of Accountants issued International Auditing Guideline 8 on Audit Evidence. The content of IAG 8 is entirely consistent with the CICA and AICPA material on assertions.

Although one can safely conclude that the use of an assertion based approach for planning and evaluating an audit is in accordance with GAAS in both Canada and the United States, assertion based methodologies do not pervade either audit practice or audit literature. Most auditing books do little more than make reference to SAS 31. It is not at all clear why the authors of such books appear to be reluctant to adopt the assertion concept. The answer may lie in the fact that auditing firms have also been very slow to integrate the concept into their audit approaches. Thus, academics in particular may be reluctant to produce a publication that is a step ahead of practice for fear that it will be rejected by their peers who would prefer to teach what they believe is the current common methodology. At this time, only two firms in the US have exposed audit methodologies that utilize the assertion concept.²

An important characteristic of the assertion based methodology described in this paper [an “optional” rather than “mandatory” role of internal control as a source of assurance] is the subject of the paper to be presented tomorrow morning by Thomas Bintinger. It would also appear that the role of internal control in a GAAS audit may be addressed by the Auditing Standards Board of the AICPA. At its March 1986 meeting, the Board reviewed a significant issues paper on the subject prepared by the staff. The following were among the issues identified:

1. Should there be a separate field work standard for the study and evaluation of internal control? Should the existing standard be incorporated into the other standards of field work?
2. How should controls relevant to a financial statement audit be defined and classified? How does an auditor relate internal controls to audit objectives?
3. What should be the relationship between reliance on internal controls and substantive tests? To what extent can an auditor use internal controls to reduce substantive tests?
4. Should a minimum study and evaluation of internal controls be required in an audit of financial statements? If so, what should the minimum be? Should there be a different minimum study for some (i.e., public) clients than for others?

5. What should be the auditor's reporting responsibility for his study and evaluation of internal control performed incident to his audit of financial statements?

The Board has instructed the staff to proceed to develop the issues into a "concepts" paper that could then be used as a basis for discussion.

Mautz and Sharaf [1961, p. 148] expressed very strong views on the role of internal control and they suggested that "a prudent practitioner will tend to give this phase of the examination a full measure of emphasis." When one considers the ASB issues noted above, it becomes obvious that a consensus does not exist within the profession as to the role of internal control under GAAS. We look forward to the discussion of this critical issue by Symposium participants.

Achieving The Audit Objective Is All That Really Matters

In auditing, like many other aspects of life, achieving the objective is far more important than how it is done. In other words, it is the final score that counts, not how the game is played. An analogy will serve to illustrate this point. Suppose that several individuals are in New York and all of them would like to go to Philadelphia [their objective]. One might take a non-stop airplane flight between the two cities while the second travels by train. The third might make the trip by bus and the fourth by automobile. It would also be possible to make the trip by any combination of airplane, train, bus or automobile. In fact, one could even go by boat. For each individual, the most important thing would be reaching the objective—Philadelphia. Each mode of transportation could be judged on the basis of its efficiency, effectiveness and economy in achieving the objective.

An audit [provided that we agree on the objective] is no different. Several practitioners could undertake the same audit and each could conduct the audit in a different way and yet still comply with GAAS. Once again, the important point would be that each achieved the objective [to obtain reasonable assurance that the financial statements "present fairly" (do not contain a material error)]. While the audit fee charged could vary significantly from auditor to auditor, that is not an issue that the profession need concern itself with provided that an agreed objective is being achieved by all participants. Over time, the market place should take care of any significant differences in the "value for money" being provided by practitioners.

Finally, we wish to stress that we recognize that the approach to auditing described below is not the only way to achieve the objective of an audit. We believe that the use of different audit methodologies, strategies, procedures and techniques throughout the profession is a healthy situation. We offer this as one alternative for consideration.

II. The External Audit Objective And The Elements Of An Audit Strategy

Financial data are mainly assertions of intangible facts. Their verification requires application of the techniques and methods of proof. Proof is a part of the field of logic which has been described by some as the "science of

proof.” Logic is concerned with how we establish facts, conclusions, and inferences as valid or invalid.

Mautz and Sharaf, p. 15

While some might argue otherwise, the objective of a financial statement audit is to arrive at an opinion as to the fairness (i.e. material correctness) of the client’s financial statements. There are probably as many ways of achieving this objective as there are auditors but, by and large, they all tend to have similar characteristics (we all like to confirm accounts receivable, vouch fixed assets, etc.) But what really distinguishes the good auditor is the type of questions he asks. We can all remember those auditors who asked something which, on the surface, seemed so innocuous, but led to a revelation in terms of audit findings when the client or, more likely, a third party responded. Asking good questions is the crux of good auditing.

At the outset, the auditor may address the financial statement audit objective by asking two questions:

1. What types of error can materially affect the financial statements and what must I know to be satisfied that these error types have not occurred?

or

2. What must I know to be able to conclude that the financial statements are materially correct?

Obviously, no auditor approaches audit planning by asking one of the above questions to the exclusion of the other. For example, when an auditor assesses inherent risk he must consider a question similar to the first and when he plans his substantive procedures he often focuses on questions similar to the second. The real issue, therefore, is not whether the auditor asks the first or second question, but which question he emphasizes and at what level in the hierarchy of his planning process he places that emphasis.

In many cases, the audit strategy that follows when emphasis is placed on answering the first question will differ, sometimes quite significantly, from that directed at answering the second question. While answering either of the two questions properly will obviously lead to an adequate audit, there may be opportunities for audit cost savings if one option leads to selecting less costly audit procedures than the other. Our view is that an auditor who emphasizes the second question has a better chance of selecting the most efficient combination of procedures. In this paper we will focus on the audit strategy that follows from that question.

In the next three sections, we examine the three main elements of an audit strategy:

1. The sources of audit assurance (See section III below)
2. The links between each of the financial statement item assertions and the relevant procedures (See section IV below)
3. The interrelationships among the financial statement items (See section V below).

These elements recognize that, in order to conclude as to the material correctness of the financial statements, the auditor must obtain reasonable

assurance with respect to the material correctness of each of the assertions for each financial statement item. Although their application is likely to differ, these elements do not change in any significant way if we were to adopt the first of the above questions as our basic strategy.

III. Audit Sampling, The Audit Risk Model And The Elements Of An Audit Strategy

The auditor requires evidence in order that he may rationally judge the financial statement propositions submitted to him. To the extent that he makes judgments and forms his "opinion" on the basis of adequate evidence, he acts rationally by following a systematic or methodical procedure; to the extent that he fails to gather "sufficient competent evidential matter" and he fails to evaluate it effectively, he acts irrationally and his judgments can have little standing.

Mautz and Sharaf, p. 68

The essential features of the audit risk model, and its relationship to audit sampling, can be found in the auditing literature in the 1930's and 1940's. For example, the principles underlying the second field work standard of generally accepted auditing standards, which permits a reduction in the extent of testing conditional on the quality of internal control, can be found in auditing textbooks written over 40 years ago:

In this day and age, when a business has a good bookkeeping system and a good system of internal check, a test audit, which efficiently samples the transactions throughout a period, is about as detailed an audit as one would expect to find.³

While this quotation was written in the context of comparing what we now call judgmental sampling to a **detailed** or **100 percent** audit, and hence is only partly relevant to today's environment, it nonetheless represents an important trade-off between the two fundamentally different types of audit evidence. It is implicit in the statement that the preferred form of evidence in terms of quality would be the **detailed** audit. However, the additional quality of this form of evidence was (and is) not always worth the additional cost if it was possible to place reliance on internal control and audit a sample. The reduction in quality in making the trade-off was not considered significant and was implicitly recognized in the extent of testing that became customary.⁴

The increased use of statistical sampling methods in auditing⁵ has brought with it the need to be more explicit in the related audit planning decisions. Proper planning of statistical audit samples requires an explicit recognition of the desired sampling precision and the sampling risk. While it is not quite so simple, the sampling precision will be determined largely by materiality considerations which leaves sampling risk as the controllable variable.⁶ It is the sampling risk that is influenced by the availability of alternative forms of audit evidence.

Over time, auditors have developed formal (and informal) methods of analyzing the effect on sampling risk of the strength of internal control and other audit procedures such as analytical review. This led to the audit risk model.

The audit risk model has taken on a variety of different forms over the past twenty years. The AICPA's SAP 54 model published in 1972 is a discrete joint risk model in which the audit risk is expressed as the product of the internal control risk and the substantive testing risk. Teitlebaum [1973] illustrated the Bayesian approach to the audit risk model and the pre-audit sample concept of defining priors. The SAP 54 model was subsequently extended by Stringer [1975] to explicitly recognize analytical review risk separate from the substantive sampling risk. Anderson [1977] presented audit sampling using an audit risk model which explicitly recognized the role of inherent risk together with the Bayesian interpretation [illustrated by Teitlebaum] in an auditing context. Anderson's approach is further described in Leslie, Teitlebaum and Anderson [1979] and in the CICA's Extent of Audit Testing Research Study [1980].

The logical evolution of the Anderson-CICA model is presented in Leslie [1984, 1985] in which the effect of preventive internal controls is distinguished from the effect of detective internal controls. (The essential Bayesian character of inherent risk assessment is also clarified in Leslie's paper.) The conditional dependency of the existence of preventive internal controls on inherent risk leads to the prior probability of error concept. The audit risk model we shall consider here is an adaptation of Leslie's model.

Our discussion has focused on a risk-based approach directed at determining substantive sampling risk. Anderson [1977, p. 130] introduced the degree of assurance concept as the complement of the combined component risks (i.e. inherent, control, and audit?). By recognizing the complement of each of the individual component risks, we introduce the source of assurance concept and the assurance-based approach to auditing.

The shift from a risk-basis to an assurance-basis is, on the surface, not a dramatic step nor is it anything fundamentally new. In fact, some firms have been using the risk-complement approach of recording their risk assessments for years.⁸ Our move to this approach was originally made because it was considered easier to use than the risk-based approach. However, the shift has the potential for facilitating a significant shift in philosophical attitudes towards auditing. In the previous section we presented two alternative auditor questions from which an audit strategy could be derived. The first question asked "what can go wrong?" and proceeds along a risk-based approach whereas the second question asked "how could the auditor know something was correct?" and proceeds using a proof-based thinking process. The risk-complement (source of assurance) approach can be effectively applied under a risk-based philosophy, but its full potential is only realized under an assurance-based philosophy.

Under the risk-based philosophy, the extent of detailed testing is viewed as a focus for the risk analysis and the effect of each risk assessment is either to increase or decrease the testing extent. The approach requires an analysis of the possible causes of error and then an assessment of the chance of each type of error occurring. This necessarily leads the auditor to invest time and effort into reviewing and evaluating the internal control system because the system will be a major factor in the assessed risks. There is no doubt that this risk-based approach is effective and, for the most part, efficient. Indeed, our firm has been using this approach since the 1960's⁹ and during the last five years has moved more towards the assurance-based alternative.

The philosophical argument supporting the assurance-basis states that it is generally more persuasive and efficient to establish the general validity of an assertion than it is to enumerate the possible ways the assertion could be incorrect and then check each of these possibilities. Thus, in an assurance-based approach, the material correctness of a particular financial statement item assertion is an implicit hypothesis for which the auditor selects a combination of sources of assurance which may support the hypothesis. The combination is chosen within the constraints of available assurance (e.g. poor internal controls provide no assurance) to achieve the objective in the least costly way.

The audit assurance model we use, therefore, consists of the following principal components:

- | | |
|--|---|
| Inherent nature of the item | <ul style="list-style-type: none"> • the complement of inherent risk, which is defined in the usual way. |
| Preventive internal controls | <ul style="list-style-type: none"> • As explained in Leslie et al.[1979] and in Leslie[1984, 1985], preventive internal controls are related to the level of inherent risk. The greater the inherent risk, the greater the need for preventive controls and conversely. The combined assessment of inherent risk and preventive internal controls is referred to as the prior probability of error. |
| Compliance procedures (applied to preventive controls) | <ul style="list-style-type: none"> • The assurance from compliance procedures is related to the existence of suitable preventive internal controls and helps support the assessment of prior probability of error. |
| Detective internal controls | <ul style="list-style-type: none"> • Detective internal controls are applied subsequent to the processing of data and increase the likelihood of detecting any errors which may have occurred and hence supports the assessment of prior probability of error. (Compliance procedures on detective controls are part of the detective internal control identification process.) |
| Analytical review | <ul style="list-style-type: none"> • The degree of assurance from analytical review depends upon whether a judgmental or regression analysis-based analytical review is being conducted. For regression analysis-based analytical review, the assurance level is determined primarily by the |

software whereas in the case of judgmental analytical review the assurance level depends upon the quality of the analytical review as assessed on a judgmental basis.

Other substantive sources

- These sources include substantive sampling together with other non-sampling substantive procedures.

In addition to the above sources of assurance, the approach also permits the explicit recognition of assurance from audit procedures directed at other financial statement assertions as explained below in section V. A practical illustration of the above assurance matrix structure is presented in Figure 2 which shows a Source of Assurance Plan for a particular financial statement assertion. Note the various minima and maxima and the highlighting of the prior probability of error. The risk-complements are recorded using Poisson factors ($-\ln \beta$) which, for purposes of acceptability by our practitioners, we have called assurance factors.

One aspect of the use of the assurance-based approach in contrast to the risk-based approach is the psychological effect of expressing the various assessments using the *positive* rather than *negative* perspective. The positive approach also facilitates discussion of testing extents and related assurance levels with clients who find it easier to understand that a procedure is adding assurance rather than reducing risk.

Technical Interlude: Inherent Risk, Smoke, and Fire

In the above discussion, the role of compliance testing was mentioned only briefly. From the source of assurance plan it is apparent that compliance procedures, which may include sampling, are directed at supporting the assessment of the assurance from preventive internal controls. Our approach to compliance testing has been based upon Dollar-unit sampling and makes an explicit assumption as to the relationship between the frequency of compliance deviations and the occurrence of monetary errors. The approach assumes a three-to-one ratio between *smoke* (i.e. compliance deviations) and *fire* (i.e. monetary error). This assumption has been discussed extensively by Leslie [1985]. In this technical interlude, we introduce a model which indicates that the actual ratio is dependent upon the inherent risk.

Consider a transaction stream of sales invoices totalling \$1,000,000 in which all invoices are \$1 and are either correct or 100 percent overstated, i.e. the customer should not have been charged at all. Materiality is \$30,000 and the invoice pricing process is such that for this audit year, the sales stream has a 20 percent error rate **before** the effect of *preventive* internal controls. Suppose the client has an independent price-check control procedure which is 100 percent effective when it is applied to a particular invoice and the only method of determining whether the checking procedure is applied is to examine the invoice. The issue is to determine the extent of compliance test that is necessary in order to have 80 percent confidence that a material error is not present after the effect of internal control.

Figure 2

SOURCE OF ASSURANCE PLAN																						
CLIENT _____	YEAR-END _____																					
GENERATING COMPONENT	ASSERTION																					
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> OVERALL LEVEL OF ASSURANCE REQUIRED (Note 1) </div> <div style="text-align: right; margin-right: 20px;"> A </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> SOURCE OF ASSURANCE (Notes 3 to 7) </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> ASSESSMENT OF PRIOR PROBABILITY OF ERROR (PPE) </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> INHERENT ASSURANCE (D-2.0) </div> <div style="text-align: right; margin-right: 20px;"> B </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> EXISTENCE OF PREVENTIVE CONTROLS (1.0) </div> <div style="text-align: right; margin-right: 20px;"> C </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> ASSURANCE FROM ASSESSMENT OF PPE (B plus C) </div> <div style="text-align: right; margin-right: 20px;"> D </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> RELIANCE ON DETECTIVE CONTROLS (1.0) or COMPLIANCE PROCEDURES (1.0) </div> <div style="text-align: right; margin-right: 20px;"> E </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> ASSURANCE OBTAINED BEFORE SUBSTANTIVE SOURCES (D plus E) </div> <div style="text-align: right; margin-right: 20px;"> F </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> ANALYTICAL REVIEW -JUDGMENTAL (0-1.5) -CGDATA (1.0-3.0) </div> <div style="text-align: right; margin-right: 20px;"> G </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> OTHER SUBSTANTIVE PROCEDURES </div> <div style="text-align: right; margin-right: 20px;"> H </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> SECONDARY SUBSTANTIVE SOURCES </div> <div style="text-align: right; margin-right: 20px;"> I </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> TOTAL ASSURANCE OBTAINED (F plus G plus H plus I) N.B. must be equal to or greater than A </div> <div style="text-align: right; margin-right: 20px;"> J </div>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 15%;">ASSURANCE FACTOR</th> <th style="width: 75%;">REFERENCE or DESCRIPTION (NOTE 2)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: middle;">M A X I M U M</td> <td style="text-align: center; vertical-align: middle;">2.0</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">M I N I M U M</td> <td style="text-align: center; vertical-align: middle;">1.0</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>		ASSURANCE FACTOR	REFERENCE or DESCRIPTION (NOTE 2)	M A X I M U M	2.0								M I N I M U M	1.0							
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Let r be the rate of compliance deviations. Assuming the inherent error is evenly distributed throughout the population and the compliance deviations also occur evenly, the expected net error rate after the application of controls is $.2r$. To meet our audit objective, we must compliance test so that there is only a 20 percent chance that $.2r > \$30,000/1,000,000$ where r is the upper limit of compliance deviations at an 80 percent confidence level. Using discovery sampling, the Poisson factor for 80 percent is 1.61 and hence the sample size is $1.61/(.03/.2)$ or 11 items. This compares with a sample size of $1.61 \times 1,000,000/(3 \times 30,000)$ or 18 when a 3:1 ratio assumption is used. Obviously, in this example, the actual ratio of compliance deviations to monetary errors is 5:1 (i.e. 1/20 percent). Applying similar reasoning to the general case in which the inherent error rate is p , the actual ratio of compliance deviations to monetary errors will be $1/p$. Thus, if the population had a 10 percent inherent error rate, then a 10:1 ratio would be satisfactory whereas a 50 percent inherent error rate would need a 2:1 ratio.

Obviously this example is extremely simplified, not only in the specific audit context but more importantly in the somewhat naive statistical approach taken. A more realistic model might use a Bayesian approach for inherent risk but would certainly need a more probabilistic approach to the distribution of monetary errors and of compliance deviations. Nonetheless, the example serves as an indication that in high inherent risk situations (i.e. when high inherent error rates are more likely) the ratio of compliance deviations to monetary errors will probably be lower than if the inherent risk were less. More research into this issue seems warranted.

IV. Assertions And The Links To Internal Control Procedures And Audit Procedures: Procedure Packages

Auditing is concerned with the verification or testing of financial statements and similar data. Such data consists of a series of assertions. . . . The total number of assertions included in a set of financial statements is considerable, but our interest here is in the essential nature of these propositions, not in their number.

Mautz and Sharaf, p. 79

In the previous section we described the source of assurance concept which categorizes audit procedures by the nature of the audit evidence they provide. As was noted, the assurance sources are organized by financial statement assertion which makes the linking of procedures (both internal control procedures performed by the client and audit procedures performed by the auditor) to assertions, a key element of an assertion-oriented audit strategy. This linking deals with the **relevance** aspect of the audit evidence that is obtained.

For example, a numeric continuity internal control procedure on work orders is relevant to the revenue completeness assertion as is the audit procedure of comparing paid service personnel hours with service revenue. Similarly, the internal control procedure of checking invoice pricing is relevant to revenue measurement as is the audit procedure of testing invoice pricing. These are examples of procedures linked to transaction stream assertions [revenue completeness and revenue measurement].

Internal control procedures are generally linked to transaction streams and not balance sheet items, as the latter are usually residuals of the netting of the underlying transaction streams. For example, the accounts receivable balance is the residual of the revenue and cash receipts streams. An exception to this is inventory when the inventory balance is derived from the inventory count and not from the underlying transaction streams, purchases and cost of goods sold. In this case the client may have controls over the count such as a second employee checking the count figures, an example of an internal control procedure directed at a balance sheet item.

Audit procedures may be linked to transaction stream assertions or to balance sheet item assertions. An example of the latter would be inventory pricing tests, an audit procedure relevant to inventory valuation.

The linking of procedures to assertions is usually straightforward. However, there are some twists. For example, a particular procedure may be relevant to more than one financial statement item assertion as is the case with a receivables circularization, an audit procedure which is relevant for both the existence assertion and the valuation assertion (with respect to overstatements and, to a much lesser extent, with respect to understatements).

The above discussion has focused on individual procedures. However, what is normally required is a **package** of procedures which jointly provide evidence relevant to a particular assertion. For example, the receivables circularization must be accompanied by adding the receivables trial balance and reconciling it to the general ledger in order to properly address the existence assertion. Similarly, when looking at internal control procedures to place reliance on internal control, the auditor considers a package of procedures. The package of procedures must be complete in the sense that the appropriate **environmental** controls are present (for example, controls over program maintenance, master file changes, proper segregation of duties) and the package of controls covers all steps in the accounting process, from initiation to the final recording in the general ledger. For example, the package of internal control procedures relevant to revenue measurement would not only include the checking of invoice pricing but also controls over the master price lists and the recording of invoices in the revenue journal.

In principle, the link between assertions and procedures can be followed in either direction, from assertions to procedures or procedures to assertions. The audit strategy described here is **driven** by assertions and thus the link is made from assertions to procedures. Alternative audit methodologies which make the link from procedures to assertions are **procedures-driven**. In these latter methodologies, **assertions are recognized** but are not the driving force behind the audit planning. In our practice we believe the **assertion-driven** methodology has some advantages over the alternative because it asks the question **why** before deciding **how**. It is more flexible since the auditor can plan to select, using a source of assurance plan within the constraints of the situation, the most economical combination of procedures packages that are relevant for each assertion.

One aspect of the above flexibility is the non-mandatory nature of a review and evaluation of internal control. An auditor would still carry out a review of the internal control environment and obtain knowledge of the client's accounting systems (this is consistent with the minimum level of review of internal

control as described in SAS 43) but a review of **internal control procedures packages** would only be carried out for those internal control procedures packages on which the auditor intends to rely.

This approach to internal control is consistent with emphasizing the second question in section II at the strategic planning level. If the first question had been emphasized, the auditor would normally require a review of the specific internal control packages to identify where in the process errors **could** occur. Using the assertion-oriented approach at the strategic planning level permits the strategy decision to be made before the auditor applies the “what can go wrong” approach at the detailed level.

Technical Interlude: Internal Control in the Audit Environment

As can be seen from the preceding discussion, internal control is treated as one of a number of sources of assurance for the auditor. There are two implications of looking at internal control in this way. The first is that the auditor should review and evaluate internal controls only when it helps to achieve the audit objective (obtaining sufficient appropriate/competent audit evidence) in the most cost-effective way possible. The second is that the auditor should review and evaluate internal controls when it is necessary in order to achieve the audit objective, i.e., when the only reliable method of obtaining sufficient appropriate audit evidence requires the auditor to look to internal control as a major source of assurance. This latter case arises most frequently when the auditor is concerned about the completeness assertion—for example, completeness of deposits in a deposit taking institution. Looking at internal control in this way flows logically from the question “What must I know to be able to conclude that the financial statements are materially correct?”

Viewing internal control in this way also logically leads to the view that the second examination (field work) standard can be eliminated from generally accepted auditing standards. Auditing is an audit evidence gathering process. The review and evaluation of internal control is one part of this process. It can be subsumed within the existing third examination (field work) standard—the audit evidence standard.

V. Interrelationships Among the Financial Statement Items

Part of an auditor's task is to recognize the subsidiary assertions contained within any financial statement propositions. Only if these are identified can evidence be obtained to support or contradict each one. Failure to identify all subsidiary propositions is failure to recognize the full scope of the audit problem. This in turn makes the obtaining of adequate evidence and fully rational judgment most unlikely.

Mautz and Sharaf, p. 104

The third element of the assertion-oriented audit strategy is a structure which takes into account the interrelationships among the financial statement item assertions that arise from the accounting model. The recognition of the interrelationships is crucial in the development of a cost-effective audit strategy. Needless to say, the basic accounting interrelationships here amount

to elementary bookkeeping concepts and can be found, in one form or another, in any practical audit approach.

The starting point for identifying the interrelationships are the accounting cycles (e.g. sales/receivables/receipts, purchases/payables/payments). Looking at the accounting cycle, sales/receivables/receipts, the relationship between the accounting cycle components can be expressed in the form of a simple arithmetic equation:

$$\begin{aligned} & \text{Receivables (beginning of year) + Revenues (during the year)} \\ & - \text{Cash receipts (during the year) = Receivables (end of year)*} \end{aligned}$$

* prior to considering bad debt provision and write-offs.

Given the above relationship, it seems obvious that procedures addressing the assertions related to the transaction streams—revenue and cash receipts—should also provide assurance with respect to the assertions related to the receivables and vice versa, procedures addressing receivables' assertions should also provide assurance with respect to the underlying transaction stream assertions.

To account for the assurance from the procedures in an appropriate manner, the auditor needs to link transaction stream assertions to the related balance sheet item assertion. This can be readily accomplished by considering, for each transaction stream assertion, what balance sheet item assertion would be affected if the transaction stream assertion was not supported. For example, consider revenue -occurrence. The impact of a revenue - occurrence error on the balance sheet item accounts receivable would be the recording of a non-existent receivable balance and therefore revenue - occurrence is linked to receivables - existence. Similarly, if all cash receipts were not recorded (i.e. cash receipts - completeness error), then again this would result in non-existent receivables balances. Therefore, cash receipts - completeness is linked to receivables - existence. Links between all transaction stream assertions and related balance sheet item assertions can be established in a similar manner. The following simple rules may be used as a shortcut to correctly identify the links.

Balance Sheet Item Assertion	Related Transaction Stream Assertions
1. Valuation	Measurement.
2. Existence	Occurrence if transaction increases balance sheet account. Completeness if transaction decreases balance sheet account.
3. Completeness	Completeness if transaction increases balance sheet account. Occurrence if transaction decreases balance sheet account.

An auditor would consider the interrelationships among the financial statement item/transaction stream assertions in developing an audit strategy

which produces a cost-effective combination of **procedure packages**. For some assertions, the greater part of the assurance required may be obtained from procedure packages linked to the balance sheet item assertion whereas, for other assertions, the greater part of the assurance required may be obtained from procedure packages linked to the transaction stream assertions. For example, in many situations the greater part of the assurance required with respect to receivables - existence is obtained from the receivables circularization whereas the greater part of the assurance required with respect to receivables - completeness is obtained from audit procedures, and control procedures, directed at revenue - completeness and cash receipts - occurrence.

An important consequence of these accounting interrelationships is their effect on the audit assurance that is applicable to a particular financial statement assertion. For example, the audit assurance on accounts receivable - existence will depend, in part, upon the assurance on revenue - occurrence and on cash receipts - completeness. However, since an existence error in accounts receivable could arise from either the revenue stream or the cash receipts stream, the combined assurance from sources directly connected with the related streams that is applicable to accounts receivable - existence cannot exceed the minimum assurance from either of the two related streams. This particular consequence is the main result of recognizing the effect of accounting interrelationships. In our experience, its effect has been somewhat less than explicit in many existing audit strategies. [See Appendix A for A BAYESIAN MODEL FOR COMBINING INFORMATION.]

VI. Audit Evaluation As The Start Of The Planning Process

Because the auditor determines the type of audit evidence pertinent to his needs, then collects that evidence, and finally uses it in arriving at judgments, it behooves him to take special precautions in reviewing it for pertinence, credibility, and usefulness.

Mautz and Sharaf, p. 106

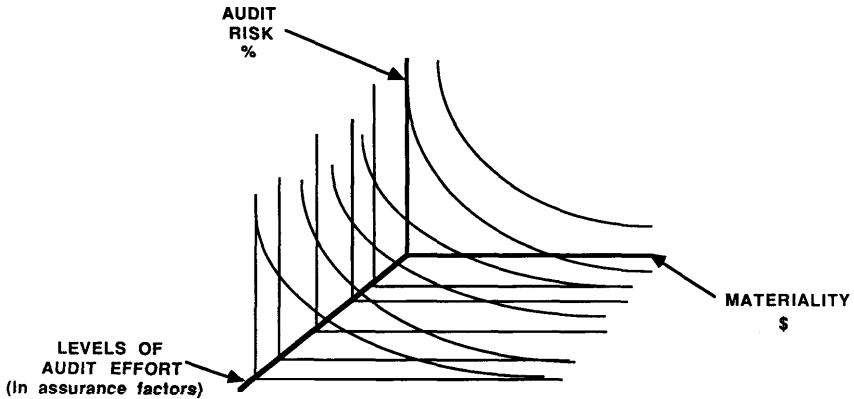
Planning an audit is like planning anything else. If you do not have a reasonably clear notion of where you are going, then you should not be surprised at where you end up. But to know where you end up, you have to be able to determine where you are at a point in time. Audit evaluation is how the auditor determines the state of his opinion on the client's financial statements, i.e., where he is at a point in time.

Audit evaluation is multi-dimensional. On the one hand, the auditor deals with the concept of materiality and its relationship to the errors (or departures from generally accepted accounting principles) in the financial statements while on the other hand the auditor must deal with the degree of assurance he has in his audit opinion. This multi-dimensional viewpoint is illustrated in Figure 3.

Thus, an audit evaluation consists of an estimate or projection of the error in the client's financial statements together with some perception or measure of the degree of assurance that the auditor has with respect to the estimate. The former depends primarily on the actual error in the client's financial statements whereas the latter depends primarily on the intensity of the audit work.

Figure 3

**MATERIALITY AND AUDIT RISK GRAPHS
FOR DIFFERENT LEVELS OF AUDIT EFFORT**



Our approach for summarizing the errors on an audit focuses on their effect on pre-tax income but also recognizes their effect on the rest of the financial statements. The achieved¹⁰ degree of assurance is summarized on the various source of assurance plans. The combined effect of these two evaluations is the maximum possible error in pre-tax income which includes the SAS 47 concept of an allowance for further undetected error in addition to the most likely error. Given this approach to audit evaluation, the planning process involves important judgments as to a reasonable materiality level and an indication of the desired overall degree of assurance for the auditors' opinion. We have not introduced anything new in this section because the approach we use for dealing with audit evaluation is already described in existing literature.¹¹

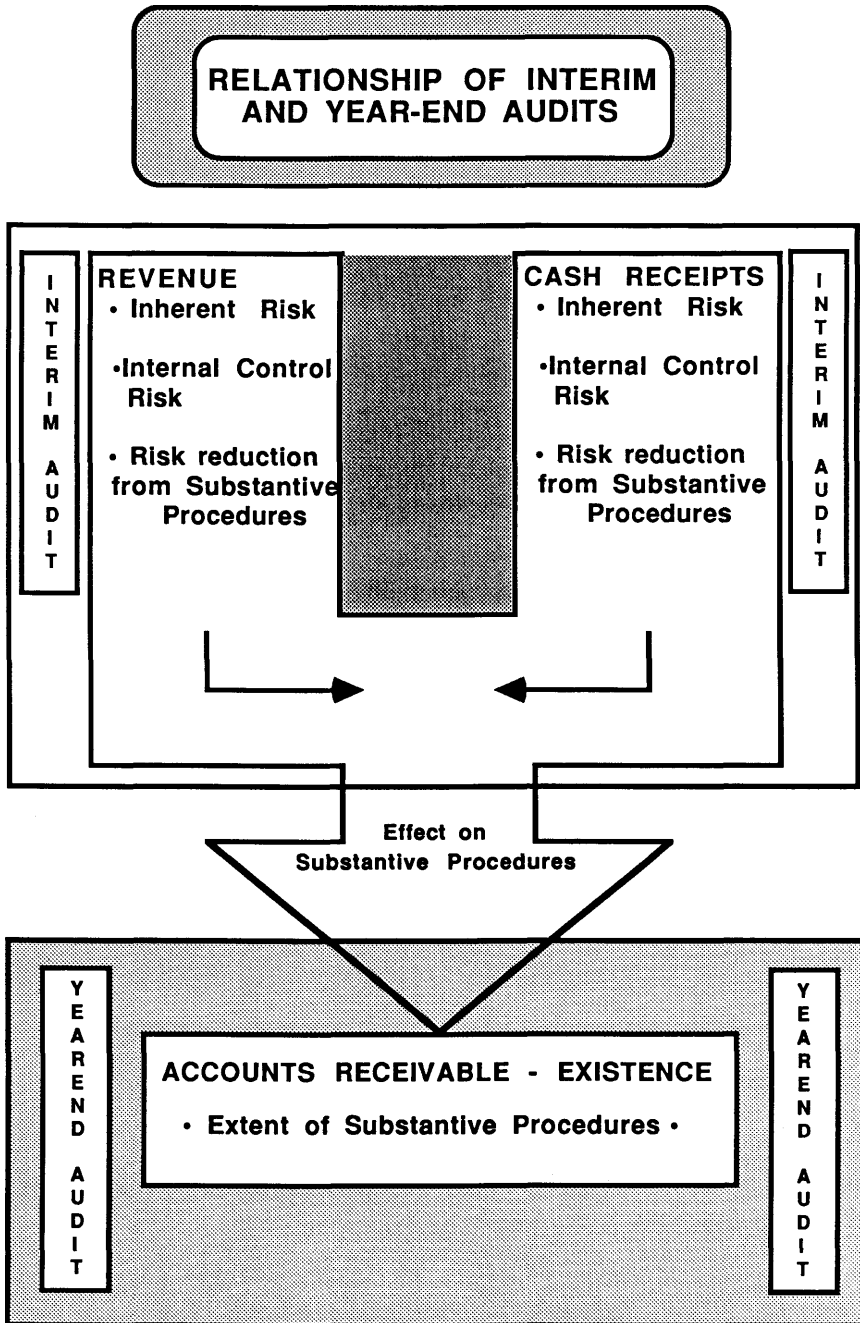
VII. Operationalizing The Elementary Concepts In A Practical Audit Methodology

Audit evidence is obtained through the application of the basic audit techniques in the form of procedures designed to fit the specific situation.
Mautz and Sharaf, p. 100

The various audit methodology components we have discussed in the last four sections can be found in the structure of any practical and effective audit strategy. They do not represent a fundamentally new discovery, but they do represent a way of thinking about the audit process that has the potential for changing the perspective some auditors take in their work.

For example, an auditor who follows a risk-based strategy would view the audit of accounts receivable-existence along the lines shown in Figure 4. The two transaction streams, sales and cash receipts, would be audited during the current or interim audit, either by transaction testing or internal control work,

Figure 4



and the accounts receivable-existence assertion would have been audited during the balance sheet or financial statement audit. This customary division of the audit process into two stages separates the often complex internal control system components from the comparatively simpler balance sheet accounts.

The perspective we have described in the previous sections attaches assertions to the transaction streams in the diagram (i.e. sales-occurrence and cash receipts-completeness) and then organizes the various sources of assurance (or risk elements, if the risk-based approach is preferred) according to their relevance to the particular assertions. Instead of burying the complexity of the client's business in an interim audit file, in which the links to the financial statement assertions may be difficult to identify, even when reviewed by the audit partner, the essential structural complexity of the client's business operation is brought forward and highlighted as an integral part of the audit process. This is illustrated in Figure 5.

The shift we are making is therefore not merely to introduce some new terminology or to call risk by another name. We are shifting our audit thinking to a more comprehensive level that deals with each of the sources of assurance in a consistent manner. In order to make practical use of this audit methodology, we need to deal with the now more visible complexity.

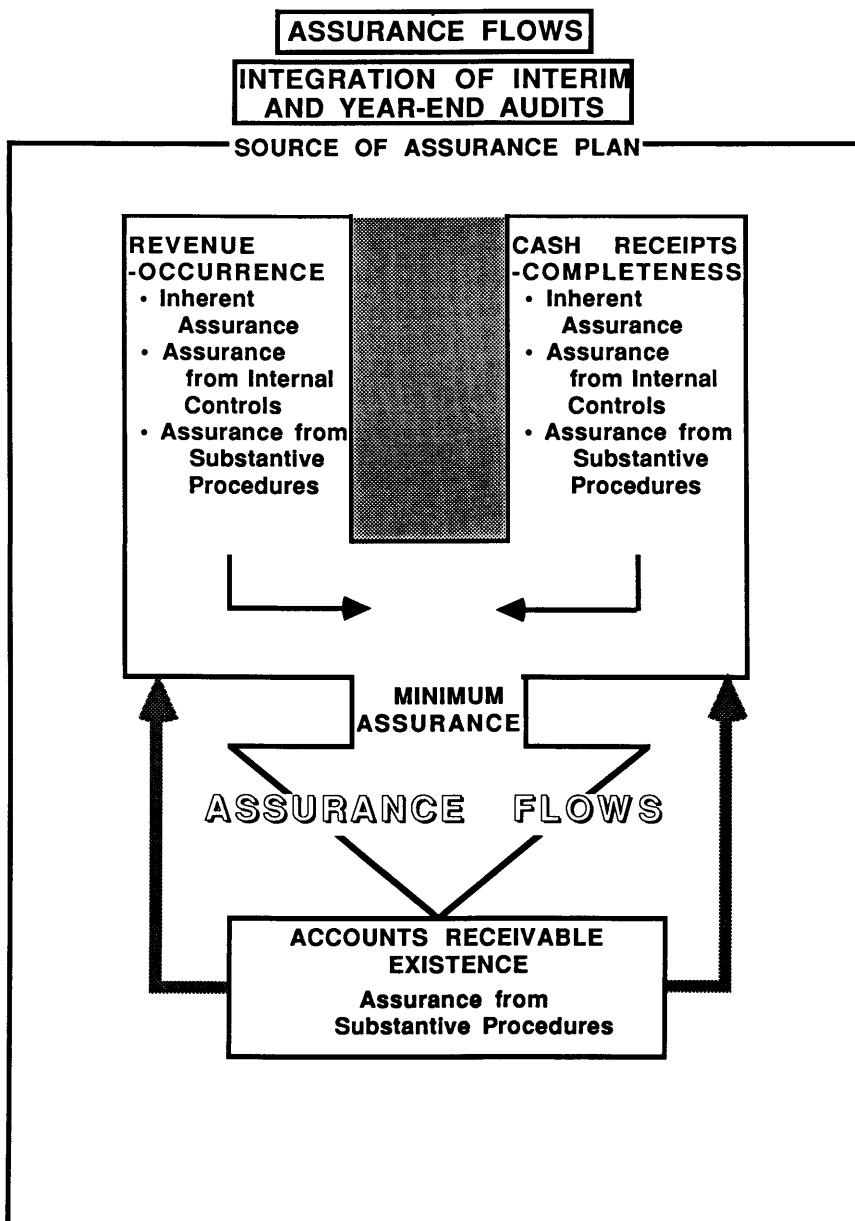
A large portion of the complexity in the planning process is due to the effect of the interrelationships among the financial statement items' assertions (see section V). This aspect can be simplified (and ultimately automated) through an audit strategy structure which permits the use of some simple rules based on accounting cycles.

The first simplification is to achieve some parsimony in the planning process. This can be accomplished if the audit strategy is organized so that each accounting cycle is included once and only once. The auditor would start out by listing the **derived components**. The derived component¹² of an accounting cycle is the component for which the value is derived from the netting of the related components. In other words, the derived component is an image of the net results of its related components at a point in time (e.g. receivables usually represents the netting of revenue less cash receipts at a point in time).

Balance sheet items will usually fall under this definition, whereas income statement items and other transaction streams such as cash receipts will not.¹³ Double-entry accounting ensures that an accounting cycle will always include one and only one derived component and therefore organizing the audit strategy by the derived components ensures that each accounting cycle is included once and only once.

The prior probability of error and the effect of internal control on the audit assurance is relevant only to the **generating components** of the accounting cycle, i.e. those components which are **not** derived. The generating components determine the value of the derived component. Because of its residual balance nature, the sources of assurance for a derived component do not directly include the prior probability of error or the assurance provided by internal controls. Typically, generating components involve transaction streams such as sales and cash receipts. For controls such as safeguarding inventory, it will often be necessary to attach the controls to a related transaction stream

Figure 5



assertion. This arises when planning for an inventory roll-forward situation since the inventory balance is derived and cost of goods sold is generating.

The audit planning process can then focus on an accounting cycle's derived component for a detailed analysis of the assurance sources in the components of the accounting cycle which affect the derived component. To perform this analysis the auditor would, for each derived component assertion, identify the related generating component assertions along the lines given in section V. For example, for the sales/receivables/receipts cycle the following relationships would be identified:

Derived Component Assertions	Related Generating Component Assertions
Receivables - Existence/Ownership	Revenue - Occurrence Cash receipts - Completeness
Receivables - Completeness	Revenue - Completeness Cash receipts - Occurrence
Receivables - Valuation ¹⁴	Revenue - Measurement Cash receipts - Measurement

As explained in section V, assurance may be obtained from a combination of procedure packages addressing transaction stream assertions (usually generating component assertions) and balance sheet item assertions (usually derived component assertions.) In principle, the auditor could directly plan to obtain the required overall level of assurance on each of the derived component assertions for the entire audit. However, from our discussions of accounting interrelationships, this would clearly involve a considerable amount of duplication and would be unduly complicated. In some cases overauditing may occur whereas in others there may be some underauditing. The solution is to employ the following **direction of assurance** rules in the development of the audit strategy.

If the derived component assertion is:

1. asset → existence/ownership
2. liability → completeness
3. expense → occurrence
- or
4. revenue → completeness

a **Source of Assurance Plan** [SAP] will be set up whereby the assurance required from procedure packages directed at the derived component assertion will be reduced by the minimum of the assurance from sources directed at the related generating component assertions.

If the derived component assertion is other than one of the four listed above, no procedures directed at the derived component assertion will be planned. Instead, all the required assurance will be obtained from audit plans providing overall assurance with respect to each of the related generating component assertions. If the related generating component is already included on another audit plan then no further planning is required for that related generating component assertion.

By following these direction of assurance rules **throughout** the entire audit plan, it can be shown that:

1. The assurance required from procedures directed at a derived component assertion is reduced by the minimum assurance obtained from procedures directed at the related generating component assertions.
2. The assurance obtained from procedures directed at the derived component assertion also provides the same level of assurance with respect to each of the related generating component assertions.

[See Appendix B for a proof of this **DIRECTION OF ASSURANCE THEOREM**]

Continuing with the example of receivables and following the direction of assurance the following plans would be required:

1. receivables → existence
2. revenue → completeness
3. revenue → measurement

Cash receipts - occurrence and measurement would be addressed by the cash plans. An example of a receivables-existence SAP is shown in Figure 6. Note

Figure 6

SOURCE OF ASSURANCE PLAN		
CLIENT <u>ABC LIMITED</u>		YEAR-END <u>JULY 31, 1986</u>
DERIVED FINANCIAL STATEMENT ITEM <u>ACCOUNTS RECEIVABLE</u>	ASSERTION <u>EXISTENCE</u>	
GENERATING COMPONENTS	#1: REVENUE - OCCURRENCE	#2: CASH RECEIPTS - COMPLIANCE
OVERALL LEVEL OF ASSURANCE REQUIRED (OVER 1)	3.7	
SOURCE OF ASSURANCE (OVER 2)	ASSURANCE FACTOR	ASSURANCE FACTOR
DIRECT ASSURANCE (0-2, 0)	REFERENCE OR IDENTIFICATION (OVER 2)	REFERENCE OR IDENTIFICATION (OVER 2)
EXISTENCE OF PREVENTIVE CONTROLS (1, 0)	1.5	0.5
ASSURANCE FROM ASSESSMENT OF PRC (IN STATE 1)	Consistent volume of transactions throughout year; revenue levels predictable.	1.0
RELIANCE ON DETECTIVE CONTROLS (1, 0) OR COMPLIANCE PROCEDURES (1, 0)	1.5	1.5
ASSURANCE OBTAINED BY THE AUDITOR (OVER 1)		1.5
APPLICABLE REVIEW - SUBSTANTIVE (0-1, 5) - COEXTA (1, 0-3, 5)	1.5	1.5
OTHER SUBSTANTIVE PROCEDURES		
SECONDARY SUBSTANTIVE SOURCES		
ASSURANCE OBTAINED BY THE AUDITOR (OVER 1)	1.5	1.5
	Total of	
	1.5	2.2
DERIVED COMPONENT	ASSURANCE FACTOR	ASSURANCE FACTOR
SOURCE OF ASSURANCE (OVER 2)	REFERENCE OR IDENTIFICATION (OVER 2)	REFERENCE OR IDENTIFICATION (OVER 2)
ASSURANCE OBTAINED BY SUBSTANTIVE PROCEDURES - OTHER PROCEDURES	1.5	2.2
APPLICABLE REVIEW - SUBSTANTIVE (0-1, 5) - COEXTA (1, 0-3, 5)		Accounts Receivable Circularization
OTHER SUBSTANTIVE PROCEDURES		
TOTAL ASSURANCE OBTAINED (OVER 1, STATE 2) U.S. MUST BE EQUAL TO OR GREATER THAN 2	3.7	

how the generating components play an explicit role here when the plan is directed at a derived component. (The SAP in Figure 2 is for generating components only.)

Obviously, if the above approach was followed for all accounting cycles in a client's business, the number of components and plans would likely be unmanageable. To simplify the process, we categorize accounting cycles as major (i.e., with a material amount and a large number of transactions) and as minor. The above process is applied to the major accounting cycles. For the minor accounting cycles such as prepaids and long-term debt (in some cases), the auditor usually employs a package of substantive procedures directed at the derived component assertions without performing a detailed analysis by source of assurance.

VIII. Automation

Since micro-computers did not even exist in 1961, Mautz and Sharaf can be forgiven for not addressing their eventual role in automation of the audit.

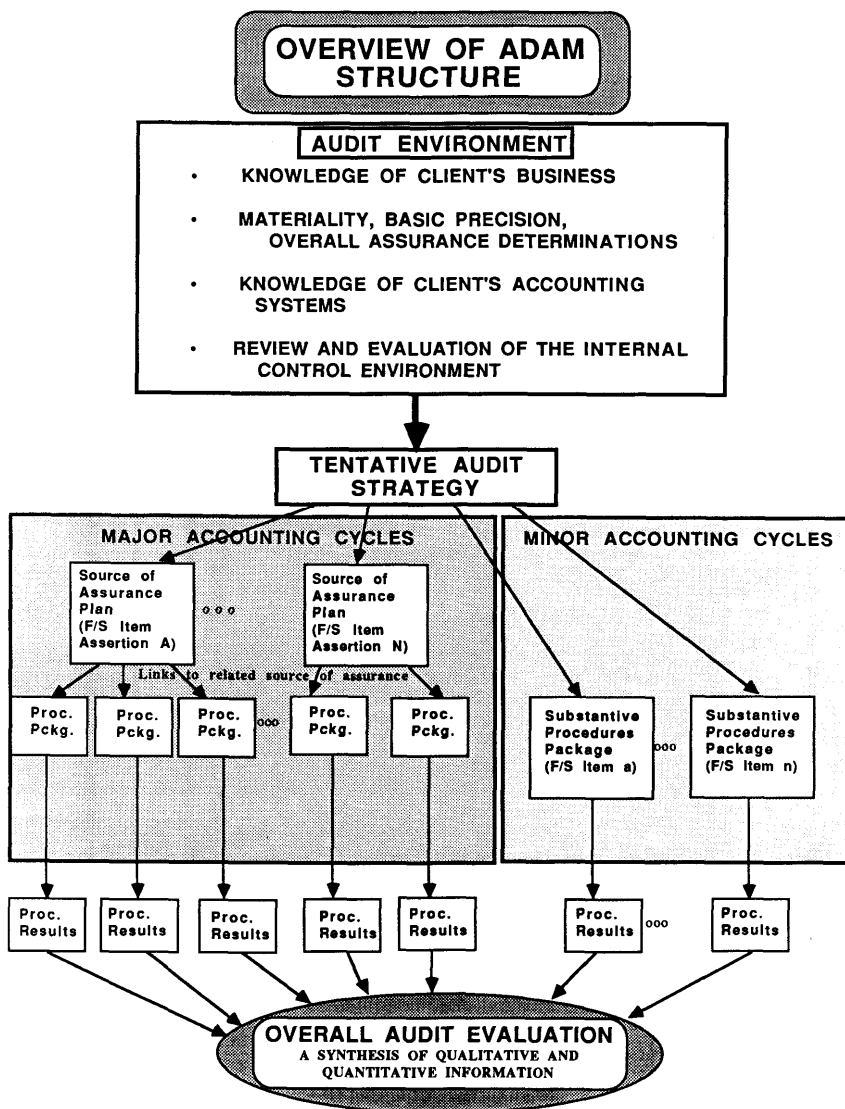
L, A, C & R

With the dramatic increase in the use, and usefulness, of microcomputers in accounting firms, it should not come as a surprise that the audit methodology we have described in this paper has been automated for use on microcomputers. The software, which we have called ADAM¹⁵ [audit decision assistance modules], runs on IBM-XT's and compatible computers and has been under development since 1982. During the development period, progressive versions of the software have evolved in a series of prototypes, paralleling the evolution of the audit methodology during this period. The current version of the software has been in limited field use since mid-1985 and we anticipate increasing use throughout our practice.

In the previous section, we commented on the inherent complexity of the audit planning process when the role of the client's internal control system is highlighted at the planning stage. Although we use simplifications in the methodology to deal with this complexity, there remain a number of areas where automation can be of assistance.

Figure 7 is a functional schematic of ADAM which shows some of the logical links between the various functions. Staff using ADAM begin by entering some overall planning information, including decisions on planning materiality and the overall level of assurance for the audit, and then summarize their knowledge of the client's accounting system by setting up the financial statement components and the principal journal entries. Staff then identify the major and minor accounting cycles and use ADAM's tentative audit strategy (TAS) modules which automatically develops a customized TAS, setting up the linkage structure from the TAS to the source of assurance plans, procedure packages and results that is appropriate for the particular client. The ADAM SAP's are essentially the same as those presented in Figures 2 and 6 but they are automated and integrated with the underlying procedure packages. The procedure packages include standard audit questionnaires together with automated planning for representative compliance and substantive sampling

Figure 7



applications. The latter are integrated with the overall planning decisions, representative sample selection, sample evaluation and overall audit evaluation.

Needless to say, we believe ADAM represents the automation of a substantial portion of the technical audit planning and evaluation task and feel that it is a major step towards an automated audit file.

IX. Prospectus

In the past, auditing has been conceived only as a practical subject with little need for or possibility of any underlying theory. Thus attention has been given to its practical applications to the almost complete exclusion of theoretical considerations. We hope we have indicated the close connection between the theory and practice of auditing, for we are convinced that the only sure solution to practical problems is through the development and use of theory. Auditing stands at the threshold of service opportunities we can as yet scarcely foresee, even in dim outline. With a well-developed theory it will not only be prepared to take advantage of such opportunities but will be able to escape confusion and misplaced effort in its desire for real service.

Mautz and Sharaf, p. 248

Auditing is a pragmatic art. In order for it to continue to be of economic value to society, auditing must continue to address society's needs which are not static but ever changing, ever evolving. The demands placed upon auditors should be expected to evolve over time, albeit at a gradual pace. As new economic entities, transactions and activities are created, as some increase in importance and others decline in importance, it will be impossible for the auditing profession to stand still. There is no such thing as a status quo when faced with the inexorable march of time.

Audit methodology deals primarily with the **how** of auditing and to a large degree it is reactive to the audit requirements imposed by society. These requirements are, by far, the most significant factor in the evolution of audit methodology. But to some extent, audit methodology is proactive since new audit techniques may permit the auditor to broaden the scope of his responsibilities and address issues that were previously impossible or uneconomic to deal with. Obviously, future audit methodologies will result from the interplay of these two factors.

Current professional developments, such as the introduction of attestation standards and standards for reporting on forecasts and projections, are responses to the needs of society. These expanded requirements will probably lead to some changes in existing audit methodologies as our present strategies are extended to provide the service. The extension of the SAS 47 risk model to the broader range of assertions contemplated in the attestation standards is one example of this evolution.¹⁶

One area to which a great deal of attention is being directed at present is the possible extension of the auditor's reporting responsibility to include reporting on internal control. Although the U.S. profession is the first to deal with this possibility at an official level, there is no doubt it will be given consideration in other countries, including Canada. It is therefore instructive to consider the implications of such an extension on audit methodology, particularly in light of the audit methodology we have described in this paper.

Perhaps the most important thing to recognize is that, generally, auditors have **never** looked at a client's internal control system in the broad sense that the client's management typically applies:

Canadian managers seemed to have little difficulty in defining internal control as a broad concept. From this perspective, internal control was

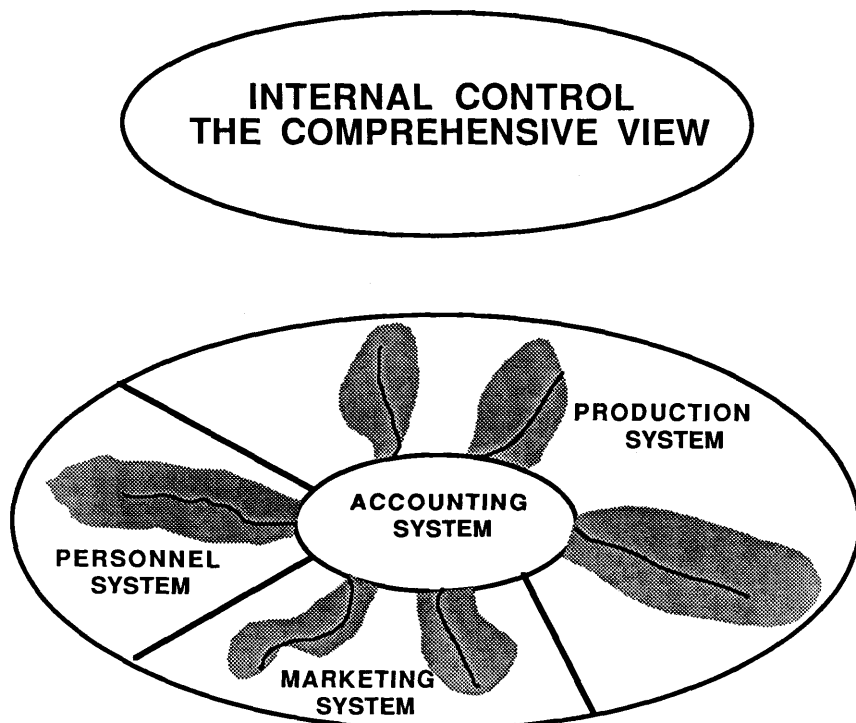
found to encompass accounting, management and operational controls, including such factors as organizational structure, quality of personnel and management, delegation of responsibility commensurate with authority, and effective and efficient management.¹⁷

This is illustrated in Figure 8 which shows a broadly defined internal control concept with the various systems. The accounting system is shown at the center for our purposes here and its **tentacles** or **nerves** stretch into each of the various systems.

Auditors who follow an internal control oriented audit approach will, for the most part, focus attention on aspects of the various systems which are directly related to the extensions of the accounting system (shaded regions in the diagrams). In the assertion-oriented audit methodology we have described in this paper, attention is directed first at the accounting system and then along the various tentacles as considered necessary given the strategic audit plan. However, in this context neither approach can be considered comprehensive in the way it addresses internal control. Hence, any extension of auditor's responsibilities towards reporting on internal control will require either a careful limitation on the scope of the responsibility or a possibly radical change in the nature of the audit methodology that is employed.¹⁸

Developments from within audit methodology have also had an influence on its evolution. The increased importance of statistical sampling and its effect on the audit risk model has been described above. The development and more

Figure 8



widespread use of techniques such as regression analysis in analytical review is another example of how audit techniques can affect the overall methodology. One technological development that should have a considerable effect on audit methodology is the microcomputer. In time, these remarkably powerful machines will become as prevalent as the hand held calculator, if they are not already. Their considerable computational power will permit the development of a computerized audit file in which expert systems and comprehensive decision support capabilities can play a major role. Technologically these are, no doubt, exciting times.

Epilogue

In this paper we have described an assertion-based approach to auditing. We have focused at the strategic level and explained the consequences of our strategic emphasis in terms of its effect on the elements of the audit strategy. Our description has included an outline of a practical approach for applying the methodology together with its automation on a microcomputer. But in the final analysis, have we introduced anything that is fundamentally new? Perhaps we have. For example, we have refined the approach for reviewing and evaluating internal controls conditioned on our inherent risk assessment and we have directed the auditor to a more comprehensive view of the financial statements in which the role of transaction streams and their assertions is placed on an equal footing to the remainder of the financial statements. But surely, these are not new discoveries.

We believe our contribution is the bringing together of all of these known and familiar concepts and, using financial statement item assertions as the organizing principle, integrating the various elements into a cohesive, consistent framework that provides a practical and effective audit methodology for our professional environment.

End Notes

1. First exposed at the *Frontiers of Auditing Research* conference at the University of Texas at Austin in 1976 [published in 1977].

2. Peat, Marwick, Mitchell & Co., "Unique Audit Methods: Peat Marwick International," by Robert K. Elliott, *Auditing: A Journal of Practice & Theory*, Spring 1983. Arthur Young at the University of Southern California Symposium on Expert Systems and Audit Judgment, 1986.

3. See Hanson [1942] p. 6.

4. Some would argue that there was no reduction in quality when sampling was employed because of the more intensive and effective effort that could be directed at a sample.

5. See Stringer [1975], Elliott and Rogers [1972], Anderson and Teitlebaum [1973] and Kinney [1983].

6. The oversimplification is due to not recognizing the interplay between statistical precision and the α and β risks. For example, in dollar-unit sampling α risks can be controlled by adjusting from planning materiality to a basic precision which allows a margin for expected error. See Leslie, Teitlebaum and Anderson [1979].

7. This refers to substantive procedures including testing.

8. See Holstrum and Kirtland [1982] for one example.

9. See Skinner and Anderson [1966] and Anderson [1977].

10. To say achieved is an overstatement. The auditor can only believe he has achieved the desired degree of assurance.

11. See for example, Leslie, Teitlebaum and Anderson [1979] and Leslie [1985].

12. We would like to acknowledge the contribution of Jean Pare [formerly with our National Office and now with Arthur Young in London, England] for suggesting the concept of derived and generating components.

13. An exception is inventory at the count date. In this situation, inventory is not derived from purchases and cost of goods sold. Instead, cost of goods sold is derived from inventory and purchases.

14. Valuation refers to pricing. A separate audit plan would be designed to address net realizable value.

15. We wish to acknowledge the contribution of David Pollard, leader of the ADAM development project.

16. See Stilwell and Elliott for an explanation of this approach.

17. See Etherington and Gordon, p. 2.

18. One might consider re-orientation of the audit objectives to the non-accounting systems on which the effect of audit procedures directed at components of the accounting system could be recognized. For example, responses to accounts receivable confirmations could give some information relevant to operations such as customer service and perhaps marketing.

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Appendix A

Technical Interlude: A Bayesian Model for Combining Information

We introduce an example in which explicit Bayesian priors are assessed for revenue-occurrence and for cash receipts-completeness and then combined to give a prior for accounts receivable-existence. In this example, the subjective probabilities are attached to specific financial statement and transaction stream assertions and their combination is the result of the interrelationship between the components of the sales/receivables/receipts accounting cycle.

In our example, we use the following assumptions:

Sales:	\$1,400,000
Cash Receipts:	\$1,200,000
Accounts Receivable:	\$350,000
Materiality:	\$20,000

Tables 1(a) and 1(b) show the posterior probability calculations for sales and cash receipts separately. The sample sizes represent either representative substantive samples (assuming such testing is an appropriate procedure) or an equivalent pre-audit sample size.

Table 2(a) shows the combined error rates that arise from combining the error rates from the two streams. Thus, the error rate of .09143 for a sales-cash receipts error rate pair of (.01, .015) is computed as $[(.01 \times 1,400,000) + (.15 \times 1,200,000)]/350,000$ which reflects the fact that a sales-occurrence error and a cash receipts-completeness error will be additive in accounts receivable.

Table 2(b) shows the combined (posterior) probabilities of each of the sales-cash receipts error rate pairs in the corresponding positions to Table 2(a). These probabilities are simple products of the posterior probabilities from Tables 1(a) and 1(b). Table 2(c) shows the probability of obtaining zero (100% tainted) existence errors in a sample of the indicated size drawn from the accounts receivable population for each of the error rates in Table 2(a) [again, in corresponding positions]. Table 2(d) is the element by element product of Tables 2(b) and 2(c) and Table 2(e) contains the relative frequencies of each of the probabilities in Table 2(d). The Table 2(e) entries are the posterior probabilities for each of the error rates in Table 2(a).

Given the posterior probabilities in Table 2(e), it is possible to compute the total of the posterior probabilities for these error rates in Table 2(a) which exceed materiality. For the example used in Tables 1 and 2, the posterior probability of a material error, i.e. one exceeding \$20,000, is .12628.

In the above example, the prior probabilities and pre-audit sample sizes resulted in a fairly low risk of error before the effect of the sample from accounts receivable. It is instructive to consider some alternative combinations of the various factors. Table 3 shows posterior probabilities of error greater than \$20,000 under a variety of situations. Case A shows the posterior risk in accounts receivables-existence when no errors are possible in cash receipts and the only sample is in the sales stream. As would be expected, the .05431 probability agrees with the probability of an error rate greater than .015 in the

sales stream alone as shown in Table 1(a). A similar effect occurs when the (pre-audit) sample size in cash receipts is made very large (e.g. 1,000,000 or more).

In Case B, less optimistic prior probabilities are assumed and the result of the limited (pre-audit) samples is a very high posterior probability of a material error. Case C illustrates the effect of sampling in accounts receivable (e.g. a circularization of accounts) in reducing the case B posterior risk to a more acceptable level. Cases D and E illustrate the effect of concentrating the audit effort on the streams and then on the residual balance. This is a very graphic example of the necessary extent of reliance an auditor must place on the transaction stream assurance sources in comparison with that needed on the balance sheet account. The differences in overall sample size are mainly due to the relative magnitudes of the streams (\$2,600,000) in comparison with the balance sheet amount (\$350,000).

Although the above combining model has some appeal, it does possess some technical weaknesses. Foremost among these is the assumption that the posterior probabilities for sales-occurrence and cash receipts-completeness are independent. We know this is not the case. For example, if the client has a good credit department that actively follows up old unpaid accounts, it is unlikely there will be a large amount of sales-occurrence or cash receipts-completeness errors. This one detective control is common to the two streams and therefore its effect on the posterior probabilities from each stream is dependent. Nonetheless, this weakness should not undermine the example as an illustrative theoretical model, but it should be kept in mind when interpreting the results.

An extension of this Bayesian combining model directed at pre-tax income could possibly serve as an approach for combining results for the audit as a whole. Although the practical utility of such a model would have to be questioned (it would be **many** dimensional), it would certainly have some theoretical value. One of the main theoretical conclusions implied by such a model can be seen in our example here. Even if the individual prior probabilities and pre-audit samples are independent, the combination of the effect of these probabilities, which is determined by the nature of the accounting model, leads to an overall model in which there are significant dependencies. An auditor wishing to draw some conclusions at the end of the audit cannot set his prior probabilities on each of the individual transaction streams (etc.) independently. They are related by the overall evaluation model and their reasonability must be assessed at both the individual level and at the overall level. This is entirely consistent with the overall audit evaluation approach outlined in SAS 47 and Leslie [1985].

Appendix B

Technical Interlude: A Direction of Assurance Theorem

One of the major assumptions made in developing audit strategies is that by focusing attention on achieving the desired overall assurance on a subset of the

financial statement assertions the auditor will obtain the desired level on all of the financial statement assertions. This permits the use of simplifications in the planning process and ensures the audit has complete coverage of the financial statement assertions. In order to apply this approach, it is necessary to introduce a method of identifying the subset. The direction of assurance rule provides the identification method and the direction of assurance theorem, which we will outline below, states that the rule leads to **minimal sufficient** audit plans, within the context of the problem framework set out below.

We consider a simplified situation with three accounting cycles:

1. Cash, Cash disbursements, Cash receipts
2. Accounts receivable, Cash receipts, Revenues
3. Accounts payable, Cash disbursements, Expenses

The results derived in this analysis would extend to more complex situations. From these cycle elements, the corresponding accounting cycle equations can be written, using the obvious notational abbreviations, as:

$$\begin{aligned} \text{Cash}(t) &= \text{Cash}(t-1) + \text{REC}(t) - \text{DIS}(t) \\ \text{A/R}(t) &= \text{A/R}(t-1) + \text{REV}(t) - \text{REC}(t) \\ \text{PAY}(t) &= \text{PAY}(t-1) + \text{EXP}(t) - \text{DIS}(t) \end{aligned}$$

We will call these the **normal form** of the cycle equations.

The **accounting cycle assurance formula** for a given accounting cycle equation can be derived by writing the accounting cycle equation in the form desired and then writing the accounting cycle assurance formula that corresponds beneath it. For example:

$$\begin{array}{ccccccc} \text{REV}(t) & = & \text{A/R}(t) & + & \text{REC}(t) & - & \text{A/R}(t-1) \\ \downarrow \text{O/S} & & \downarrow \text{O/S} & & \downarrow \text{O/S} & & \downarrow \\ \text{REV}_{\text{U/S}} & \Leftarrow & \text{AR}_{\text{U/S}} & \wedge & \text{REC}_{\text{U/S}} & & \text{audited in prior years} \end{array}$$

This assurance formula shows how audit assurance (measured discretely in terms of Poisson factors) on A/RO/S and RECO/S provides assurance on REVO/S. The “ \wedge ” symbol in the formula indicates that only the minimum assurance can be carried over.

In the remainder of this discussion, the assurance formulas will be written out explicitly using the following symbols for the **direct** assurance obtained with respect to each component error exposure (we focus here on error exposures rather than assertions since the main results arise from interrelationships between various accounting cycle components of an arithmetic nature. The extension to assertions is straight forward.): CashO, CashU, RECO, RECU, DISO, DISU, A/RO, A/RU, REVO, REVU, PAYO, PAYU, EXPO and EXPU. Thus, REVO represents the assurance level, expressed as a Poisson factor, obtained from audit procedures **directed** at the revenue account and effective at detecting overstatements. Since it is an **assurance level**, it can be derived only from inherent assurance, internal control assurance (preventive or detective), analytical review assurance or substantive procedures such as testing of the revenue transaction stream. In any particular situation, some of the sources may not be available ... e.g. direct inherent

assurance (and internal control assurance) on A/RO is negligible although this type of assurance can be found in the related component exposures REVO and RECU. Similarly, there is little direct assurance possible on A/RU.

The total assurance on any particular component exposure will be expressed as $v_x(*)$ where * represents the component exposure and x represents/indicates the accounting cycle (x is one of either cash (C), receivables (R) or payables (P) cycles). Thus,

$$v_R(\text{REVO}) = \text{REVO} + \min \{A/\text{RO}, v_c(\text{RECO})\}$$

is the explicit formula for the accounting cycle assurance formula: $\text{REVO}/S \Leftarrow A/\text{RO}/S \wedge \text{RECO}/S$ introduced above. The fact that REC is an element of both the receivables (R) and cash (C) cycles requires the use of $v_c(\text{RECO})$ when it appears in a formula for an R-component exposure.

The formula says that the total assurance on revenue overstatements obtained from the revenue cycle is equal to the sum of the direct assurance on REVO/S plus the minimum of the direct assurance on $A/\text{RO}/S$ and the total assurance on receipts overstatements obtained from the cash cycle.

Using this notation, it is possible to develop audit programs that ensure a **sufficient** level of audit assurance is obtained on each financial statement component exposure. Stated in terms of the v_x operator, if the required overall level of assurance is 3.0, then a **sufficient** audit plan must have:

- | | |
|----------------------------------|-----------------------------------|
| I. $v_C(\text{CashO}) \geq 3.0$ | II. $v_C(\text{CashU}) \geq 3.0$ |
| III. $v_R(A/\text{RO}) \geq 3.0$ | IV. $v_R(A/\text{RU}) \geq 3.0$ |
| V. $v_P(\text{PAYO}) \geq 3.0$ | VI. $v_P(\text{PAYU}) \geq 3.0$ |
| VII. $v_R(\text{REVO}) \geq 3.0$ | VIII. $v_R(\text{REVU}) \geq 3.0$ |
| IX. $v_P(\text{EXPO}) \geq 3.0$ | X. $v_P(\text{EXPU}) \geq 3.0$ |

For convenience, each of the v_x formulas will be referred to as source of assurance plans, i.e. SAPs.

Obviously, an auditor could develop a sufficient audit plan by entering factors so that each of the above ten inequalities was satisfied, but this would be inefficient since it would not recognize the structural relationships between the various component exposures. Thus, for efficiency, the auditor is interested in finding the minimum number of SAPs which when "satisfied," i.e., indicate the required overall level of assurance, imply that all the other SAPs are satisfied. The following theorem answers this question for the three-cycle situation.

Direction of Assurance Theorem

In the three-cycle situation, a minimal sufficient audit plan must have at least five SAPs. The following SAPs constitute a minimal sufficient audit plan:

- | |
|-----------------------------------|
| I. $v_C(\text{CashO}) \geq 3.0$ |
| III. $v_R(A/\text{RO}) \geq 3.0$ |
| VI. $v_P(\text{PAYU}) \geq 3.0$ |
| VIII. $v_R(\text{REVU}) \geq 3.0$ |
| IX. $v_P(\text{EXPO}) \geq 3.0$ |

Proof

To prove the theorem, it is necessary to show that a minimum of five SAPs is required and that the five SAPs listed provide a sufficient plan since they imply that the remaining five SAPs are also satisfied. We begin by expressing each of the SAPs in terms of the basic assurance elements (e.g. EXPO, CashU, etc.) and writing out the equivalent inequalities. These are as follows:

- | | |
|---|--|
| <p>I. $v_C(\text{CashO}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{CashO} + \text{RECO} + \text{REVO} \geq 3$ 2. $\text{CashO} + \text{RECO} + \text{A/RU} \geq 3$ 3. $\text{CashO} + \text{DISU} + \text{PAYO} \geq 3$ 4. $\text{CashO} + \text{DISU} + \text{EXPU} \geq 3$ | <p>II. $v_C(\text{CashU}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{CashU} + \text{RECU} + \text{REVU} \geq 3$ 2. $\text{CashU} + \text{RECU} + \text{A/RO} \geq 3$ 3. $\text{CashU} + \text{DISO} + \text{PAYU} \geq 3$ 4. $\text{CashU} + \text{DISO} + \text{EXPO} \geq 3$ |
| <p>III. $v_R(\text{A/RO}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{A/RO} + \text{REVO} \geq 3$ 2. $\text{A/RO} + \text{RECU} + \text{CashU} \geq 3$ 3. $\text{A/RO} + \text{RECU} + \text{DISU} + \text{PAYO} \geq 3$ 4. $\text{A/RO} + \text{RECU} + \text{DISU} + \text{EXPU} \geq 3$ | <p>IV. $v_R(\text{A/RU}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{A/RU} + \text{REVU} \geq 3$ 2. $\text{A/RU} + \text{RECO} + \text{CashO} \geq 3$ 3. $\text{A/RU} + \text{RECO} + \text{DISO} + \text{PAYU} \geq 3$ 4. $\text{A/RU} + \text{RECO} + \text{DISO} + \text{EXPO} \geq 3$ |
| <p>V. $v_P(\text{PAYO}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{PAYO} + \text{EXPO} \geq 3$ 2. $\text{PAYO} + \text{DISU} + \text{CashO} \geq 3$ 3. $\text{PAYO} + \text{DISU} + \text{RECU} + \text{REVU} \geq 3$ 4. $\text{PAYO} + \text{DISU} + \text{RECU} + \text{A/RO} \geq 3$ | <p>VI. $v_P(\text{PAYU}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{PAYU} + \text{EXPU} \geq 3$ 2. $\text{PAYU} + \text{DISO} + \text{CashU} \geq 3$ 3. $\text{PAYU} + \text{DISO} + \text{RECO} + \text{REVO} \geq 3$ 4. $\text{PAYU} + \text{DISO} + \text{RECO} + \text{A/RU} \geq 3$ |
| <p>VII. $v_R(\text{REVO}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{REVO} + \text{A/RO} \geq 3$ 2. $\text{REVO} + \text{RECO} + \text{CashO} \geq 3$ 3. $\text{REVO} + \text{RECO} + \text{DISO} + \text{PAYU} \geq 3$ 4. $\text{REVO} + \text{RECO} + \text{DISO} + \text{EXPU} \geq 3$ | <p>VIII. $v_R(\text{REVU}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{REVU} + \text{A/RU} \geq 3$ 2. $\text{REVU} + \text{RECU} + \text{CashU} \geq 3$ 3. $\text{REVU} + \text{RECU} + \text{DISU} + \text{PAYO} \geq 3$ 4. $\text{REVU} + \text{RECU} + \text{DISU} + \text{EXPU} \geq 3$ |
| <p>IX. $v_P(\text{EXPO}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{EXPO} + \text{PAYO} \geq 3$ 2. $\text{EXPO} + \text{DISO} + \text{CashU} \geq 3$ 3. $\text{EXPO} + \text{DISO} + \text{RECO} + \text{REVO} \geq 3$ 4. $\text{EXPO} + \text{DISO} + \text{RECO} + \text{A/RU} \geq 3$ | <p>X. $v_P(\text{EXPU}) \geq 3$ is equivalent to</p> <ol style="list-style-type: none"> 1. $\text{EXPU} + \text{PAYU} \geq 3$ 2. $\text{EXPU} + \text{DISU} + \text{CashO} \geq 3$ 3. $\text{EXPU} + \text{DISU} + \text{RECU} + \text{REVU} \geq 3$ 4. $\text{EXPU} + \text{DISU} + \text{RECU} + \text{A/RO} \geq 3$ |

Thus, in the above analysis, each of the ten SAPs has been analyzed into its equivalent set of four inequalities that must be satisfied by the basic assurance elements. There are 40 such inequalities but they are not all distinct as a cursory review of the table would show.

The distinct inequalities in the above list can be grouped into 2-term, 3-term and 4-term subgroups as follows:

Distinct inequalities

- | | |
|--|--|
| <p>2-Term</p> <ol style="list-style-type: none"> (a) $\text{A/RO} + \text{REVO} \geq 3$ (b) $\text{A/RU} + \text{REVU} \geq 3$ (c) $\text{PAYO} + \text{EXPO} \geq 3$ (d) $\text{PAYU} + \text{EXPU} \geq 3$ | |
| <p>3-Term</p> <ol style="list-style-type: none"> (a) $\text{CashO} + \text{RECO} + \text{REVO} \geq 3$ (b) $\text{CashO} + \text{RECO} + \text{A/RU} \geq 3$ (c) $\text{CashO} + \text{DISU} + \text{PAYO} \geq 3$ (d) $\text{CashO} + \text{DISU} + \text{EXPU} \geq 3$ | <ol style="list-style-type: none"> (e) $\text{CashU} + \text{RECU} + \text{REVU} \geq 3$ (f) $\text{CashU} + \text{RECO} + \text{A/RO} \geq 3$ (g) $\text{CashU} + \text{DISO} + \text{PAYU} \geq 3$ (h) $\text{CashU} + \text{DISO} + \text{EXPO} \geq 3$ |
| <p>4-Term</p> <ol style="list-style-type: none"> (a) $\text{A/RO} + \text{RECU} + \text{DISU} + \text{PAYO} \geq 3$ (b) $\text{A/RO} + \text{RECU} + \text{DISU} + \text{EXPU} \geq 3$ | <ol style="list-style-type: none"> (e) $\text{A/RU} + \text{RECO} + \text{DISO} + \text{PAYU} \geq 3$ (f) $\text{A/RU} + \text{RECO} + \text{DISO} + \text{EXPO} \geq 3$ |

$$(c) \text{ PAYO} + \text{RECU} + \text{DISU} + \text{REUV} \geq 3 \quad (g) \text{ PAYU} + \text{RECO} + \text{DISO} + \text{REVO} \geq 3$$

$$(d) \text{ EXPO} + \text{DISO} + \text{RECO} + \text{REVO} \geq 3 \quad (h) \text{ EXPU} + \text{DISU} + \text{RECU} + \text{REUV} \geq 3$$

There are 20 distinct inequalities here. Since each of the ten SAPs is equivalent to only four inequalities, it is therefore obvious that at least five are required in order to form a sufficient audit plan. This proves the first part of the theorem. To prove that SAPs I, III, VI, VIII and IX are sufficient, it is only necessary to show that each of the above 20 inequalities are included in the set of inequalities implied by these SAPs.

Thus,

- I. is equivalent to $3 - T(a), 3 - T(b), 3 - T(c), 3 - T(d)$
- III. is equivalent to $2 - T(a), 3 - T(f), 4 - T(a), 4 - T(b)$
- VI. is equivalent to $2 - T(d), 3 - T(g), 4 - T(e), 4 - T(g)$
- VIII. is equivalent to $2 - T(b), 3 - T(e), 4 - T(c), 4 - T(h)$
- IX. is equivalent to $2 - T(c), 3 - T(h), 4 - T(d), 4 - T(f)$

Simple inspection shows that the above are indeed distinct and therefore equivalent to the distinct inequalities listed above. This proves the theorem.

Corollary

By reflection (i.e. $o/s \rightarrow u/s$, $u/s \rightarrow o/s$), the SAPs II, IV, V, VII and X are a minimal sufficient audit plan.

Thus, as one would expect, minimal sufficient audit plans are not unique.

Corollary: Direction of Test Concept

In the three-cycle situation, the audit strategy of testing debit account overstatement exposures directly, credit account understatement exposures directly and then relying on the accounting model to provide assurance in all other areas leads to a sufficient audit plan.

Proof: The sufficient audit plan of the Theorem is an example of this strategy. If sufficient direct procedures are applied to CashO, A/RO, PAYU, REVU and EXPO, the required SAPs listed in the theorem are obviously satisfied.