

Using Top Cycle Modeling in Audit Analytical Procedures  
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The Top Cycle Modeling approach (TCM) originated in the Netherlands as part of the Dutch tradition of audit. Recently, Weigand and Elsas (2012) have extended the technique to Model Based Auditing (MBA) using the REA modeling approach as a template. The TCM approach relies heavily on the so-called BETA equations. These equations can be constructed for a variety of business scenarios. They relate the concepts of the stock and flow of goods and value within an enterprise for a given audit period. This paper applies the TCM approach to the use of analytical procedures in the audit process. The insights provided by the TCM approach, especially in the construction of relevant BETA equations, allows for a rational consideration of the possibilities of constructing analytical procedures for planning audit procedures, substantive testing and forming an overall audit opinion. This involves tying the TCM approach to the audit risk model. This paper provides a demonstration of the usefulness of using the TCM approach to inform the development of analytical procedures within a risk-based audit process. It does this by using the value-chain model to develop BETA equations.

Analytical procedures can be applied at three different stages of the audit process. Those stages are during planning, during substantive testing and during the final review of the audit evidence prior to formulating the audit opinion. This paper considers the usage of the TCM approach during each stage in turn although some usages will build on each other from stage to stage during the audit process. The planning stage is considered first. Within the context of this paper, analytical procedures are defined with respect to the AICPA's standards, specifically to AU 329 which has been adopted by the PCAOB. Citations from other sources are explicitly referenced as such. Analytical procedures are defined in Section 329 as

evaluations of financial information made by a study of plausible relationships among both financial and nonfinancial data. Analytical procedures range from simple comparisons to the use of complex models involving many relationships and elements of data. A basic premise underlying the application of analytical procedures is that plausible relationships among data may reasonably be expected to exist and continue in the absence of known conditions to the contrary. Particular conditions that can cause variations in these relationships include, for example, specific unusual transactions or events, accounting changes, business changes, random fluctuations, or misstatements. (AU 329.02)

One of the difficulties in using analytical procedures is the broadness of their definition. The challenge is to find "interesting" relationships among the data available to the auditor. The TCM approach provides one constraint that can help narrow what relationships may prove "interesting." The general principle of the BETA equations is that the difference between the final state of a stock of resources or value, denoted "E", and the initial state of that stock, denoted "B", equals the difference between all the additions made to that stock, from the beginning of the relevant audit period until its end, denoted "T", and all the subtractions made from it, from the beginning until the end, denoted "A", i.e.  $E - B = T - A$ . This 'law' is known in the Dutch accounting and auditing tradition as the BETA equation, since  $B - E + T - A = 0$ , and it is applicable to every individual stock of value, (Starreveld et al., 1988). So one of the types of

relationship that interest the auditor are those where the BETA equation holds. The search for interesting analytical procedures can be further restricted by using a risk based audit approach and the value chain during the planning stage as detailed below.

Audit risk is the risk that there will be a material misstatement in the financial statements after the auditor issues a clean opinion. This risk is controlled by adequate audit planning which consists in part by considering management assertions and the disaggregated risk associated with those assertions. In order to understand the risk associated with the various assertions during the planning stage of the audit process, the auditor must understand the nature of the client's business. This includes both of the client's business model and their industry as well as other factors. The value chain model can help focus consideration of risk by pointing out where value is generated by the client and throughout the client's industry. The following references the Statement on Management Accounting entitled "Value Chain Analysis for Assessing Competitive Advantage" published by the Institute of Management Accountants. There are several main foci in the value chain model. One is that a firm can be analyzed both in a microeconomic sense in terms of the value it delivers to its customers directly and in a macroeconomic sense which considers the broader value chain of the economy taken as a whole. Another focus is reducing the effect management can have on the business process into two areas: increasing customer value and cost reduction activities. Value is generally measured through the revenue streams or sales volume data whereas cost reduction focuses on the cost drivers within the firm's business model. Since risk is a measure of variability, the auditor can focus on relationships within BETA equations representing the client's business model under "interesting" conditions. These conditions include parameters which historically have experienced relatively large fluctuations and those which might be expected to have fluctuations in the current period due to perturbations in the client's business model or business environment. So the following three conditions can be used to constrain the use of the TCM approach for developing analytic procedures during the planning stage of the audit process:

1. Looking for conditions where the BETA equations will hold,
2. Focus on value generating activities or cost drivers either in the clients business model or their business context, and
3. Focus on parameters which experience variability in their measures within the audit period or across audit periods.

This paper considers the case where the auditor uses the TCM to set up analytical procedures that are used in all three phases of the audit process in a consistent fashion, that is, as a cohesive approach. This is done to provide a consistent example throughout this short paper. Other examples of stand-alone uses in each of the three audit stages are also possible but are not considered here. As an example, consider an airline carrier. Because of limited space here, the example is kept quite simple. Besides the BETA equations, the TCM approach also models both the physical flows of material and the measures of those flows, usually in financial terms. In the airline carrier example, part of the business model is the use of jet fuel to power the planes which generate revenue through the sale of seats to paying customers. In a period of rapidly falling jet fuel prices, the auditor may be concerned that their client could use the situation to manipulate earnings. The assertions involved are the completeness of the expenses and their valuation. Therefore, they could consider the beginning and ending stock of jet fuel for their client and the contract purchases and uses of the fuel during the period of the audit. There is also the client's

use of derivatives to provide insurance in fluctuating commodity markets. The auditor can then set up A BETA equation modeling this situation, looking at physical stocks of fuel, the changes to those stocks during the period through purchase contracts and flight schedules and the final stock of fuel at the end of the period. The purchase contracts are used to value the fuel and fuel expense in monetary terms. Since this is during the planning stage of the audit, we assume that the auditor will plan to collect evidence as to the stocks, flows and valuation of the fuel during the substantive phase of the audit. That is, the auditor will use the TCM approach to help plan the procedures to perform during the audit. So the three conditions are met: there is a BETA equation, it focuses on miles flown and the use of fuel in an environment where the price of the fuel is fluctuating. The BETA equation here is a normative expectation of the relationship of interest.

During the substantive phase of the audit, the auditor will collect data relating to the elements of the parameters in the BETA equation. The standards give the following guidance with respect to using analytical procedures during the substantive phase of the audit process:

The expected effectiveness and efficiency of an analytical procedure in identifying potential misstatements depends on, among other things, (a) the nature of the assertion, (b) the plausibility and predictability of the relationship, (c) the availability and reliability of the data used to develop the expectation, and (d) the precision of the expectation. (AU 329.11)

The two assertions considered in the airline example are completeness and valuation. Taking each assertion in turn, the nature of the completeness assertion in this example is that there has been a complete accounting for all of the fuel used by the airline during the audit period. This will provide some evidence against hidden expenses. The construction of the BETA equation requires the auditor to collect and examine evidence for two measures and two populations of transactions. The two measures are the beginning and ending balances of fuel inventories. The beginning balance is usually relied on as the audited ending balance of the prior period. The ending balance requires the auditor to test inventory measures at the various airports which the carrier visits. The two populations are the purchases of fuel (or fuel deliveries on contract) and the use of fuel. Contract volumes can be inspected and confirmed with the jet fuel providers. The use of fuel is recorded in the maintenance records of the airline which can be sampled. The relationship is evidently predictable and the data available. The reliability of the data concerning the two populations will be affected by the client's system of internal controls which should be tested prior to reliance on the data. The TCM approach captures the precision as follows. The positive formulation of the equation is  $B - E + T - A + \delta = 0$ . Here  $\delta$  stands for the deviation error. In the normative modality,  $\delta = 0$ , which is the conjunction of (i) correctness (A being overstated and thus  $\delta \geq 0$ ), and (ii) completeness (A being understated and thus  $\delta \leq 0$ ). In this case completeness is the quality of concern. For the valuation assertion, the auditor can rely on the physical volume BETA equation and evidence gathered and confirmed from the purchase contracts concerning the pricing of the jet fuel. Consideration of any insurance issues brought about by hedges against the contract prices may also impact this part of the analysis. Analysis of the size of  $\delta$  are used to determine if additional procedures are required before making a judgment on the completeness and valuation assertions.

During the final stage of the audit, analytical procedures are used as follows:

The overall review would generally include reading the financial statements

and notes and considering (a) the adequacy of evidence gathered in response to unusual or unexpected balances identified in planning the audit or in the course of the audit and (b) unusual or unexpected balances or relationships that were not previously identified. (AU 329.23)

The auditor considers the size of  $\delta$  once again at this stage. The importance of the auditor's evaluation of any difference at this stage will depend on the weight attached to the results of the substantive testing stage and whether any additional procedures were performed to test the completeness and valuation assertions.

This paper outlined an approach which uses the Top Cycle Modeling approach to inform the construction of analytical procedures in the audit of a firm. The approach includes using risk-based auditing principles and value chain analysis along with the TCM to constrain the possible analytical procedures to focus on risky accounts and assertions. It demonstrated the approach through an example which flowed through the three stages of the audit process where analytical procedures are appropriate. The approach has several possible extensions. The first is to provide a more formalized statement by extending Weigand and Elsas 2012 work on Model Based Auditing (MBA). The extension is needed to include non-financial data and explicit consideration of analytical procedures. The addition of assertions to Weigand and Elsas' model is already characterized in Nehmer *et al.* (working paper). Another extension is to look much more deeply into the value-chain model for additional insights on how it can be used to help construct analytical procedures. The combination of value-chain analysis with risk based auditing and the TCM approach promises to provide a better structural for developing analytics, perhaps for operational purposes as well as the audit. A final extension is to more explicitly consider the REA model with respect to analytical procedures.

## References

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