"Revenue Accounting" in the Age of E-Commerce: Exploring Its Conceptual and Analytical Frameworks

by Jonathan C. Glover and Yuji Ijiri
Graduate School of Industrial Administration
Carnegie Mellon University
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ABSTRACT

This paper explores "revenue accounting" in contrast to traditional "cost accounting." Revenue accounting is to serve information needs of managers and investors in planning and controlling a firm's sales activities and their financial consequences, especially in the E-Commerce Age. Weaknesses of traditional accounting have become particularly evident recently, for example, the lack of 1) revenue mileposts, 2) revenue sustainability measurements, and 3) intangibles capitalization. Some tentative remedies are considered. Several revenue mileposts are explored to gauge progress in earning revenues and a Markov process is applied to an example involving mileposts. Revenue momentum, measured by the exponential smoothing method, is examined as a way of getting feedback on revenue sustainability; and the use of the sustainability concept in the analysis of fixed and variable revenues is illustrated. A project-oriented approach in a manner similar to capital budgeting and to Reserve Recognition Accounting is proposed by treating each customer as a project. Standardization of forecasts are also considered as an important way of bypassing the capitalization issue. The paper emphasizes at the end the need to develop a conceptual framework of revenue accounting and, as a tentative measure, proposes five basic postulates and five operational postulates of revenue accounting.

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The authors are Associate Professor of Accounting and Robert M. Trueblood University Professor of Accounting and Economics, respectively, at the Graduate School of Industrial Administration, Carnegie Mellon University, Pittsburgh, PA 15213. Comments are welcome and should be directly addressed to either of the authors, jglover@andrew.cmu.edu or ijiri@andrew.cmu.edu. Submitted to the *Journal of Accounting and Public Policy*.

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1. Need for Revenue Accounting

This paper explores "revenue accounting" in contrast to traditional cost accounting. Cost accounting was developed in the Industrial Age in which measurement, analysis, and control of product cost became an indispensable part of doing business. Cost accounting has contributed significantly by making various phases of production processes measurable, analyzable, and controllable in monetary terms.

The E-Commerce Age, started near the turn of the century with a big blast, was created by the Internet and related breakthroughs in science and technology. While their impact was concentrated in the last decade of the twentieth century, the shift from the product-orientation in the Industrial Age to the customer-orientation in the E-Commerce Age was evident even several decades earlier. This shift was caused by society becoming rapidly affluent, thus moving from a product-scarce society to a customer-scarce society.

In addition, the Internet brought a qualitative difference in the way business is conducted. It opened a way to short-circuit traditional distribution channels. It has now become technologically possible for producers, who had to rely on wholesalers and retailers to distribute their products, to directly deal with end-users.[1] It is no longer a question of "whether" but a question of "how" to join e-commerce, minimizing any frictions with those in traditional distribution channels. The number of customer accounts of such companies has skyrocketed as a result. They have become much more sales-oriented companies than before. Demand for data on customers has increased drastically.

E-commerce, in return, produces a huge amount of transaction and customer data online that would not otherwise be collected. In addition, a number of data mining techniques

[1] In addition to this "business-to-consumer (B2C)" segment, the Internet has opened the "business-to-business (B2B)" segment which has also become an indispensable component of doing business for many companies.

have been developed to produce needed information quickly and cheaply.[2] Data and information have become abundantly available. On top of data recorded and reported in traditional accounting, we now have much finer, tailor-made classifications of revenues and customers as well as many pre-revenue data such as orders and website visits.

In spite of this dramatic development in business, accountants seem to have been rather slow in taking actions. If the Industrial Age needed cost accounting, the E-Commerce Age now needs "Revenue Accounting," accounting oriented toward serving information needs of managers and investors in planning and controlling a firm's sales activities and their financial consequences.[3] As cost accounting was developed in cooperation with production people, revenue accounting should be developed in cooperation with marketing people. It is the purpose of this paper to explore how such a system of accounting may be developed and to provide examples of key concepts that may be used in developing a conceptual framework for revenue accounting.

2. Weaknesses of Traditional Accounting and Their Remedies

Weaknesses of traditional accounting, especially from the standpoint of Internet start-up companies, have been pointed out in many aspects of accounting. Perhaps some of the most serious ones for which improvements are desperately needed can be summarized as: revenue mileposts, revenue sustainability measurements, and intangibles capitalization.

1) Revenue Mileposts: A first weakness of traditional accounting, as far as the revenue side is concerned, has been on having only a single point of recognition, i.e., the realization principle under which revenue is recognized all at once upon delivery of the product. Exceptions

[2] Berry and Linoff (1997) discusses in detail several such techniques including market basket analysis, memory-based reasoning, cluster detection, link analysis, decision trees and rule induction, artificial neural networks, genetic algorithms, and on-line analytic processing.

[3] While "customer accounting" might capture a broader range of activities in marketing as well as in accounting, because of the strong financial nature we want to incorporate, the term "revenue accounting" was adopted. It may later be expanded toward "customer accounting" as more non-financial customer data are incorporated in accounting. Note that revenue accounting is not just for e-commerce enterprises. It is, instead, presented here as a new type of accounting "in the E-Commerce Age" applicable to non-e-commerce enterprises as well.

exist in the case of long-term construction contracts and installment sales, but this principle is in sharp contrast with cost accounting in which costs are accumulated at various stages of production. The same accumulation of efforts does exist on the revenue side of activities, too, in developing customer relations and product recognition. The only difference is that production efforts are embodied in the product frequently with tangible changes in the product, while the effect of marketing efforts is often not visible until the point of sale at which the product changes hands. Nevertheless, some mileposts of revenues, such as the receipt of inquiry or order, may be developed and the progress toward them reported systematically.

2) Revenue Sustainability Measurements: A second weakness of traditional accounting on the revenue side has been on the lack of information regarding the sustainability of revenue. Recurring revenues are much more valuable than non-recurring revenues yet traditional accounting has not provided benchmarks by which revenues can be divided into the two or even finer categories. Valuation of a firm with a given amount of annual revenues can vary greatly depending upon how sustainable such revenues are likely to be in the future. While measurement of revenues along the dimension of sustainability is difficult, revenue accounting should at least be able to provide information to assist managers and investors in assessing the value of the firm.[4]

3) Intangibles Capitalization: The third and perhaps the most serious weakness is the bias in traditional accounting against recognizing intangible assets on the balance sheet. Start-up companies spend enormous sums of money in advertising and promotion to develop customer base and capture market share. Start-up companies also spend large amounts of money on R&D.[5] Such expenditures correspond to investments in properties, plant, and equipment (PPE) in the Industrial Age.

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[4] At a 10% discount rate, perpetually recurring revenues of $1 million a year are worth $10 million or ten times more than $1 million in non-recurring revenues.

[5] Baruch Lev has been a convincing advocate for the capitalization of intangible assets and R&D in particular. See, for example, Lev and Sougiannis (1996) and Lev and Zarowin (1999).

Capitalization of PPE expenditures has been an accepted principle in traditional accounting, even if the market value of the investment may be less than the book value.[6] Yet, capitalization of advertising or R&D expenditures has been unacceptable in traditional accounting, with minor exceptions, in spite of the fact that the benefit of investment or its disposal value is often just as uncertain regardless of whether the investment is tangible or intangible. The existing accounting practice is viewed as an obsolete carryover from the Industrial Age in which a firm's value was largely built on bricks and mortar and other tangible assets.

Furthermore, resources of start-up companies are often concentrated in yet another intangible, human resources (officers and employees as well as customers). Human resource accounting that was discussed in the accounting literature some 30 years ago[7] is now becoming a serious issue in many Internet businesses. Even shareholders are viewed as important human resources of the business, as the caliber of major shareholders themselves enhances the value of the business. It is indeed a network of all people related to the business that creates the value of a business.[8]

These weaknesses of traditional accounting are often viewed as reasons for the large gap in the market value and the book value of Internet companies and for negative price-earnings ratios. Many of such accusations are misplaced. It is definitely possible that market valuation may be found to be overly optimistic especially in view of a recent sell-off of technology stocks. Furthermore, accounting valuation need not be equal to or closely approximate market valuation for it to be useful since market valuation may still be identified through a suitable transformation of accounting valuation.[9] However, such a rebuttal does not excuse accountants from improving the system by making it more suitable for the new economy. The valuation gap

[6] See, however, an FASB (1995) statement No. 121 on impairment of long-lived assets which requires a mark down of book value when future cash flow forecasts are such that book value may not be recoverable.
[7] See American Accounting Association (1973) for a comprehensive overview and bibliography in this field.
[8] For a theory of the firm as a nexus of contracts and its implications for accounting, see Sunder (1997).
[9] Also we should not forget that predicting stock price is only one of many functions accounting performs.

should thus be viewed as suggesting opportunities for accounting to stay in touch with the transition in business and economy from the Industrial Age to the E-Commerce Age.

In later sections, we will consider tentative remedies to each of the above three key deficiencies in traditional accounting. Here, however, we first consider a couple of other key issues in developing revenue accounting.

3. Competitive Advantages of Accountants

As accountants deal with marketing data to develop revenue accounting, their competitive advantages over marketing people may become an issue. E-commerce is so wide-open that anyone can move into it overnight. Yet to stay competitive and survive, one must have some competitive advantages. Accountants doing consulting work have advantages over other consultants in that accountants are often familiar with the client's accounting system. Likewise accountants' competitive advantages in developing revenue accounting must lie in their knowledge of accounting systems and standards in traditional accounting. This point requires further elaboration since, on the surface, any knowledge of traditional accounting may seem to be a hindrance in developing anything in the world of e-commerce in which speed and flexibility are indispensable.

Even in this new age, standardization plays an important role. Data obtained without standards can be highly subjective and difficult to communicate precisely and difficult to gain trust on. If they are developed and used for decisions by the same person, this may not be a problem. However, quite frequently one must explain the data to get an approval on a decision or to account for the decision. Even a chief executive officer must describe business performance to venture capitalists to keep getting funding from them. Data used for such purposes must have a certain minimum level of objectivity. Standards are essential, though not sufficient, for assuring objectivity. Marketing data is no exception.

Hence, accountants' first competitive advantage lies in their experience in developing and maintaining measurement standards. This offered an important source of contribution in dealing with production data in cooperation with production people. It should also offer the same in dealing with marketing data in cooperation with marketing people.

Accountants' second advantage in dealing with marketing data comes from their experience in creating a system of integrated performance measurements from numerous individual measurements. Net income is a typical performance measure that is derived from a huge set of heterogeneous transactions following generally accepted accounting principles. Furthermore, the fact that this performance measure has gained considerable trust of investors and managers is observed routinely.

For example, reported accounting earnings are widely used in incentive compensation plans; for the creator of information, there is perhaps no greater compliment than people actually betting their money trusting the information. In addition, stock price is often sensitively tied to changes in accounting standards that affect reported accounting earnings without any changes in the economic conditions of the firm. The Securities and Exchange Commission's recent crack down on big bath accounting and other earnings manipulations is also a good indication of the investors' trust on reported accounting earnings.[10] These are indeed great compliments to accountants' long-term efforts in creating and maintaining the performance measurement system which gained investors' trust so much.

Accountants' third advantage comes from their experience in developing and refining cost accounting systems. Measurements, records, models, analyses, reports, principles, and standards in cost accounting are all valuable sources in developing systems in revenue accounting. This does not mean that a blind translation of cost accounting terms and concepts will be useful in revenue accounting. But it does mean that this legacy from accountants in the past

[10] See, for example, MacDonald (2000) and Zagorin (2000) on the SEC's latest crackdown on revenue booking.

will likely offer a valuable checklist and a springboard in designing revenue accounting. Some example of how the cost-revenue parallelism can be used will be shown in a later section.

Accountants' fourth advantage is their abilities and experiences in establishing systems of audit and other control and compliance mechanisms. Accounting and auditing go hand-in-hand in establishing reliable systems. Auditing plays an even more crucial role in e-commerce because of the lack of face-to-face contact in traditional trade. The importance of the role played by the auditors in building trustful relationships in e-commerce has been emphasized in e-commerce publications as something indispensable in "a new age, new purpose, and new commerce.[11]"

4. Revenue Accounting: Managerial and Financial

The next question we need to consider is whether or not revenue accounting should be developed as a part of managerial accounting or financial accounting. Managerial accounting is oriented toward managers or internal users of data, while financial accounting is oriented toward investors or external users of data. But this distinction based on the users being internal or external is becoming less and less important as more detailed data are disclosed to investors; for example, in the E-Commerce Age, venture capitalists work closely with managers.[12]

However, the question is still important because of the significant difference between the two branches of accounting in terms of the level of standardization. Standards developed in financial accounting are enforced upon all listed corporations in the country and the compliance is audited. In contrast, with the exception of regulated industries, any standards developed in

[11] See Keen, Ballance, Chan, and Schrump (2000) on the importance of the role played by the auditors in building trustful relationships in e-commerce, in particular Chapter 8 on "Auditing for a New Age, New Purpose, and New Commerce." In spite of its importance, auditing issues cannot be dealt with without some clear understanding of the structure on the accounting side, hence they will not be discussed in this paper so as to focus on accounting issues. Once accounting issues are identified, we should be ready to develop corresponding auditing issues. See also Kalakota and Whinston (1996) Chapter 13 on the role of accounting in dealing with various aspects of e-commerce.

[12] Similarly, in the expansion periods of the 1890s and 1920s, Industrial Age companies worked closely with banks.

managerial accounting have much more limited applicability and enforcement. A high level of standardization may promote more trust and reliance from the users of data, especially if coupled with a compliance audit, but at the same time it may stifle efforts to experiment and flexibly apply standards in light of specific individual situations.

Here again, we can learn from cost accounting. While cost accounting is typically taught under the heading of managerial accounting, cost accounting also has many ties with financial accounting because inventory costs derived from cost accounting must satisfy financial accounting standards. Thus, for example, while a firm may adopt variable costing for managerial accounting purposes, ending inventory balance must be recomputed using full costing for financial accounting purposes. Depreciation may be applied flexibly but at the end of a period, it must be adjusted back to meet financial accounting standards. In fact, cost accounting has been constructed so as to meet the needs flexibly for both managerial accounting and financial accounting[13] out of a single system.

Cost accounting and revenue accounting are sister accountings to each other. Think of a company split between two subsidiaries, one specializing in production and the other in sales. The production subsidiary uses cost accounting. The sales subsidiary uses revenue accounting. The holding company takes care of all financing and administrative functions. Cost accounting and revenue accounting are both subparts of "income accounting" in which revenues, costs, and expenses are all integrated. They both have managerial accounting components and financial accounting components. This understanding helps us to conclude that revenue accounting should be developed with both managerial accounting and financial accounting in mind. Obviously, it is much easier to start with management accounting components where things can be created, modified, and standardized much more flexibly. But in all steps, we should have an eye

[13] The same holds true with tax accounting as well, although we will not discuss this branch of accounting here to focus on the remaining two types of accounting.

on financial accounting components so that some of the important standards developed in managerial revenue accounting will eventually be worked into financial accounting standards.

Ultimately, we believe that revenue accounting should lead to comprehensive "revenue statements," just as cost accounting led to comprehensive cost statements such as a statement of cost of goods manufactured or a statement of cost variances. In this way, reporting standards can be developed in tandem so that both the revenue side and the cost side of the income statement are given equal weight by means of these statements. What form such revenue statements take may be difficult to say before revenue accounting is given a structure. But in developing revenue accounting we should always keep in mind the forms and contents of revenue statements.

We now move to some tentative solutions to the three deficiencies in traditional accounting mentioned earlier. They will be discussed in the sections that follow, namely revenue mileposts in sections 5 and 6, revenue sustainability measurements in sections 7 and 8, and intangibles capitalization in sections 9 and 10.

5. Establishing Revenue Mileposts

Cost accounting was developed tracing the tangible movements of goods through the production process, adding costs at each stage of the process. Conceptually at least, revenue accounting should do the same, tracing the process in which customers' demand is turned into revenues. While this process has often been unobservable in the past, e-commerce has made at least a portion of the process observable through complete on-line recording of customers' or potential customers' browsing of the website. At least initially, this data should form a valuable

input to managerial revenue accounting and may eventually find a way to financial revenue accounting as demand for early feedback increases among investors.[14] We shall present nine key candidates grouped into I. Pre-Revenue (promotion, inquiry, ordering); II. Revenue (delivery, payment, return); and III Post-Revenue (warranty, liability, disposal).

a) Product promotion: This is a point at which product announcement, advertisement, or other form of promotion, is made. It may be beneficial to distinguish between company promotion and product promotion so that revenue accounting may treat them differently.

b) Product inquiries: This is a point at which a customer takes an action, requesting information about the product, browsing the website for it or otherwise inquiring about it. The number of website visits, brochures given out, or phone answers given, may all be important indicators of potential orders.

c) Product ordering: That is a point at which an order is received. While this is not a point at which accounting transactions are initiated, for many sales people, this is the point where they consider a touchdown was made. In fact, the so-called "book-bill ratio," the ratio of booking orders to billing upon delivery, is an important indicator of how the flow of orders and the flow of deliveries match up in the revenue generating process. There is no reason why revenue accounting cannot get started at the order point, which may be identified as "revenue origination" in contrast to "revenue realization.[15]"

d) Product delivery: This is the point at which revenues are considered to have been "realized" or "earned" because the seller's commitment has been largely fulfilled with possible

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[14] Trueman, Wong, and Zhang (2000) find that net income does not have a significant positive association with the stock prices of internet companies (the R^2 is 3%). When gross profit is added to the regression, the R^2 jumps to 50%. When "pageviews" is added (to a regression with gross profit and other components of net income), the R^2 jumps another 16 percentage points. They also distinguish between e-tailers and portal/content/community firms. The second group has characteristics more similar to traditional companies than do e-tailers.

[15] Near the end of the 16th century, an English court, for the first time, recognized promises in a contract as enforceable. Thus the current accounting practice, in which recording starts only when one of the contracting parties actually performs his/her side of the bargain, is behind the law by four centuries. Transactions should in fact start with contracts in accounting as they do change financial position of the firm and are especially important in revenue accounting. See Ijiri (1980) for an early attempt to move the accounting recognition point to the point of contract. Possibilities of contract cancellation and non-performance can be handled by setting up allowance accounts just as in dealing with receivables collectibility.

exceptions of warranty or other minor commitments. This is the normal revenue recognition point in traditional accounting.

e) Product payment: This is the point at which the customer makes payment for the product they received. This point may coincide with d) product delivery as in the case of credit card sales or may precede it in the case of an advance payment. This is a transaction invariably recorded under traditional accounting.

f) Product return: This is a point at which the customer returns the product for a refund. This is also a transaction recorded under traditional accounting.

g) Product warranty: This is a time period in which the product is under a warranty. The end of the warranty period may be considered the end of the revenue accounting cycle under normal circumstances since all commitments made by both parties are now fully performed.

h) Product liability: This is a time period in which the product is contingently exposed to product liability suits or recalls due to defects. While, normally, there may be no need to be concerned with such contingencies, revenue accounting should cover all interfaces with customers including these contingencies if and when they become likely or imminent.[16]

i) Product disposal: This is a point at which the product is disposed of in a way that is environmentally acceptable. The seller of the product may be held responsible for the proper disposal or, at least, may take steps voluntarily for the customers to return the product to the seller for safe disposal as currently observed in the case of printer cartridges.

At each of these nine or more phases in revenue accounting, there are quantitative information that is important for managers and for investors. The challenge for revenue accounting is to standardize measurements at each phase so that they can be interpreted with minimum risk of misunderstanding. The measure should be in monetary terms as long as this is

[16] This same aspect is observed in cost accounting, in which revenues do appear for planning and control purposes. Revenue accounting, likewise, can include costs for planning and control purposes.

possible but, if not, it may be in non-monetary terms such as frequencies, volumetrics, or other physical measures.

As a customer goes through each phase in a particular purchase, the progress is recorded and evaluated instantly in comparison with data on what this customer did in the past. Probabilities are applied, not only based on the company's overall experience, but also based on this particular customer's actions. Decisions on whether or not transactions should be recorded on the basis of estimates may also be customized based on the individual customer's buying habit. For managerial revenue accounting, transactions may be recognized early and refined as the customer makes progress. For financial revenue accounting, recognition may have to be delayed to a later point in the cycle. In either case, recognition on the books of revenue accounts must be made under a set of well-specified standards.

6. Using Mileposts: A Markov Process with Payoffs

Let us now consider analytical uses of mileposts so that data collected at these points can be used profitably by managers and investors. There have been and will be numerous models developed in marketing to take advantage of the data explosion. The following is merely an illustration of how a partitioning of the revenue generating processes might improve the task of managing and investing, just as a partitioning of the production processes have in the past. Here the model we choose to illustrate is a Markov model with an associated payoff matrix.[17]

To illustrate the process in the simplest way, let us consider only two states that a customer can be in, a "browser" and a "buyer," the meaning of which will be explained shortly. A customer in any period belongs to one and only one state and, at the end of a period, can move

[17] A Markov process is a process in which a system moves among n distinct states in every period and the transition probability that it will move from its state i (i = 1, 2, .. n) to a state j (j = 1, 2, .. n, in particular j may be equal to i, i.e. no change in state) in the current period is a constant that depends only upon the previous state i. Many dynamic systems have been analyzed by using Markov models. We adopt a particular variation that incorporates transition payoffs.

to the other state or stay in the same state. The probability the customer will be in a given state during the current period depends only on the state s/he was in during the immediately preceding period (the previous period). A period here may be a day, a week, a month, a quarter, or a year, depending upon how frequently the product is bought by customers on the average--for groceries a week may be appropriate, while for appliances a year or longer may be appropriate. Here, for the purpose of concreteness, we will assume that a month is used as a period. We shall also assume, for simplicity, that a firm sells only one product.

For any given month, a customer is a "buyer" if s/he bought the product of the firm during the current month and is a "browser" if s/he did not. All customers are assumed to browse the website of the firm.[18] In the short run, browsers cost the firm as marketing and advertising costs are needed to generate browsing, while buyers benefit the firm from their purchases. The amount of cost or benefit depends upon not only the current state the customer is in but what state s/he was in the previous period.

If a customer was a browser in the previous period and is also a browser in the current period, designated by "browser/browser", the cost to the firm is $2 (a payoff of -$2) in the current period, while if s/he was a browser in the previous period and a buyer in the current period (browser/buyer), the benefit to the firm is $3 (a payoff of $3) in the current period. On the other hand, if a customer was a buyer in the previous period and is a browser in the current period (buyer/browser), the cost to the firm is $1 (a payoff of -$1), while if a customer was a buyer in the previous period and is also a buyer in the current period (buyer/buyer), the benefit to the firm is $9 (a payoff of $9). These payoffs along with transition probabilities, which will be explained shortly, are depicted in Figure 1 and summarized in Table 1 in the form of a payoff matrix and a transition matrix.

==========[Enter Figure 1 and Table 1 Here.]==========

[18] A three-state model can further classify customers into non-browser, browser, and buyer.

We now move on to the transition matrix in Table 1. If a customer was a browser in the previous period, there is an 80% (0.8) probability that s/he will stay as a browser (with no purchase) in the current period and a 20% (0.2) probability that s/he will become a buyer (with a purchase) in the current period. On the other hand, if a customer was a buyer in the previous period, there is a 40% (0.4) probability that s/he will become a browser (with no purchase) in the current period and a 60% (0.6) probability that s/he will stay as a buyer (with a purchase) in the current period.

We then trace a customer who was a browser in period 0, called "initial browser." Applying the above transition probabilities, in period 1 s/he will be a browser with probability 0.8 and a buyer with probability 0.2, which we shall state as [0.8, 0.2]. In period 2, s/he will become a browser in one of two ways -- i) s/he was a browser in period 1 and stay as a browser in period 2 with probability 0.8*0.8 = 0.64; and ii) s/he was a buyer in period 1 and become a browser in period 2 with probability 0.2*0.4 = 0.08. Hence the probability that the initial browser will be a browser in period 2 is 0.8*0.8 + 0.2*0.4 = 0.64 + 0.08 = 0.72.

The probability that s/he will be a buyer in period 2 is obviously 1 - 0.72 = 0.28, but this can be computed more minutely as 0.2*0.6 = 0.12 for buyer/buyer and 0.8*0.2 = 0.16 for browser/buyer, the total being 0.12 + 0.16 = 0.28 as expected. Thus, this customer's probabilities in period 2 may be represented as [0.72, 0.28]. Likewise, we obtain [0.688, 0.312] for period 3 and it can be shown that the series converges to [2/3, 1/3].[19]

For a customer who was a buyer in period 0, called "initial buyer," using exactly the same computations we obtain [0.4, 0.6] for period 1, [0.56, 0.44] for period 2, [0.624, 0.376] for period 3, and again it can be shown that the series converges to [2/3, 1/3]. Hence, in the long

[19] Howard (1960) shows computational shortcuts by means of "z-transform," the discrete version of Laplace transform. This allows a separation of the permanent component and the transient component of the transition matrix P. Using the numerical example above, the n-th power of the transition matrix can be written as follows (easily verified numerically for small n). This book also shows an early attempt to incorporate a payoff matrix with a transition matrix.

run, it does not matter whether a customer is an initial browser or an initial buyer since the probabilities converge to [2/3, 1/3] and the firm can expect on the average 2 browsers and 1 buyer out of 3 customers.

Let us now combine the transition matrix and the payoff matrix to find the value of a customer to the firm. First, consider an initial browser. S/he has a probability of 0.8 of staying a browser, thus causing a -$2 payoff to the firm, and a 0.2 probability of becoming a buyer, thus causing a $3 payoff to the firm. Therefore, the expected value of the payoff to the firm in period 1 is 0.8*(-2) + 0.2*3 = -1 or cost to the firm of $1. Likewise, the expected value of the payoff to the firm in period 1 from an initial buyer is 0.4*(-1) + 0.6*9 = 5 or a benefit to the firm of $5. As a short-hand, we combine payoffs for both an initial browser (-1) and an initial buyer (5) and express them as {-1, 5}. This is shown in the last column of Table 1.

To figure the payoff in period 2 from this initial browser, we move one period backward. If this customer stays as a browser in period 1 (probability 0.8), the expected payoff in period 2 is, as computed in the above, -$1, while if s/he becomes a buyer in period 1 (probability 0.2), the expected payoff in period 2 is $5. Hence, the expected payoff in period 2 is 0.8*(-1) + 0.2*5 = 0.2. Likewise, we compute the payoff in period 2 from an initial buyer. If this customer becomes a browser in period 1 (probability 0.4), the expected payoff in period 2 is, as computed in the above, -$1, while if s/he stays as a buyer in period 1 (probability 0.6), the expected payoff in pe-riod 2 is $5. Hence, the expected payoff in period 2 is 0.4*(-1) + 0.6*5 = 2.6. Again, we express the combined payoffs as {0.2, 2.6}.

Repeating the process of going backward one period at a time, we figure the expected payoffs in period 3 to be {0.68, 1.64} since 0.8*0.2 + 0.2*2.6 = 0.68 and 0.4*0.2 + 0.6*2.6 = 1.64. The same for periods 4 and 5 are, respectively, {0.872, 1.256} and {0.9488, 1.1024}, after which the payoffs converge to {1, 1} rather quickly. This is quite understandable since the transition

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$$P^n = \begin{bmatrix} 2/3 & 1/3 \\ 2/3 & 1/3 \end{bmatrix} + 0.4^n \begin{bmatrix} 1/3 & -1/3 \\ -2/3 & 2/3 \end{bmatrix}$$

probabilities for both the initial browser and the initial buyer converges to [2/3, 1/3], no matter what their starting state was; hence, their payoffs also converge to 2/3*(-1) + 1/3*5 = 1 regardless of their starting state. Table 2 below provides a summary of transition probabilities and expected payoffs over the first several periods.[20]

==========[Enter Table 2 Here.]==========

We close this section with emphasis on the benefit of mileposts that lead to revenue realization. With the knowledge of a steady state distribution of [2/3, 1/3] and the associated expected payoffs of {1, 1}, it is now easy to say that a customer on the average contributes $1 per period to the firm regardless of whether they are currently browsers or buyers. But we must keep in mind that these data were obtained as a result of a more finely tuned analysis behind these numbers that was made possible by the milepost data. In addition, the milepost data also allows the transitional process leading to a steady state to be examined carefully and promotes understanding of the near-term transitional phenomena as well. For this reason, the above analysis was presented as a way of illustrating the importance of mileposts by means of a simple example.

Having started with the most minute milepost analysis leading to revenue realization, we now move to a higher level issue dealing with the sustainability of revenues. Here, our focus will be on revenues, not the processes leading up to the revenue realization, to see what kind of new concepts and measurements may need to be introduced in order to answer questions related to the sustainability of revenues.

[20] [Deleted]

7. Revenue Momentum and Sustainability Measurements

The concept of sustainability of revenues mentioned earlier is closely related to the notion of momentum explored in momentum accounting (Ijiri 1989). Once revenue is earned, it often keeps repeating itself in the future. This is due to a customer's tendency to go back to the same seller in order to avoid an additional cost of getting acquainted with a new seller. The tendency of revenues to recur is called revenue momentum.

While revenue is (i) measured in a monetary unit such as dollars and (ii) measured for a given period of time such as for year 2001, revenue momentum is (i) measured in a monetary unit "per period" such as dollars per month and (ii) measured at a given "point in time," e.g., as of 12/31/2001. Revenue is a flow concept, hence it appears in a statement of flows such as an income statement, while revenue momentum is a stock concept, hence it appears in a statement of stocks such as a balance sheet. In fact, revenue momentum is an important "asset" of the firm that can be measured and evaluated at a single point in time.

If revenue momentum is constant, revenue is equal to revenue momentum times duration in which the momentum lasts. Revenue momentum of $10 million/month will produce $10 million revenue if its duration is 1 month (i.e., $10 million/month x 1 month = $10 million to clarify dimensions), while it will produce $120 million if its duration is 12 months. Similarly, actual revenue of $144 million for a year may be converted into its equivalent average revenue momentum of $12 million/month that lasted for 12 months.

Traditional accounting takes a view that revenues should be measured and reported assuming zero momentum. Under this view, revenues are always earned from scratch. Hence, if a $10 million revenue is earned in this month, the entire sum reflects the contribution of the management in this month.

An alternative view, stated in its extreme form, is that once revenues are created, they recur forever with no dissipation whatsoever. Under this view, the management that created

the revenue momentum initially should get credit for revenues earned from that point on to eternity.

Traditional accounting's view is analogous to the Aristotelian view of motion, which says a moving object keeps moving because force is applied constantly. Momentum accounting's view, in its purest form, is analogous to the Newtonian view of motion, which says a moving object keeps moving on a linear path with a constant velocity without any force. The two views differ in drawing a picture of the "status quo." Traditional accounting draws the line of status quo at zero revenue; momentum accounting draws the line of status quo at revenue being earned at a constant speed.

Truth probably lies between the two. Revenue does have momentum but it dissipates at some dissipation rate. The question is which of the two offers a better base to start from. Clearly in the E-Commerce Age in which values are projected into the future at a far greater pace than before, the momentum accounting view is the one that is most in line with the norm of business. Here, how fast momentum dissipates must be measured, just like a depreciation rate, based on the available data either on a customer-by-customer basis or on an aggregate revenue basis. Furthermore, revenue momentum may not just dissipate; it may grow in the future as one satisfied customer begets another, yielding a negative dissipation rate.

Revenue accounting should be built upon a concept and measurement of revenue momentum under a set of standards. Here we will show only a simple approach using an exponential smoothing model,

(1) $M^* = (1 - \alpha)M + \alpha A.$

This says that ending momentum, M*, is a weighted average of beginning momentum M and average actual momentum A for the period, where weights of $(1 - \alpha)$ and α are applied, respectively, $0 \leq \alpha \leq 1$. If beginning momentum M = \$30/mo (/mo is short for "per month" and \$ millions omitted), A = \$40/mo, and $\alpha = .3$, ending momentum M* is obtained as $M^* = (1 - .3)*30 + .3*40 = 33$ or \$33/mo. An equivalent form of (1) may make the process clearer, that is:

(2) $M^* = M + \alpha(A - M)$.

That is, ending momentum M* is equal to beginning momentum M with a fractional (α) adjustment for the momentum change (A - M). The latter is a change from beginning momentum M to average actual momentum A. Under this formula, M* = \$30/mo + .3(\$40/mo - \$30/mo) = \$33/mo. For α = .3, then 30% of the change from M to A is added to M to update it.[21]

Here, α is called a smoothing constant. A smaller value is chosen for a mature, stable environment because a sudden change in revenue is not likely to last, and a larger value is chosen for a immature, volatile environment because a sudden change in revenue may signal a fundamental shift in the market. This process is analogous to inventory costing methods such as FIFO, LIFO, and weighted average methods which are ways of mixing new and old prices adaptively. Exponential smoothing applied to revenue momentum is likewise a way of mixing new and old momenta adaptively. In the latter, however, we may want to leave management more discretion to update the smoothing constant α to determine how quickly or how slowly we want to adapt to the changing environment; errors can be made by adapting too quickly as well as too slowly.

Table 3 and Figure 2 show an example of exponential smoothing of monthly revenues, using smoothing constant, alpha, equal to 0.5, 0.2 and 0.05. For example, in the previous month, the firm had \$100 revenue which is treated as the starting value of revenue momentum. In month 1, we find that the actual revenue was \$80. We then adjust and update the momentum by taking α times the difference of 80 and 100. Hence, using (2), the new momentum is 100 + α(80 - 100) which is 90 for α = 0.5, 96 for α = 0.2, and 99 for α = 0.05.

==========[Enter Table 3 and Figure 2 Here.]==========

[21] For a further illustration and an application of momentum measurement to brand valuation, see Farquhar, Han, and Ijiri (1992).

In order to minimize the room for misunderstanding, the disclosure of the value of the smoothing constant may become common practice whenever revenue momentum is reported, just like the discount rate is disclosed in pension accounting. Standard or guideline values may be recommended as in depreciation in traditional accounting, depending upon the age of the product, the company, or the market.

While revenue momentum is an abstract concept, the above method compares with it observable, actual revenues converted into the equivalent average momentum amount. Then a fraction of the change is used to update the momentum amount. And this is done in every period, for example, every month. To get the process started, we must give an estimated amount of revenue momentum, but any error of estimate here will be corrected by observable revenues in every period. How rapidly this can be done depends upon the amount of initial error and the smoothing constant.

Undoubtedly, sustainability of revenues is fundamentally a subjective judgment. However, subjectively classified revenues are not likely accepted unless the judgment is accompanied by some objective measurements. As a mechanism, therefore, the above approach offers a promising starting point. Venture capitalists may be able to contract with a start-up company if it can reach sustainable monthly revenue of $10 million as a condition of further funding. Here, sustainability is to be computed using the exponential smoothing method with the smoothing constant to be negotiated between the company and the venture capitalists, in a manner analogous to the determination of allowable costs in a defense contract in which the learning curve is used with a choice of the coefficient, such as 80% or 90%, to be negotiated.

8. Use of Sustainable Revenue Concept: Fixed vs. Variable Revenues

One of the important concepts introduced at a relatively early stage in the development of cost accounting was the distinction between fixed and variable costs. Fixed cost is a cost whose total amount in a given period is fixed and does not vary when activity volume varies.

Variable cost is a cost whose total amount in a given period varies proportionately (thus "proportional cost" might have been a more accurate term) as activity volume varies.

While this was a simple idea, it made cost accounting much more analyzable since many product costs did behave as the names indicated. Depreciation, factory rental, property taxes, supervisors' salaries, are examples of fixed cost, while cost of raw materials and labor that are directly associated with the product are variable cost (sometimes called "direct cost"). The fixed or variable nature of cost is not expected to last for all possible values of activity volume but is assumed to last at least for its "relevant range." As a corollary, terms like "semi-fixed" or "semi-variable" costs were also defined for finer tuning, although the simplicity of dichotomizing costs into fixed and variable is most widely accepted.

Flexible budgeting was developed building on the fixed-variable cost concepts. Unlike the ordinary fixed budget, the flexible budget offers a budget linked with activity volume depending upon whether the cost item is fixed or variable. This form of budget offered much more realistic budget amounts than the ordinary fixed budget.

Furthermore, a costing method based on variable costs alone was developed under the name of "variable costing" or "direct costing" in contrast to "full costing." All fixed costs are treated as period costs and expensed immediately under variable costing.

Cost-Volume-Profit (CVP) analysis was developed also building upon the same fixed-variable cost concepts. If R is selling price, V is unit variable cost, and F is total fixed cost for a given period, profit for the period Π is given as a function of volume x by:

(3) $\Pi = Rx - Vx - F$, or

(4) $x = (F + \Pi)/(R - V)$,

which gives the volume as a function of a target profit when three constants, R, V, and F are given. In particular, when $\Pi = 0$, the analysis is called a "breakeven analysis" and the volume necessary to breakeven x_0 is given as:

(5) $x_0 = F/(R - V)$,

which offers a benchmark for judging how easy or difficult it is to attain the breakeven volume when one is opening a new business.[22]

Interestingly, there is a counterpart of this analysis which may be called "Revenue-Volume-Profit" (RVP) analysis, based on a dichotomous classification of revenues into fixed revenues and variable revenues. Fixed revenue is a revenue that is expected to recur in each period constantly, unaffected by the volume of advertising and other promotional activity; while variable revenue is a revenue that is expected to change proportionately with this activity volume x in the period. Here the volume may be measured, for example, by the frequency of advertising or number of promotional materials given out, etc.

In RVP analysis, if F is total fixed revenue for a given period, V is variable revenue per unit of activity volume, and C is cost per unit of activity volume, profit for the period Π is given as a function of volume x by:

(6) $\Pi = F + Vx - Cx$, or

(7) $x = (F - \Pi)/(C - V)$,

which gives the volume as a function of a target profit when three constants, C, V, and F are given. In particular, when $\Pi = 0$, the analysis is a breakeven analysis and the volume necessary to breakeven x_0 is given as:

(8) $x_0 = F/(C - V)$.

Figure 3 below shows an example. Suppose that a one-minute TV commercial costs $2 (million omitted) per run but generates $1 in revenue per run. There is a fixed revenue of $4 every month that can be earned without any commercials, perhaps from loyal customers or from endowment income, etc. No other operating costs are involved and all are transacted in cash. Then, Figure 3 shows that cash will be just exhausted and income will be exactly equal to zero if

[22] The term "breakeven analysis" has also been widely applied to cases of nonzero profit. For a comprehensive discussion of breakeven analysis and its numerous variants, see, for example, Schweitzer, Trossmann, and Lawson (1986).

the firm runs 4 one-minute commercial in a month, above which the firm will have cash deficit and negative income. It is also easy to see that if the firm needs to earn $2 target profit Π (= $2 surplus cash), then the firm can afford to run only 2 one-minute commercials.

This type of analysis offers a benchmark for judging how much one can spend on promotional activities and still expect to breakeven or earn a target profit for the period. Such a consideration may be very important for start-up companies trying to make ends meet and still take action that will maximize the growth potential of the firm.

==========[Enter Figure 3 Here.]==========

This is just one of many possibilities that concepts and models in cost accounting may be effectively applied in revenue accounting. Quite often such models exhibit with opposite signs as in the above example. In CVP analysis, x_0 is the minimum volume below which the firm will show losses, while in RVP analysis, x_0 is the maximum volume above which the firm will show losses. The same sign change is necessary in applying cost variance analyses to revenue variance analyses. While cost accumulates during production processes, revenue diminishes during marketing processes as potential customers drop out and as selling costs are netted back.[23]

Furthermore, applications can be and should be modified to accommodate the differences in the conditions under which production and marketing activities take place. For example, the above RVP analysis may be extended to "dynamic RVP analysis," taking into account the fact that some non-recurring customers are converted into recurring customers and vice versa.

[23] For this reason, there is some merit in viewing revenue accounting as "up-side-down cost accounting" or "negative cost accounting." Incidentally, in a long-term supply contract of Kuwait crude oil between Gulf Oil (in charge of production) and Shell Oil (in charge of selling world-wide) that lasted several decades until it was dissolved shortly after the oil crisis in 1970s, the contrasting nature of the two types of accounting was exhibited. Gulf accumulated production costs and Shell netted-back revenues deducting marketing and transportation costs, and the two companies shared the remaining profit equally.

The fixed vs. variable classification may also lead to a new system of variable revenue accounting which focus on recording, analyzing, and reporting of variable revenues in relation to the volume of marketing activities.

The objective of such analyses is normally oriented toward solving particular business problems on hand. However, accountants should keep an eye on developing a system of records and analysis models so that recurring problems will have tailored data available. Furthermore, there are many higher-powered models used in marketing and operations research, which make accounting models rather primitive. Yet advantages of accounting models often lie in simplicity and standardization, both aimed at making explanations easier. For example, business plans will be much easier to explain and venture capitalists will be more receptive to such explanations by means of familiar and simpler models.[24]

9. Intangibles Capitalization: Project, not Period, Accounting

Capitalization of intangibles, the third and perhaps most important weakness of traditional accounting, involves many difficult issues. However, at a minimum, it is possible to improve disclosure on relevant expenditures. For example, total amount of advertisement of a product in the past several years may be disclosed in such a way that users can adopt any capitalization/amortization policy they want and recalculate the book value of the intangible. Currently, in financial accounting, they are all expensed; in managerial accounting where a more optimistic capitalization policy may be allowed, a full capitalization followed by a lenient long-term amortization may be adopted. Venture capitalists and other investors may use an approach that lies between the two by fitting the expenditure data to their own estimates of the life of the advertising asset to see their impact on assets and earnings.

[24] On a recent plane trip with one of the authors, the CFO of an internet company said he found an extremely simple accounting measure helpful--the payback period for customer acquisition, approximated by a period's advertising and marketing expenses divided by the difference between the current period's revenues and the previous period's revenues.

The same approach may be used in dealing with R&D and human resource expenditures. Each such expenditure should be classified in sufficient detail to allow users' discretionary computations of capitalization and amortization. If these expenditures and their classifications are sufficiently standardized, it is possible to provide guidelines of amortization so that users can compute their book values and annual impact on net income.

While the issue appears to be the age-old one of matching cost and revenue, with no new perspectives arising from revenue accounting, e-commerce seems to have brought in an unexpected viewpoint. In traditional accounting, the matching principle has always been to put revenues and costs in the same *period* if they are causally related. In revenue accounting, we can now have a different kind of matching. Namely, the costs of intangibles may be divided and matched with "projects," not "periods," viewing customers as projects.

For example, there may be costs associated with inviting potential customers to an exhibition, giving them demos and samples, and following them up with further materials. It may make sense to capitalize these costs and, when customer orders start flowing in, the "investment" may be compared with cash inflows to date along with expected future cash flows. The internal rate of return (IRR)[25] or the net present value (NPV) may be computed on a customer-by-customer basis.[26] Using cash flows and project accounting, we can bypass the issue of whether advertising expenditures should be capitalized or expensed. This is because in capital project evaluation where the focus is solely on cash flows, there is no need to distinguish whether a cash outlay results in an acquisition of assets or not.

Furthermore, there is a precedent for this type of accounting, namely the "Reserve Recognition Accounting" for oil and gas industries initiated by the Securities and Exchange Commission in late 1970s. The proposal was to require oil and gas companies to capitalize all drill-

[25] Also called "discounted cash flow (DCF) rate."
[26] While we shall focus on internal rate of return in this paper, some of the arguments made here in favor of project-orientation can also be demonstrated by using the net present value and cost of capital measurements. Internal rate of return was adopted here since its use insures the full retirement of investment at the end of the project life.

ing costs until the well is proven to be dry or successful. If dry, all accumulated drilling costs up to that point were to be expensed. If successful, the reserve volume was estimated along with a lifting schedule in the future. The future income stream from the well was then estimated and the net present value was computed using 10%, the discount rate specified by the SEC. The well was then to be listed on the balance sheet at this present value. In other words, RRA required all future benefits to be recognized at the point of discovery of a successful well, after which income flows by the passage of time only for the interest portion. A full implementation of this proposed RRA was rescinded due to strong opposition from the oil and gas industry. However, a portion of the RRA measurements and disclosure was implemented and is still practiced, including reserve valuation based on the net present value of future cash flows discounted at 10%.[27]

Analogously, performance evaluation may be made not just in the aggregate but also on the individual customer basis, taking full advantage of details of on-line data collected automatically. Successful customers and failed customers may be analyzed by finding factors that appear to be responsible. The impact of a particular customer mix on the firm's overall internal rate of return may be evaluated.

In addition, even in project evaluation, periodic performance determination is still possible using the IRR and "sinking-fund depreciation."[28] We shall illustrate this by means of a simple example.

As in any capital project evaluation, we first start with cash flow forecasts over the life of the project. Assume the project requires a cash outlay of $1.000 (million) at the end of year 0, and generates cash recoveries of $.551 at the end of each of years 1, 2, and 3. To simplify the issue, we shall assume that the project will incur no expenses, other than depreciation to be dis-

[27] For further details of RRA, see, for example, Price Waterhouse & Co. (1979).
[28] For an early attempt to develop a periodic performance measure based on cash flows, see Ijiri (1978).

cussed later, and all revenues are collected in cash immediately. Hence, cash recoveries and revenues are the same thing in this example and the project generates $.551 revenues a year.

This project has a 30% IRR, since its net present value at 30% is -1.000 + .551/1.3 + $.551/1.3^2$ + $.551/1.3^3$ = 0, subject to a rounding error. Under the basic rule of the IRR, this rate derived from the cash flow series should be applied to each and every period of the project.[29] It is *not* viewed as an average of different rates of periodic returns. Hence, as soon as the beginning investment balance is given, the amount of return (net income) for that period is determined by simply applying the IRR to the balance, just like the way banks can determine the amount of interest earned on their money lent to borrowers.[30]

We next consider depreciation. The initial investment of $1.000 becomes worthless at the end of 3 years regardless of whether investment was in plant and equipment or advertising. Hence, it must be charged to each of the 3 years so that at the end of 3 years, the book value of the investment will become zero. The depreciation method that is built on the basic rule of IRR is called "sinking-fund depreciation,[31]" which we shall discuss using Table 4 and Figure 4 below.

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[29] If there is more than one sign change in the cash flow series, such as [-1.000, 2.500, -1.560] which has two sign changes (- to + and + to -), the project may have multiple internal rates of return up to the number of the sign changes. In this case, internal rates of return of 20% as well as 30% make the net present value of the cash flow series equal to zero, as can be easily verified. (The negative cash flow toward the end of the life of the project, -1.560, is often related to "closure cost," cost to close the plant in a manner that is environmentally safe.) However, the multiple rate problem can be solved simply by introducing a financing rate of return j, the rate the firm expects to earn by lending the surplus cash tentatively. Then it can be shown that for any cash flow series, no matter how many sign changes may occur, the internal rate of return can be split between an investing rate i and a financing rate j, the two having one-to-one relationship (see Teichroew, Robichek and Montalbano 1965). Then, for any period which starts with an unrecovered investment balance, the investing rate is applied; while in any period which starts with an over-recovered investment balance, the financing rate is applied. The internal rate of return for a multiple rate project is simply the investing rate at a given financing rate. We compute the rate working backwards. For example, if the financing rate of 15% is chosen, the firm must preserve 1.560/1.15 = 1.357 out of the 2.500 cash flow in year 1 to meet the final obligation to pay 1.560 at the end of year 2. This means 2.500 - 1.357 = 1.143 can now be allocated to the recovery of investment. Hence, the internal rate of return is uniquely determined as 14.3%. We will not discuss multiple rate cases in the rest of this paper but the above simple introduction should be sufficient to follow examples discussed below to apply them to multiple rate cases. The existence of investing rate and financing rate is an important exception to the basic rule of IRR.

[30] All cash flows are assumed to occur at the end of a period. Continuous cash flow cases can be handled by using continuous compounding.

[31] This is sometimes called annuity depreciation. In the older accounting literature (for example, Dicksee, 1903), annuity depreciation referred to constant depreciaiton charges whose present value equals the depreciable base of the asset (cost less estimated residual value). This method is not tidy in that the some of the depreciation charges is greater than the depreciable base of the asset; the difference is credited to interest revenue. For analyses of the incentive properties of a generalized version of annuity/sinking-fund depreciation, see Rogerson

We will first examine the column for Year 1 on the left half of Table 4 marked "Revenues Determining Depreciation." Beginning investment is $1.000 and revenue is $0.551 as given earlier. We then determine net income by using the basic rule of IRR, namely the beginning investment balance of $1.000 times 30% IRR, or net income of $0.333. Depreciation is then *determined* as the difference between revenue and net income. Depreciation of $0.251 reduces the investment balance to $0.749, which is shown at the top of the column for Year 2. This times 30% is $0.225 which is net income for Year 2 and depreciation for Year 2 is derived as 0.551 - 0.225 = 0326. The same process is repeated for Year 3.[32]

==========[Enter Table 4 and Figure 4 Here.]==========

Thus, we can see that Table 4 offers a benchmark for evaluating periodic performance. For example, suppose that actual revenue in Year 1 happens to be only $0.333 instead of the originally expected $0.551. This gives a warning both to management and to investors that the 30% internal rate of return as initially reported might have been too optimistic. If the actual revenue is continued at that level in year 2 and year 3, the actual internal rate of return will become 0% since total revenues over 3 years is just enough to recover the original investment without any return on it. In addition, the reason for this poor result can be traced to depreciation variance and net income variance since the format of Table 4 is the same as the income statement, by which actual and standard can easily be compared.

(1997) and Reichelstein (1997). We shall stay with the term "sinking-fund depreciation" since it identifies the method unambiguously. See the discussion that follows and the next footnote on its formula and properties.

[32] If r is the IRR and n is the length of the project in periods, the formula for the sinking-fund depreciation d in the first period is $r/[(1+r)^n -1]$ to be multiplied by the investment amount. In each subsequent period, the rate is (1+r) times the rate for the previous period. Letting c equal to the constant revenues (cash recovery) per dollar of investment, the above procedure uses the relationship $d = c - r$ since $d = r/[(1+r)^n -1]$ while $c - r = r/[1 - (1+r)^{-n}] - r = [r -r + r(1+r)^{-n}]/[1 - (1+r)^{-n}]= r/[(1+r)^n - 1]$ which is the same as d. The same verification may be made for d in the subsequent period. For example, in period 2, the above formula is adjusted to $(1+r)d = c - r(1-d)$ which is true since $d = c - r$. Hence, although the formula for sinking-fund depreciation assumes a constant recovery series,

Compared with traditional income statement, however, project accounting seems to require a complex process for determining income for a period. We start with a forecast of all cash flows from the project in the future, determine the internal rate of return, and then prepare an investment schedule as in Table 4 before income in any given year can be determined. This apparent difference in complexity disappears if we look into the process carefully, as we attempt to in the next section.

10. Standardizing Forecasts in Intangibles Capitalization

Even in traditional accounting, depreciation schedules require forecasts into the future. The only advantage depreciation schedules have over revenue (i.e., cash recovery) forecasts is that depreciation schedules are highly standardized in terms of depreciation methods, estimated lives of assets, and estimated residual values. In contrast, we have very few standards, if any, in revenue forecasts. To emphasize this point, consider the right half of Table 4 marked "Depreciation Determining Revenues." In this table, straight-line depreciation is used as an example of methods popular in traditional accounting. More importantly, net income and depreciation are computed first and then revenues are *determined* by adding the two. Note that while the left and the right halves of Table 4 looks identical in format, there is a subtle change in the order of computation in this regard.

Figure 4 is also provided to help understand the difference between the two. In the left half of Figure 4, the upper line for revenue is determined first and the bottom line for depreciation is derived, while the opposite sequence is true with the right half of Figure 4.

Now we come to a crucial point to be noticed. Given an internal rate of return, say 30%, if the depreciation schedule [.333, .333, .333] is fixed, management has no more discretion in forecasting future revenues. A revenue schedule of [.633, .533, .433] must be adopted since oth-

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the approach can be applied to a non-constant recovery series. For simplicity, we will not demonstrate such cases.

erwise periodic net income will not be equal to beginning investment times internal rate of return in all periods, the basic rule of IRR.

Another way of saying this is that standardizing the depreciation schedule and standardizing the revenue schedule are the same thing because, under a given internal rate of return, there is a one-to-one correspondence between the two as evident when the two halves of Table 4 are compared. In project accounting this traditional notion of depreciation is replaced by the notion of retiring a portion of investment as a result of cash recovery in each period.

Thus, standardizing recovery patterns will be an important step in making project accounting a feasible alternative in revenue accounting. In addition, guidelines and standards may be developed and disclosure of key parameters may be required in a way similar to pension accounting.

What about the possibility that management may manipulate the forecasts and make it overly optimistic or pessimistic? This is certainly possible. However, disclosure of the IRR and of periodic feedback on the project performance will at least protect top management and investors from overly optimistic forecasts by the lower level management.

In addition to making the IRR overly optimistic, there is another way of making performance look good in earlier years of the project life. In the above example, the 30% IRR can also be produced by a project whose cash recoveries in year 1 and in year 2 are both zero, and in year 3 is \$2.197 since $2.197/1.3^3 = 1.000$. Then, any positive revenue in year 1 will give feedback that actual performance was better than forecasted. Thus, the disclosure of the revenue pattern, in addition to the IRR, is very important. Investors should be careful about unusually high IRR as well as revenue patterns that are heavily weighted toward the end of the project's life, the so-called "hockey stick projection" -- near future is so-so but long-term future is fantastic. It is also possible to treat such patterns as not being in conformity with generally accepted accounting principles.

However, we have the same problem with depreciation. The reason that depreciation is accepted as a standard way of doing accounting is because standards are so well established that overly optimistic or pessimistic depreciation rates are often rejected automatically as not in conformity with generally accepted accounting principles. The same can be said with forecasted future revenues once standards are well established and basic factors are disclosed such as the revenue patterns and the internal rate of return.

In both depreciation or revenue forecast methods, the important thing is not that forecasts are used in income determination since their use is inevitable; it is that forecasts be verified and adjusted by objective feedback the management gets by the passage of time. Like depreciation, several patterns may be singled out as being acceptable. For example, the level revenue pattern is likely a popular choice because of its simplicity. The level depreciation pattern as shown in the right half of Table 4 is the one that produces a level retirement of investment throughout the project's life [.333, .333, .333]. Obviously, constant growth or a declining method may also be used in conjunction with the rate of growth or decline.

While an adoption in financial accounting standards may be a long way, the project orientation in managerial use and voluntary disclosure may prove to be very much welcome by investors. It is ironic that in capital budgeting the basic object of evaluation is project-oriented cash flows; nevertheless, in post completion evaluation they are discarded and replaced by period-oriented earnings flows. As a result, feedback on capital budgeting has been rather scarce. Revenue accounting and its project-orientation might provide effective means of bridging this gap between planning and control of capital expenditures.

11. Toward a Conceptual Framework of Revenue Accounting

A conceptual framework of revenue accounting will become indispensable in order to put revenue accounting on a solid foundation and to have development efforts efficiently coordinated from the beginning. This does not mean that the framework, once established, should be

rigidly maintained. On the contrary, the framework should always be viewed as being tentative. Its objective is to promote common values and terminologies to facilitate communication and understanding, and to suggest problems and solutions that may not be evident unless we are continuously reminded of the big picture we are trying to develop. It is a blueprint that should be reviewed and revised frequently as we go along.

In developing traditional accounting, notable publications served as de facto conceptual frameworks. In particular, Sanders, Hatfield and Moore (1938) as well as Paton and Littleton (1940)[33] had significant influence in stimulating and uniting the efforts to develop principles and standards in financial accounting. In the 1960s, Moonitz (1961) and Sprouse and Moonitz (1962) appeared. They were prepared as AICPA Accounting Research Studies. The efforts also provided a base for AICPA's Accounting Principles Board (1970). Soon after this 1970 publication, AICPA Study Group on the Objectives of Financial Statements (1973) was established after a period of extensive studies interviewing a large number of investors, analysts, corporations, regulators, and academics.

When, in 1973, the Financial Accounting Standards Board was established, one of its first items on the agenda was to get the Conceptual Framework Project started, from which a series of publications followed starting with Financial Accounting Standards Board (1978). The unprecedented amount of trust placed on accounting earnings mentioned earlier would not have been brought about without accountants' continuous efforts over many decades to maintain a tightly-knit network of accounting standards built upon a conceptual framework.

Efforts to develop a conceptual framework of revenue accounting should start with postulates of revenue accounting. Postulates are assumptions, which may or may not be true or agreeable, but are proposed for the sake of promoting discussions. They should cover essential ingredients of a conceptual framework including objectives, concepts, and principles. Based on

[33] This was prepared as a follow-up of a short document published a few years earlier by the Executive Committee of the American Accounting Association (1936).

the various properties of revenue accounting we examined, we propose, as tentative postulates, the following 5 basic postulates and 5 operational postulates in the final section that follows.

12. Tentative Postulates of Revenue Accounting: Basic and Operational

Basic Postulate 1 (Basic Objective): *The basic objective of revenue accounting is to serve information needs of managers and investors, in the age of e-commerce, with respect to the firm's sales (as against production) activities and their financial consequences.* By emphasizing information needs of managers and investors, this postulate states the hybrid nature of revenue accounting, part managerial and part financial accounting.

Basic Postulate 2 (Need for Standards): *Revenue accounting must be built on a set of standards that satisfy information needs of managers and investors objectively and reliably.* By emphasizing standards, this postulate distinguishes information coming out of revenue accounting from other marketing information on the firm's sales activities which may be less standardized and less objective in nature. Standards are important to gain trust on the information from external investors; they are also important to gain trust on the information from internal managers at various levels of hierarchy. Some standards may be applied only to information released externally, some only to those released internally, and some to both.

Basic Postulate 3 (Modeling after Cost Accounting): *Revenue accounting should be developed, at least initially, by modeling it after systems in cost accounting so as to take full advantages of concepts and measurement structures already developed there, making sure signs are properly adjusted so that, for example, cost minimization is translated into revenue maximization.* This postulate states the importance of building revenue accounting on the legacy developed in cost accounting at least initially to gain momentum for the new development. After all, revenue accounting and cost accounting are sister systems which must be linked together eventually.

Basic Postulate 4 (Adapting to the E-Commerce Age): *Revenue accounting should, at the same time, adapt to the new E-Commerce Age by departing from traditional concepts and measurement structures and incorporating new features wherever deemed beneficial.* This postulate state the need to make revenue accounting adaptive to the new environment in the E-Commerce Age. Some of the new orientations not observed in cost accounting will be stated as operational postulates below.

Basic Postulate 5 (Revenue Statement): *Revenue accounting should include standards on reporting various sales activities summarized in "revenue statements," which are linked with the income statement but give a birds-eye-view of sales activities and their revenues in greater detail to meet the increased information needs of managers and investors.* This postulate emphasizes the need to provide more weight on the revenue section of the income statement by means of a supplemental revenue statement.

Operational Postulate 1 (Intangibles Recognition): *Revenue accounting should establish first disclosure standards and later measurement standards on the recognition and amortization of intangibles, such as advertisement, R&D, and human resources, so that standards are more in line with costs and benefits of investments over a long horizon even though the measurement of benefits may be difficult initially.* This postulate states the need for standards dealing with intangibles through disclosure and measurements.

Operational Postulate 2 (Project Accounting): *Wherever it is appropriate, revenue accounting should adopt, not the period-orientation as in traditional accounting, but the project-orientation as in capital budgeting and in Reserve Recognition Accounting in the oil and gas industry, in which a project or a customer over the lifetime is treated as the basic unit of measurement.* This postulate states the importance of slicing the continuous flow of activities not only by time period but also by project or customer over the lifetime. This allows a treatment of all expenditures as cash outlays without classifying them into assets and expenses. Even though fu-

ture cash flows over the project's or the customer's lifetime must be estimated, this view seems to be most in line with the e-commerce practice where acquisition and retention of customers are the central focus of their business.

Operational Postulate 3 (Revenue Mileposts): *Revenue accounting should start at a point much earlier than the current revenue realization point, e.g., order point or even inquiry point, and track the progress of the potential sale through various mileposts, so as to give much earlier feedback to managers and investors on essential marketing activities and their consequences.* This postulate states the importance of starting revenue accounting at the earliest possible point at which some financial or non-financial measurements can be made with a reasonable degree of objectivity, and track them thorough various mileposts in a way analogous to process cost accounting.

Operational Postulate 4 (Revenue Sustainability): *Revenue accounting should include standards on how to classify revenues by their "sustainability," the likelihood that the revenue will be sustained in a given future period, the simplest classification being fixed revenues and variable revenues, so as to supply information critical to marketing and financial decisions.* This postulate states the importance of recognizing different patterns of sustainability of sales in evaluating the value of the firm's customer base and projecting future revenues from newly acquired customers.

Operational Postulate 5 (Revenue Momentum): *Revenue accounting should also include standards on how to define "revenue momentum" based on a formula, such as an exponential smoothing model, applied to time series data on aggregate revenues as well as standards on what level of a smoothing constant is considered reasonable depending upon the history of the firm as well as of the industry.* This postulate states the need to determine based on a formula the portion of revenues that are considered to be "sustainable" and "not-sustainable." This method is fundamentally analogous to inventory costing methods which allocate total available inventory costs to cost of goods sold and ending inventory based on a formula such as FIFO or

LIFO. The approach offers a quantitative check on the reasonableness of fixed and variable revenues that are classified based on qualitative judgment.

In conclusion, revenue accounting is most likely to play important roles in the E-Commerce Age, just as cost accounting played important roles in the Industrial Age. Promotion of sound practice in revenue accounting will become one of the crucial public policy issues in accounting in the E-Commerce Age. Regulatory agencies such as the SEC and standard setting bodies such as the FASB can expedite such development of revenue accounting by taking leadership in this area, recognizing the fact this new age demands new approaches to accounting. Before an official conceptual framework of revenue accounting is created, however, many private publications comparable to the classical literature, cited in the early part of the previous section, are needed. This paper takes only a small step toward a construction of such a conceptual framework.

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14. Tables and Figures

Figure 1: Transition Diagram with Payoffs and Probabilities

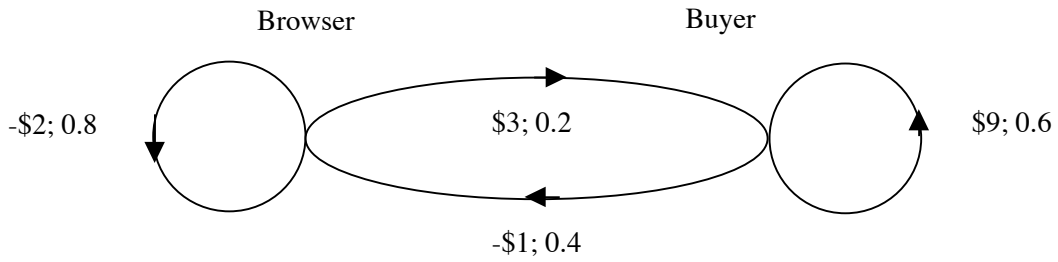

Table 1: Payoff Matrix and Transition Matrix						
		Payoff Matrix		Transition Matrix		Expected Payoff
		Current Period		Current Period		
		Browser	Buyer	Browser	Buyer	
Previous Period	Browser	-$2	$3	0.8	0.2	-$1
	Buyer	-$1	$9	0.4	0.6	$5

Table 2: Transition Probabilities and Expected Payoffs						
	Transition Probabilities				Expected Payoffs	
	Initial Browser		Initial Buyer		Initial	Initial
State at end	Browser	Buyer	Browser	Buyer	Browser	Buyer
Period 0	1	0	0	1		
1	0.8	0.2	0.4	0.6	-1	5
2	0.72	0.28	0.56	0.44	0.2	2.6
3	0.688	0.312	0.624	0.376	0.68	1.64
4	0.6752	0.3248	0.6496	0.3504	0.872	1.256
5	0.67008	0.32992	0.65984	0.34016	0.9488	1.1024
.....						
∞	0.666667	0.333333	0.666667	0.333333	1.00000	1.00000

Table 3: Smoothed Monthly Revenues (Smoothing Constant α = 0.5, 0.2, 0.05)													
Month	0	1	2	3	4	5	6	7	8	9	10	11	12
Actual ($)	100	80	112	133	150	131	98	87	115	130	143	150	145
Alpha 0.5	100	90	101	117	134	132	115	101	108	119	131	141	143
Alpha 0.2	100	96	99	106	115	118	114	109	110	114	120	126	130
Alpha 0.05	100	99	100	101	104	105	105	104	104	106	108	110	111

Figure 2: Smoothed Monthly Revenues (Smoothing Constant α = 0.5, 0.2, 0.05)

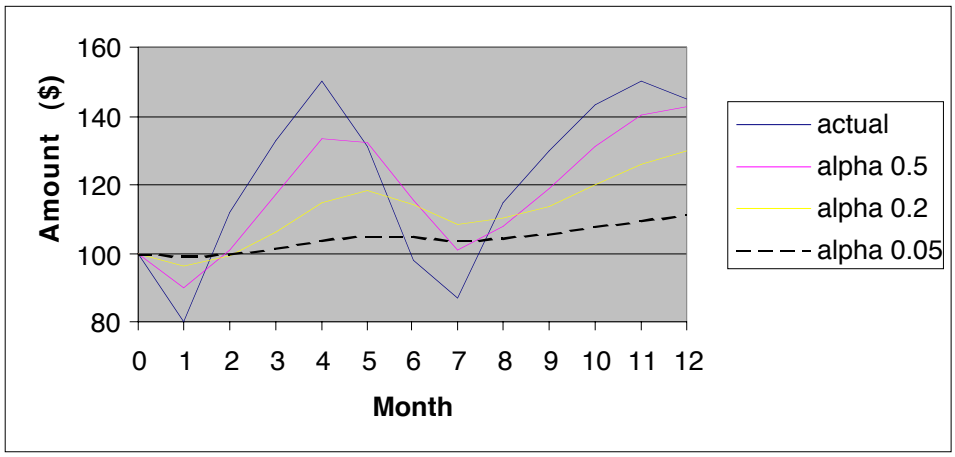

Figure 3: Revenue-Volume-Profit Analysis

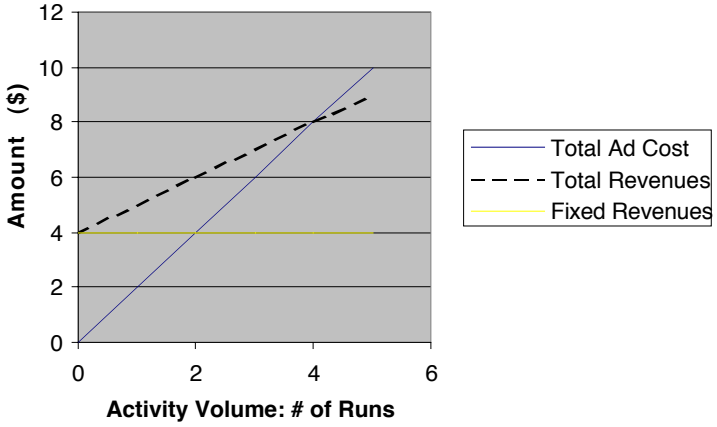

Table 4: Revenues Determining Depreciation and Vice Versa						
IRR = 30%: w/ rounding errors	Revenues Determining Depreciation			Depreciation Determining Revenues		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Beginning Investment	$1.000	$0.749	$0.424	$1.000	$0.667	$0.333
Revenues	0.551	0.551	0.551	0.633	0.533	0.433
Depreciation	0.251	0.326	0.424	0.333	0.333	0.333
Net Income = Beg Inv*IRR	0.300	0.225	0.127	0.300	0.200	0.100

Figure 4: Revenues Determining Depreciation and Vice Versa

(Upper Line = Revenues; Lower Line = Depreciation; Difference = Net Income)