Reporting for Success: The Baltimore and Ohio Railroad and Management Information, 1827-1856

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In 1995, a major collection of nineteenth century annual reports in the Bruno Business Library at The University of Alabama was "rediscovered." These reports had been in the cellar of the previous facility—but had been moved into storage as the Bruno Library was built. When the new library opened the annual report trove reemerged prominently. In this collection, the Baltimore and Ohio Railroad [B&O] reports were the oldest and most complete dating back almost to the company's founding in 1827 and continuing through the merger with the Chesapeake and Ohio in 1962. The relative age and completeness of the B&O annual reports aroused an interest as to their content. This, in turn, led the authors to undertake a literature search as to the B&O's importance. Only a few works had begun to focus on the railroads accounting role [Vangermeersch, 1979, pp. 318-337; Mason, 1933, p. 211; Rosen and DeCoster, 1969, pp. 124-136]. None, however, were comprehensive in scope of examination or they failed to identify important antebellum developments in effective railroad management information. What the B&O annual reports availed was a detailed disclosures archive of railroad development, financing, invention and construction, technology progress, and economic, financial and accounting development of this major corporation in an important infrastructure industry during the years prior to the Civil War.

The B&O annual reports of 1827-1856 led the authors to examine the work of business and history scholars such as Hungerford, Chandler and others who recognized the importance of the B&O in the economic development of the nation. From the archival and literature research came the understanding that the Baltimore and Ohio Railroad was significant for its leadership role ("B&O University") in railroading and its open corporate communication posture,

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which encouraged comparisons in technical and financial materials with other railroad enterprises during this stage [Salisbury, 1967, p. 300].

Noteworthy B&O innovations in engineering construction, financial, organization and administrative practices disclosed in annual reports have been detailed in an unpublished companion paper, "Exploring the Content of the Baltimore and Ohio Railroad Annual Reports: 1827-1856" [Previts and Samson, 1998].

This follow-up paper addresses the B&O's contributions to managerial information which moved accounting from mere bookkeeping to a useful tool of efficient decision making.

The remainder of this paper is organized as follows. A review of the literature and a description of the B&O annual report archives are presented first. Next, the history of the formation, construction and early operation of the B&O railroad is detailed. This history is then analyzed and placed in context of "virtues" of the early years of the nation. From the literature review, history and analysis, the historical importance of the B&O and its contributions are ascertained. Next, the model of reporting and disclosure by management to shareholders is described. This section is followed by the company's cost accounting developments and innovations. The final section summarizes the findings of this study and draws conclusions about the importance of the B&O contributions to business development.

Prior Research

Other researchers have pointed out the significance of accounting information to managers prior to 1850 in the Lowell Mills and Springfield Armory. Important examples of the B&O's impact on the development of the country are found in the research contribution of Alfred Chandler, who discusses railroads as the first modern U.S. business [1977, pp. 81-121]. Chandler points out that the new technology of railroads required managerial and organizational innovations. Railroad operation necessitated close coordination, efficiency and timing which heretofore had never been attempted; this, in turn, led to new organizational structure. A hierarchy of salaried employees administrated the business separately from capital providers. This led to a professional management "class" with a major incentive in the long-term continued and successful operation of the railroad venture, despite the fact such managers held little actual ownership interest in legal terms. Furthermore, a railroad venture represented an investment in property and equipment on a scale unfamiliar to other enterprises other than perhaps canals. Chandler identifies the B&O's innovations, especially in the areas of the development of a controllership department and internal controls.

Others who have focused on the B&O for accounting innovations and practices include Boockholdt [1978, pp. 9-28] who looked at financial reporting of the early railroads, Vangermeersch who examined managerial informa-

tion disclosures in the annual reports, and Giroux [1997, pp. 1-20] who noted the B&O's leadership in financial reporting.

Archival Research

The B&O annual reports are housed in a collection of historical annual reports at the Bruno Library at The University of Alabama (Tuscaloosa, AL). These are now a complete set, extending from the formation of the road in 1827 to 1962 when the B&O merged with the Chesapeake & Ohio. Missing reports were obtained from the B&O Museum, Johns Hopkins University Library (Baltimore).

Noteworthy is the size of the annual reports during the first thirty years as well as the detailed content. Unlike the "postcard" reports of industrial companies at the end of the nineteenth century, the B&O's annual report are extensive in pages and detail. The reports evolved from a corporate charter requirement for such "clear and distinct statement of affairs" [Article 9 of the Charter of the Baltimore & Ohio Railroad Company, (An Act passed by the General Assembly of Maryland) February 28th 1927]. Length varied, but frequently the reports exceeded 150 pages during the period under study. The number of tables and exhibits included in this total were usually well into double digits—with more than thirty being common in the annual reports. Much of the detail of reports reflects the innovative practice of having senior managers (master of transportation, chief engineer, superintendent of machinery) report on their areas of responsibilities to the shareholder. Hence, in addition to the president and treasurer, operating officials' reports were included within the annual report providing a dialogue and detail even more complete than in the "Management Discussion and Analysis" section of current annual reports.

Early History of the B&O

With the success of the Erie Canal and the surge of canal building in Ohio, Indiana and Illinois as means to transport goods and people between the East Coast cities and the West, merchants of Baltimore saw that their commercial advantage of having been linked to the National Road was declining. Indeed freight hauled via cart across even the best road for relatively short distances increased sixfold the cost of goods being shipped. Thus canals linking the seaports of the East with the Mississippi River Valley were seen as a major transportation improvement that would allow the raw materials and agricultural goods of the West to be exchanged for the imports and manufactured goods flowing in from the Eastern seaboard.

The Baltimore merchants realized without a competitive transport system their city, (then the third largest in the young nation), was threatened with decline. In a strategic gamble, involving new technology, these merchants supported the B&O as a "railed" road to move people and goods from Baltimore to a point on the Ohio River. In 1827 when the B&O was organized, a steam locomotive-powered train was then merely experimental. The founding

investors envisioned a train of horse-draw wagons and coaches pulled on the rails. Wind-propelled sail cars were tested as alternative to a horse-drawn train. Stationary engines located at strategic points of incline would provide another source of power. In 1831, the use of a small engine, the *Tom Thumb,* by the B&O along with careful cost analysis of horse-drawn versus steam power, led to the Baltimore and Ohio being the first U.S. railroad to adopt the steam engine for hauling passengers and freight [Gerstner, 1842-43, p. 834].

A greater hurdle, greater than the related problem of power, was the sheer challenge to construct a *railroad* from Baltimore to the Ohio River given that much of the 380 miles was across difficult terrain.

The B&O was initially capitalized in 1827 with $3,000,000 issue of stock. Virtually every citizen of Baltimore owned a share as the offering was oversubscribed. Half of the shares had, by charter, been reserved for the City of Baltimore and the State of Maryland. It took three years to construct thirteen miles of track; it would take twenty-five years (1853) to reach the Ohio River. The pace of construction was slow, not only because of physical obstacles, but because of the cost of the project was underestimated and new funding had to be continually sought. Construction often stopped as funds ran out and workers went unpaid; construction resumed when more capital had been raised. In the process, four times the amount of original contributed capital had to be raised to finance the construction, not including the reinvested profits from the operation of the B&O.

In terms of capital requirements, the B&O was unique. Nothing had been attempted during the first 75 years of having the nation's history, to match the $30 million of capital invested to link the port city of Baltimore with the Ohio River. This soon dwarfed the $7.6 million to construct the Erie Canal which had been considered a staggering sum in the mid-1820s.

Innovation took place to solve practical problems. Technology was experimented with, adopted and improved. The B&O started as risky "high-tech" investment and developed into a successful enterprise; but not without excitement, several crises and bankruptcies. The B&O and other railroads linked states economically. It politically influenced the markets of a nation. Cost of freight dropped radically and travel became affordable to a larger segment of the population. Goods and people moved with precision, speed and efficiency, albeit not always with safety. Industries were created—including civil engineering, tourism coal mining and a rapid communication telegraph system. As the profession of civil engineering emerged, bridges, tunnels, structures and gradient all became customary aspects of railroads. Financial and managerial accounting professions evolved to provide members as staff to prepare, audit and analyze corporate information.

The Virtues of Business

Early nineteenth century thought was heavily influenced by the moral and work axioms of Benjamin Franklin and his *Poor Richard's Almanac.* Franklin

cited (1) avoidance of idleness (industry), (2) care and management in overseeing tasks, (3) need to save and the control of expense, and (4) care in details, as keys to success. Among his thirteen virtues, Franklin lists Resolution (#4), Frugality (#5) and Industry (#6) [Harvard Business School Case, 383-160, 1983]. These axioms support the notion of success as representing the "efficient" use of limited resources. During its period of business development and operations, such exhortations would become measured in units of cost per units of performance. These measures such as cost per ton mile of freight or cost per passenger mile, were the product of an emerging "efficient management information" mindset which sought to reduce expenses to the lowest level of unit cost by improving technology and its application to rail transport.

The Business of Virtue

The virtuous employment of the B&O was to assure the success of the city. Noteworthy by its absence is the emphasis on profit as a motive for the formation of the B&O. Indeed the railroad was a quasi-public, civic enterprise to serve the City of Baltimore's interest and prevent its decline as a seaport and a commercial center. This was the "virtuous" purpose per the charter. As a mission statement, there is every reason to appreciate its sincerity and to assess the system of accounting accordingly. The dedication scroll, inserted in the "cornerstone" for the B&O, describes the virtuous objectives as follows:

> The stone is deposited in commemoration of the Baltimore and Ohio Railroad, a work of deep and vital interest to the American people. Its accomplishments will confer the most important benefits upon this nation by facilitating its commerce, diffusing and extending its social intercourse, and perpetuating the happy union of these confederated states [Jacobs, 1995, p. 5].

The B&O was incorporated by Acts of state legislatures (Maryland, then Virginia and Pennsylvania) because of the belief of the long-term benefit that such an entity could produce for the region. The stock was more than fifty percent owned by the State of Maryland and the city government of Baltimore. Beyond their direct investment, the state and the city also loaned funds to the B&O in times of financial difficulty to ensure its continuance.

In addition to the equity ownership, the city and the state exercised the right to appoint a number of directors so as to protect not only the financial interest of the city and the state but the public's interest in railroad matters. To this end, rate-setting authority was retained by the state, per terms of the charter. Thus revenues were a function of volume. Profitability required careful control of expenses rather than passing on cost increases to passengers and freight tariffs.

In market terms, a "virtuous" efficiency of operations was needed to convince capital providers of the efficacy of the road's cost structure. Efficiency secured capital on an ongoing basis during the first twenty-five years of the B&O.

One means of communicating management's "virtuous efficiency" was the annual report. Management explained, in great detail, performance, investment and operating information in a detailed, comprehensive fashion. The annual report was not only a document of communication between managers and shareholders about "virtuous" conduct, it explained and documented performance measures, presenting comparisons of revenues to expenses of the year to listed monthly revenues and expenses, and comparisons of the B&O to other railroads, as well as internally among branch lines of the B&O. Details included disclosure of freight revenue and passenger revenue versus freight expense and passenger expense. Resource allocation decisions also were presented and discussed. For example, alternative routes to the Ohio were compared by costs and distances; cost of horse versus steam power locomotion was compared; cost and profit behavior were studied. Understanding these new relationships ("proportions") revolutionized managerial information systems, as rudimentary fixed and variable cost patterns become understood.

The B&O annual report also was a "textbook" for the emerging transportation industry. It revealed information often of a technical nature that was beyond shareholder interest but which helped educate construction, equipment and operating engineers at the other lines. This openness was praised early in 1835 by the editor of *American Railroad Journal:*

> We acknowledge the favor by the President of the Company, of a copy of the Ninth Annual Report of the Baltimore and Ohio Rail Road Company, and cannot refrain from here expressing our own, and we believe the thanks of the entire Rail Road community, as well in Europe as in America, for the candid, business-like liberal manner, in which they annually lay before the world the result of their experience.
>
> It will not be say too much, we are sure, to nominate them the Rail Road University of the United States. They have labored long, at great cost, and with a diligence that is worthy of all praise in the cause, and what is equally to their credit, they have published annually the results of their experiments, and distributed their reports with a liberal hand that the world might be cautioned by their errors and instructed by their discoveries. Their reports have in truth gone forth as a textbook, and their road and workshops have been a lecture-room to thousands who are now practising and improving upon their experience. This country owes to the enterprise, public spirit and perseverance of the citizens of Baltimore, a debt of gratitude of no ordinary magnitude, as will be seen from the President's report in relation to their improvements upon and performances with their locomotive engines, when compared with the performances of the most powerful engines in Europe, or rather in imagination, in 1829, only six years ago [Hungerford, 1928, p. 112].

The B&O was truly the "Railroad's University." Its voluntary disclosures exemplified later state or federal requirements. Internal managerial information was disclosed as well as technical engineering information. Revenue and profits were measured on a monthly as well as annual basis. The B&O disclosure model was adopted by other railroads. Decades later, the Interstate Commerce Commission (ICC) utilized similar formats for railroad reporting as had developed at the B&O during its early years.

The B&O's principal "virtue" was its innovative character. Innovations in engineering, technology, information, analysis, accounting, control and disclosure are among the examples.

Efficient Management Information

To date, one of the least recognized, yet major innovations of the B&O was its contribution to managerial information and the achievement of an efficient cost structure. Albert Fink, famous for his design of iron bridges, began his distinctive railroad career at the B&O in December 1849 [Busbey, 1896, p. 155]. Galambos and Pratt consider him to be worthy of the title "The Father of Cost Accounting" [Galambos and Pratt, 1986, p. 48]. Our examination suggests that the foundations of the B&O managerial analysis preceded Fink's arrival by many years. Railroads integrated the most important data from bookkeeping sources into a system of information which managers employed to operate and to measure the business. The B&O "University" employees and "alumni" led the way.

Many of the important managerial information in innovations were not the work of accountants. Innovative managerial information and reports at the B&O were influenced by the road's engineers including Benjamin H. Latrobe and J. Knight. Engineers established the proportions or relationships between the dollar amount and effects of use on equipment and service. This analytical approach influenced the gathering of data and the design of management operations. These served as building blocks or ingredients that moved bookkeeping from its double-entry data function to a useful managerial information tool.

The early B&O annual reports reflect the analysis which was to provide for efficient managerial information. Engineering reports included in the second and third annual reports suggest the beginning. The second annual report contains a letter from the board of engineers to the company directors, which contains construction reports based on details of data (miles, cubic feet, etc.). The third annual report indicates that the company's financial condition had deteriorated. Cash was short as cost overruns consumed capital. To reflect the cost-consciousness that management had in carrying out the building of the railroad, the quantity measures of progress contained not only the physical measure but also per dollar cost terms. This practice continued and expanded. Progress and objectives were measured physically and in "cost per" physical unit terms in adjacent columns in exhibits and schedules of the annual report. The measures became "cost per mile," "cost per cubic yard" (the contracts for excavation specified the compensation in cents per cubic year of earth moved).

With the operation of steam locomotives, costs became measured in "per train," "per round trip" and "per train per day." Soon operating costs were measured and controlled by cost per ton and cost per passenger. This suggests that a rationale for joint cost allocation was developed. Further refinement occurred with these operating costs compared to the transported passenger–miles and the ton of freight-miles. This led to the B&O developing cost per passenger-mile and cost per ton-mile as the measures of operating efficiency. Other railroads adapted this statistic and version of these became standards in the industry. The B&O engineers then compared the company to other railroads on the basis of these measures in its annual reports. [Knight and Latrobe, 1838, pp. 1-42]. Such comparative displays were useful to show legislators that the B&O was an efficient, low cost provider of rail services. Such efficiency also supported the case for rate increases to meet patterns of increased costs experienced at efficient levels.

Cost Volume –Profit Behavior

One finding in our research is an appreciation of how quickly engineers who constructed and operated the B&O appeared to have grasped the behavior of operating costs of the railroad.[1] Barely had the first dollars of revenue been received when Superintendent Woodville, newly appointed to manage transportation, noted that certain expenses of the railroad would not be changed as the railroad construction progressed, yet the revenues would increase. Thus, he noted that these expenses as a percentage of revenues would decline as the railroad continued to expand. Other expenses, he observed, would increase proportionally with revenues. Table 1 contains Woodville's statements in his letter in the 1831 annual report.

What Woodville had noticed was fixed and variable cost behavior. The understanding of cost behavior grew at the B&O. In the 1833 (seventh) annual report, Knight's analysis of alternative routes to Washington, D.C. from Baltimore included grouping expenses according to behavior. Table 2 is an excerpt of Knight's analysis in which expenses are categorized as fixed or proportional.

Extensive discussion of fixed and "floating" expense behavior is described in Woodville's section in the 1834 B&O annual report (pages 34-46). Table 3 contains the excerpts of the Woodville report. Superintendent Woodville, who also held the role of auditor for several years, went on to perform income projections assuming revenues doubled and tripled with certain expenses remaining fixed. His illustration was designed to demonstrate profit potential to the

[1] David Solomons, in his "The Historical Development of Costing," suggests that Fink may have learned to group the cost accounts based on behavior (i.e. fixed, variable, mixed) by reading Donysius Larnden's 1850 treatise, *Railway Economy.* However, our findings suggest cost behavior was understood much earlier by Fink's predecessors, including Benjamin Latrobe and W. Woodville, Superintendent of Transportation. Indeed, Fink was Latrobe's understudy at the B&O. See: Ellen Fink Milton, *A Biography of Albert Fink,* (Rochester, 1951) p. 33.

shareholders of the day but it is perhaps most significant in its representation of an important managerial information development demonstrating that fixed-variable cost behavior was clearly understood before Albert Fink who had moved on in 1857 to the Louisville and Nashville where he wrote a treatise on cost behavior in 1875 [Fink, 1875, p. 48].

As reported in the B&O annual reports of 1831 and 1834, the relationship of volume of activity upon "fixed" and "floating" expenses was studied by the managers of the B&O. It would eventuate that the key for profitability was to increase utilization of the larger capacity or volume or "throughput." Learning to measure costs was important to profitability.

Cost-Managerial Accounting Developments

The first thirty years of B&O annual reports reflects the company's evolution from a company focused on construction of the railroad to an operating business in which the focus shifted to running an efficient railroad. This transition occurred in steps. The period from 1827 to 1831 was devoted solely to construction. In 1831 revenues from train service commenced. With each succeeding year, the B&O focus on operations grew. The company's operations reached the Ohio River in 1853.

Accompanying this evolution into an operating company was the development of managerial accounting techniques that were created to manage scarce resources, control performance of activities, present benchmarks of achievements and budget projections. Managerial cost control techniques are developed to manage each of the facets of the business, construction and operations. The remainder of this section examines the special reports included in the early B&O annual reports.

Construction and Managerial Accounting

Managing the unprecedented amount of costs constructing a railroad (excavation, filling, bridging and tunneling) meant that seldom would estimated times or expenditures be foreseen with accuracy. The company regularly overran its estimates and constantly was short of cash to pay its bills. To cover the construction cost overruns, the company regularly revisited the capital market and issued stock and bonds. Convincing the owners of capital to turn cash over to the B&O required the company to boost investor confidence that management was careful and prudent in its expenditures on construction. At the same time, progress on lengthening the railroad had to be shown. The second annual report (1828) began to report on association of miles and costs to come up with the measure of efficiency: cost per mile. Once the B&O had built a few miles of track, this cost per mile history became the basis for estimation of expenditures (budgeting) for future construction. Thus, cost per mile had become the focus and the measure of efficiency of construction. This metric was used in 1828, the first year of construction.

The third annual report reveals the widespread use of a new cost statistic: cost per cubic yard of excavation. Since building the railway required leveling the track plane, large amounts of earth and rock had to be shifted to reduce the ridges and inclines while filling in the ravines that were being traversed. The B&O contracted with private individuals to do much of the excavation work. The contracts called for payment by the cubic yard of excavation. Hence, a managerial cost metric was applied and in some cases served as a compensation incentive. The term of these contracts were disclosed in the third (1829) annual report along with a projection (budget) for the following year's work.

The fourth (1830) annual report disclosed a new cost measure: cost per rod. This statistic was a refined, detailed control over cost when cost per mile was too large a unit to control the cost of construction. In the fifth (1831) annual report, costs were accumulated by divisions and by sections of track. The sections were in differing lengths—and units of cost measures differed from section to section with one division utilizing poles while another division used rods as the measurement unit. Actual cost for a division was compared to the budgeted amount when the track was completed. Where bridge masonry had to be done, another measure—cost per perch—was developed. While standard costs as such were not developed, budgeting of costs had.

Operations and Managerial Accounting

The B&O began train operations in mid-1830 as a few miles of track had been completed. Despite the short distance and the horse-drawn carriages, passenger excursions became a popular activity such that the B&O produced revenue for the first time. $20,012.36 was collected in revenue from passenger excursions. No freight revenues were collected, however. The extension of the track to thirteen miles in the following year led to both passenger and freight revenues with 81,905 passengers and 5,931 tons of freight hauled by horse-drawn trains. The B&O's President mentions "income" of $31,405.24 and expenses of $10,944.87 almost as an afterthought in his 1831 letter to shareholders. His focus clearly was on construction of the line 67 miles to Harper's Ferry rather than on the fledgling operations. However, the "Superintendent of Transportation," W. Woodville wrote a memo to the President, included in the 1831 annual report, observing that transportation expenses had averaged 35% of revenues, an example of ratio analysis. Woodville went on to observe the cost of transportation behavior would not increase as fast as revenues as the length of the railroad increased or as the volume of traffic or utilization of trains increased. That such a cost behavior pattern was understood at such an early stage of operations is remarkable. Cost behavior was extended even further in the 1833 (seventh) annual report. J. Knight analyzed cost by cost per car and by train per day. He then analyzed costs per train per trip and determined that some expenses were related to distance, grade and curvature of track. Other expenses, he noted, were proportional to distance and other expenses were the same on any route. Still other expenses represented overhead

(general expenses, salary of depot employees, etc.). Knight included in his cost per train per round trip an interest cost for the investment in locomotive equipment cost. "Prime costs" and overhead costs were analyzed carefully in deciding whether the B&O should open a "stem" branch line from Baltimore to Washington, D.C.

In 1834's annual report, W. Woodville first used the terms "fixed" and "floating" expenses to describe the expenses behavior in relationship to revenues. He also allocated costs of locomotives between the passenger and freight revenues such that the profitability of each revenue source could be analyzed. This joint cost allocation is further evidence of the innovative practices at the B&O.

By 1843, the statistics that transportation managers focused upon included cost per passenger-mile and cost per freight-ton mile. This statistic captured the utilization and distance aspects of revenues and associated the cost with the revenue activity. Locomotive repair costs were also measured on a per mile run basis.

The 1844 president's letter reflects another use of a "cost per ton-mile" statistic to justify a rate increase request to the Maryland legislature.

During the late 1840s, B&O's annual reports began to use comparisons between the B&O and other "leading" railroads. The main comparison was cost per passenger mile and cost per freight-ton mile. These comparisons supported the assertion that the B&O was a cost efficient carrier of people and goods. In 1847, repair cost comparisons between types of track were shown in the annual report. Also wages were shown and compared between two years. The 1847 annual report also contained a monthly comparison of costs. Thus, costs were being accumulated by many types of objects and comparisons made to "benchmark" costs.

By the early 1850s, labor costs per mile for maintaining the track were computed as were cost of repairs by month. Construction and maintenance costs were published per water station, per bridge and per depot. This provided section and divisional cost comparisons to measure performance of managers. Also during this time, records of repair costs were kept for each locomotive, of "burden" and passenger car.

In summary, transaction accounting cost numbers were being developed to manage the railroad comparatively and in unit operating measures. Costs were the focus. They were accumulated by activity center and by object. Comparison of costs helped monitor performance. Cost behavior in the relationship with revenue activity was understood early and afforded better planning of operations.

Special Cost Studies

From the second report forward, there are special reports included in the annual report. These studies were on a variety of resource allocation and technological alternative decisions. They did more than inform the investors about the details of important company decisions concerning using scarce resources,

these studies also informed others in the industry about important engineering developments.

The second annual report (1829) contains a construction report from the B&O's Board of Engineers to the Board of Directors, describing in detail the cost of stone construction versus the cost of wood for bridges. The third annual report (1829) contains an analysis of route alternatives. The fourth annual report (1830) contains an engineering study of the track and track curvature for weight and speed of horse-drawn versus steam locomotives. It discusses the Peter Cooper's *Tom Thumb* experiments. The 1830 (fourth) annual report contains a comparison of costs of construction to Harper's Ferry if done in conjunction with the building of the Chesapeake and Ohio Canal. The 1831 (fifth) annual report includes the initial report of the Superintendent of Transportation which focuses on a key operating ratio between the transportation department's generating expense and revenue as "nearly 1 to 2.86 or about 35 percent." (p. 128). The report goes on to explain how expenditures support a high capacity level of activity, even when demand is low. In explaining why running trains even if empty made economic sense, Woodville pointed out the public would be inconvenienced (if the train did not run when not fully loaded) and "although by such reduction in the ratio of expenses to the receipts might have been improved, the *net* revenue (sic net income) would not in any degree have been increased by it." Managers seemed to have understood the cost behavior relation to revenues.

The next sentence of the report is also revealing about insights into cost behaviors: "As another cause of the high rate of expenses, it may be remarked that some of the charges, on the department of transportation, will not be increased on the further extension of the road, or by a great addition to its commerce; - and that so far from the expenditures continuing to advance proportionally with the income, they will, at each augmentation of traffic, relatively recede from each other." This demonstrates that the fixed cost nature of some railroad operating expenses was understood.

In the 1832 (sixth) annual report, the special reports compared the cost of horse versus steam-powered locomotion. The data support the cost advantage of steam over horse drawn trains. Also in this was an analysis of cost of wagon versus railroad shipments of coal.

The 1833 annual report detailed estimated costs of building a stem line to Washington, D.C. via alternative routes. This report runs for more than one hundred pages—the bulk of the annual report. Such detailing of costs of route alternatives was repeated in the 1835 (ninth) annual report when routes to Wheeling (on the Ohio River) were surveyed and cost of construction estimated and compared.

The following year the President's letter detailed a comparison between the B&O and six other railroads as to the amounts charged per passenger per mile and per ton of goods per mile.

By the 1840s, coal hauling had become a very important part of the B&O's business. The 1844 annual report contained an in-depth study of potential rev-

enues and costs including a revised estimate based on a car especially designed to haul only coal (i.e. the coal car).

Conclusion

The Baltimore and Ohio Railroad was an equivalent of a modern day high-tech, start up company. It was innovative technologically and managerially as the B&O uses of accounting information for management purposes moved forward in great strides. Railroad accounting became a useful tool of management whereby the focus shifted from recordkeeping to using accounting information in the operation of the business.

At the B&O, accounting numbers were used to convey the efficiency which management was using the scarce resources. Such efficiency was indeed a "virtue" reflective of Franklin's axioms. "Cost per" units of activity were developed to deliver this message of efficiency. In short order, the accounting information became employed by management to control railroad activities, to compare and measure performance, to insure responsibilities were being carried out effectively, to allocate resources and to plan and to budget.

A new appreciation for the contributions of early B&O engineers and managers as to cost behavior—fixed and variable patterns as revenues changed—is one important focus and finding of our research. Cost behavior was clearly known and applied forty years before Albert Fink, President of the Louisville and Nashville Railroad published his treatise on the concept. Hence, Woodville and Latrobe are worthy candidates for a "father of managerial accounting" title and over time others may also emerge as candidates as well.

The pioneering use of efficient management information at the B&O during its first two decades of operation as demonstrated in special reports, comparative data and ratio terms opens new opportunities to scholars for increasing our understanding of the origins and developments of managerial accounting during the antebellum period.

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Table 1: Cost Behavior Discussion

First Annual Report of the Superintendent of Transportation

Office of Transportation,
Baltimore and Ohio Rail Road,
October 1st, 1831

Philip E. Thomas, Esq.
President,

Sir,

Having, in addition to my duty as auditor, been appointed superintendent of Transportation on the Rail Road, I respectfully submit to you the accompanying documents, as the result of the operations in that department from the 1st of January to the 30th, September of this year.

In the tables marked I. J. are presented, respectively, detailed statements of the amount received for the Transportation of persons and of tonnage;—and in that market K, is shown the aggregate revenue arising from both those sources, during each month of the period stated above, amounting to the sum of $31,405 24.

In the document marked L, is exhibited a return of the actual expenditures by the Company, under the head of "expenses of transportation," amounting to $10,994 87; it embraces all the disbursements of this department during the period above referred to; but these, as will be perceived, do not include any charges for the construction, the repairs or the wear and tear of wagons and cars,—that branch of the service of the Company being under the immediate care and superintendence of a committee of the board.

It will be observed that the expenditures are to the receipts as nearly 1 to 2.86, or about 35 per cent.

This ratio although greatly reduced below that of last year, is still high, and from causes which will be explained, probably higher than it will be at any future period.

The whole revenue of the Company having, until lately, been almost exclusively derived from passengers, attracted to the road by novelty or amusement, has necessarily been extremely fluctuating and dependent on a variety of contingencies: whilst the expenses unavoidably attendant upon the uniform maintenance of a moving power calculated to meet the demands of the public on days of activity, although such days occur irregularly, have been great and of daily recurrence. The expediency of supporting an establishment of this magnitude, calculated to meet a great, rather than a medium, demand for transportation, may be explained by the fact that, if the moving power had been materially reduced, the public accommodation would in consequence have been seriously and inconveniently curtailed;—and that, although by such reduc-

tion the ratio of the expenses to the receipts might have been improved, the net revenue would not in any degree have been increased by it.

As another cause of the high rate of expenses, it may be remarked that some of the charges, and the department of transportation, will not be increased on further extension of the road, or by a great addition to its commerce; - and that so far from the expenditures continuing to advance proportionately with income, they will, at each augmentation of traffic, relatively recede from each other.

Source: B&O's 1831 Annual Report, pp. 128-129.

Table 2: Cost Behavior Analysis

The analysis of $33.89, the expenses per train for each circular trip, will therefore be as follows:

1.	Expense that will be proportional to actual distance, ascents, and curvatures.		
	Fuel		$10.50
2.	Expense that will be proportional to actual distance and curvature.		
	Wear and tear of Locomotive Engine and tender,	$5.85	
	Wear and tear of the train of 10 laden cars,	3.72	
			9.57
3.	Expenses that will be the same upon any of the routes		
	Engineer, assistant, and interest on prime cost of spare engines and tenders, =	4.67	
	Interest on prime cost of 40 spare cars for 10 laden cars in the train, =	1.15	
	General expenses, for salaries, depots, &c. &c. =	8.00	
			13.82
	Total cost of each train per circular trip, =		$33.89

Source: B&O's 1833 Annual Report, p. 123.

Table 3: What if Analysis

The general expenditures of the Company resolve themselves into two classes:—the one not being affected either by a diminution of the commerce of the road or by its increase to a considerable extent,—and, consisting of the maintenance of the Railway,—the support of depots, pay of agents, &c.—may be called the *fixed expenses:*—the other, being governed in its amount by the actual transportation,—rising or falling relatively to the extent of such transportation, and embracing the cost of moving power and the repairs of vehicles, &c. may be considered as *floating expenses.*

Under the first denomination,—that of *fixed expenses,*—may be classed:—

1st. The maintenance and repairs of the Rail Road and the support of the police of the road:—this portion of the expenditures being caused by the cost of removing slips, or opening ditches, drains, &c—the adjustment of the rails deranged by settling,—by the removal of defective materials from the Railway,—and arising, generally, from causes unconnected with the number of carriages which may pass over the road, and not being consequently affected by its amount of business,—have been considered as *fixed.*

2nd. The pay of officers, agents and conductors.—The individuals thus receiving pay from the Company, as before stated, cannot be reduced, being absolutely required at the depots that have been established;—yet a much greater amount of business could be effected by them without any increase of their number,—and it would not be hazarding an assertion, rashly, to state that if the business of the road, in its present extent, were augmented three fold, these charges could remain without any increase: —for the purposes of this exhibit they may, therefore, be assumed as *fixed.*

3rd. Depot expenses and contingencies,—expenses of stations, &c. These items are precisely similar in their character to the preceding—as although their number cannot be reduced, yet they are adequate in their present extent, to the demands of a more extended commerce.

The aggregate outlay on these several accounts has been—viz:—

Repairs of Railways, &c.	$22,795.90
Pay of Superintendent, Agents & Conductors,	13,453.20
Depot & Station expenses,	
Contingencies, &c.	16,135.23
Total of fixed expenses	$52,384.33

Under the second class of disbursements, that of *floating expenses,* are embraced:—

1st. The cost of moving power—that is the feed, wear and tear, and general attendance on the horses and mules employed on the road,—the pay of their drivers, &c.

2nd. The use of locomotives, their fuel, and the pay of engineers and repairs of the engines, the repairs of wagons and carriages,—and contingencies.

These items have amounted to—viz:—

Moving Power and wear and tear of Horses,	64,428.31
Use of Locomotives, &c—and the repairs of Cars, Contingencies, &c.	16,049.77
Total of *floating* expenses,	$80,478.08

The general expenses are thus subdivided and classed as follows—viz:—

Fixed Expenses	$52,384.33	
Floating Expenses	80,478.08	
Total Expenses		$132,862.41

The results, therefore, which may be deduced from this analysis are the following—

1. The actual Receipts have been $205,436.58
   The expenses have been,—viz:

Fixed	$52,384.33	
Floating	80,478.08	
		132,862.41
The Net Revenue,		$72,474.17 [sic.]

2. Had the Receipts been doubled the following result would have been obtained:—

Actual Receipts, $205,436.58 x2 =		$410,873.16
Expenses, viz:—		
Fixed,	$52,384.33	
Floating, $80,478.08 x2 =	160,956.16	
		213,340.49
Net Revenue would be		$197,532.67

3. Again,—the assertion has been made that had the receipts been threefold as great as those collected on the road, yet on the principle alluded to, the following results would have been presented,—viz:—

Actual Receipts, $205,436.58 x3 =		$616,309.74
Expenses, viz:—		
Fixed	$52,384.33	
Floating, $80,478.08 x3 =	241,434.24	
		293,818.57
Net Revenue will be		$322,491.17

Table 3 (continued)

Or, to apportion these expenses between the passenger and tonnage business, as stated in Table C, No. 4, the following exhibit would appear,—viz:—

Expenses	Passengers		Tonnage		Total
	Fixed	Floating	Fixed	Floating	
FIXED—viz.					
Repairs of Rail Road, &c	$11,397.95		$11,397.95		$22,795.90
Pay of Officers, Agents, and Superintendent,	5,538.98		7,914.22		13,453.20
Depot Expenses, Contingencies Supervisors and stations on Road,	6,611.78		9,523.45		16,135.23
FLOATING—viz					
Moving, Power, and wear and tear of live Stock		25,851.83		38,576.48	64,428.31
Repairs of Wagons, Carriages, use of Engines, &c.		9,715.36		6,334.41	16,049.77
	$23,548.71	$35,567.19	$28,835.62	$44,910.89	$132,862.41

Thus, although with the present limited business of the Company, the net revenues has only been $72,574.17, yet if the road possessed a commerce of three times its actual extent, instead of its net revenue advancing only in a direct ratio,—or to $217,722.51, it would, from the causes stated, be increased to $322,491.17.

Source: B&O's 1834 Annual Report, pp. 36-38.