



Accounting's representation of industrial expansion and decline: Some evidence from practice at Vickers Shipbuilding, 1910–24



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ABSTRACT

This paper puts forward an exploratory methodology for measuring the yearly representational effects of accounting, as the difference between the constructed profit measure and its underlying transactional base, in response to a call from the World Congress of Accounting Historians for research on differences in the way accounting represents organisational success across periods of industrial expansion and decline. The suggested approach has then been applied to data drawn from the archives of one of Britain's most important shipbuilders, Vickers at Barrow, across a period of unprecedented change in the industry, providing a basis for discussion of the observable representational effects.

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1. Introduction

The operations of commercial companies lead to transactions with parties outside the organisation that can be readily summarised. These transactional flows are typically augmented with 'year-end' adjustments which have no external referents but are believed to provide investors and other users with a better statement of operational performance, the profit and loss account. This belief is questionable and has been widely questioned since the 1960s (see, for example Chambers, 1976; Edey, 1963; Lawson, 1979; Lee, 1972; Rayman, 1970; Thomas, 1969). In this paper, financial accounting profit signals are seen not as inventions of economic or financial reality but as temporally adjusted representations of an (incomplete) underlying economic or financial reality.¹

In recent times, the reporting of cash flow statements *and* profit and loss accounts means that users can choose the signal which they find most useful.² Before the era of accounting standards, this was not possible, although those who were knowledgeable about accounting practices could produce a funds flow or cash flow statement from a pair of successive published balance sheets, together with the linking profit and loss account, using the 'statement of changes' approach, even if the result could be rather skeletal if the required disclosure levels were modest.

The basic methodology for converting accruals information to a funds or cash flow form is now well-established. The deficiencies of the profit and loss account and the related case for using cash or funds-flow statements were widely discussed

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¹ Any economic or financial 'reality' thus provided is a limited transactional one; it could not be complete unless non-transactional value changes in asset and liability holdings were also identified and included. For reservations about the extent to which even reformed accounting procedures can provide an unambiguous representation of reality, see McSweeney (1997).

² From 1975 to 91, UK Accounting Standards required that users be provided with a profit and loss account and a funds-flow statement.

in the literature in the 1960s and 1970s, with the arguments often related to a range of financial accounting issues that included important profit and loss accruals effects such as depreciation (see, for example, [ASC, 1975](#); [Chambers, 1976](#); [Edey, 1963](#); [Heath, 1978](#); [Henry, 1975](#); [Lee, 1972](#)). Relatively little attention was paid to management accounting issues, or trading account mechanisms such as full cost overhead allocation, that ensures some of the production overheads that essentially relate to the accounting year just ended will instead be carried forward and set against the revenues of the following year, a process of considerable importance to businesses with significant levels of work in progress or manufactured stock ([Drury, 2006](#), pp. 111–130; [McLean, 1995](#); [Weetman, 2010](#), pp. 104–120).

Although the impact of many accounting procedures on a single balance sheet is fairly clear, the effect of their use on successive balance sheets over a period of time is less certain, particularly during periods in which the level of economic activity expands and declines to any considerable extent, when other influences, such as changes in trade credit flow conditions, will also be felt. Our limited understanding of these effects was recently recognised by the organisers of the World Congress of Accounting Historians, when they selected the ways in which accounting functions across periods of industrial expansion and decline as the special theme of the recent conference at Newcastle University.

In this paper a particular version of the funds-flow statement is taken as the starting point, as a statement that summarises the firm's transactions, i.e. its legally recognised dealings with the outside world, whether they take place in cash or credit form. The essential choice, or 'accounting problem', is then whether to view such a statement as sufficient, to supplement it with year-end accruals adjustments (relating to matters seen as relevant to the measurement of net assets but where no transactions have taken place) so as to provide a view of the firm's profit or loss or, alternatively, whether to strip out credit transactions over the year in order to identify the underlying cash flows, consistent with what is widely seen to be the primary objective of the firm ([FASB, 1978](#); [IASB, 1989](#)).

The representational effects of accounting can then be expressed as the observable differences between comparable versions of these measures; this paper examines the various alternative versions of the cash, funds flow or accruals measures and discusses their comparability and utility. Different forms of performance measurement provide the basis for different explanations of business situation and the approaches suggested in this paper are applied to the unusually full information in the archival holdings of one of Britain's more important manufacturing businesses, Vickers shipyard at Barrow, across a period of unprecedented change, 1910–24, in order to demonstrate how they function and to provide some evidence on the relationship between accounting representation and conditions of business expansion and decline.

There are six further sections to the paper. The first discusses the connections and differences between profits, funds and cash flows and the representation of industrial performance, the next two provide background information on Vickers entry into shipbuilding and its subsequent expansion and decline at the shipyard and the fourth outlines the availability and nature of the main data source. The penultimate section identifies and discusses the outcomes from applying a number of alternative measures of financial performance to Vickers Shipbuilding and the last section draws some conclusions.

2. Profits, funds and cash flows and the representation of industrial performance

Although the earliest forms of accounting focused on reporting the cash outcomes of transactions, the inclusion of credit transactions then followed. Finally, the development of the accruals or matching concept came to provide a profit figure that, when compared with the capital employed in the business, could be seen to indicate the level of business performance (see [Bryer, 2000](#); [Edwards, Dean, & Clarke, 2009](#); [Toms, 2010](#)).

The 'creative' possibilities that came with the accruals approach became increasingly apparent during the 1920s and 1930s, although it was not until the 1960s and 1970s that the case for reporting cash (or funds) flows was made in any sustained way in the academic accounting literature (see, for example, [Arnold, 1997](#); [Arnold & Matthews, 2002](#); [Edwards, 1979](#); [Hastings, 1962](#); [Napier, 1991](#)). Thus Edey argued that the financial reports should focus on cash rather than profits since "in the end it is money that buys things and not figures of profit" and that investors were likely to find a cash forecast the 'most useful' type of accounting statement ([1963](#), pp. 999–1001). Rayman criticised the accruals system for its failure to distinguish between the results of actual events and the effects of accounting procedures and advocated a segregated system of funds-flow accounting ([1970](#)) and [Lee \(1972, 1984, 1985\)](#) and [Lawson \(1979, 1985\)](#) produced papers that established a substantial case for publishing both forecast and actual cash flows. The case for some increased reporting of cash flows may well have been strengthened by the statement by the Financial Accounting Standards Board of America that the firm's essential objective was the generation of cash flows ([1978](#), para. 37).³

Differences between the three alternative flow statement approaches, cash, funds and accrual-based, can best be considered by looking to the principle of articulation between flow and stock statements; thus any flow statement identifies the causes of the changes over a period of time in a defined set of balance sheet items.

From this analytical perspective, cash flow statements are the narrowest measure, but the most reliable, precisely because they identify the causes of the annual change in a small set of 'cash' (or near-cash) items. The balance sheet that the cash flow statement on its own can support consists only of the selected cash (or near-cash) items, and a capital employed section

³ See also [Egginton \(1984\)](#). Although the connections between information provided on alternative bases on past company performance and the estimation of future corporate cash flows are complex, such that the relative utilities of the three main concepts are unclear, tests in both the UK and USA suggest that earnings results differ significantly as signals of performance from their cash flow equivalents and that funds-flow numbers may be the best predictors of future cash flows see [Bowen, Burgstahler, and Daley \(1986\)](#) and [Arnold, Clubb, Manson, and Wearing \(1991\)](#).

consisting of the cash paid for shares, as yet unclaimed cash surpluses and cash provided in the form of loans. The cash flow statement can be produced by two different means, leading to statements that take accordingly different forms. The first to be used, and the simplest, is the 'direct' approach which looks to the books of the company as the basis for a summary of its cash receipts and payments. The other, the 'indirect', is used where there is no access to the internal records of the firm. Here the starting point is two successive balance sheets, and the profit and loss account that connects them, and a process of working backwards by undoing or reversing two categories of non-cash items can provide a statement of the deduced, underlying cash flows of the business. The first set of reversals are year-end accruals adjustments such as depreciation and transfers to reserves and the second is changes in a set of working capital items (including debtors, creditors and stock).⁴

The concept of cash is fairly straightforward, even though individual companies differ over which items are sufficiently liquid to be viewed as 'cash'. A 'fund' is a more complex idea and has been defined as "a unit of operations, a centre of interest, with a specified purpose or set of activities, consisting of assets and equities" (Godfrey, Hodgson, Holmes, & Tarca, 2006, p. 110). In the particular context of accounting standards for funds-flow reporting, a common approach was to "adopt a 'working capital from operations' concept of funds. As such, statements prepared under these standards were designed to show how working capital has been generated from operations and how that working capital has been applied" (Godfrey et al., 2006, p. 111). Thus IAS 7, as issued in 1977, required companies to publish a funds-flow statement that explained the change in balance sheet items under two headings, sources of funds and applications of funds, with the difference representing the net change in working capital.⁵

In this paper, the 'fund' will be defined as cash plus credit items (i.e. cash, short-term investments, debtors and creditors) and the funds-flow statement will accordingly provide a summary of the firm's transactions. The funds-flow statement, so defined, can then be reconciled to an indirect version of the cash flow statement by the adjustment of the credit components (debtors and creditors).

The most familiar of the flow statements is the profit and loss account, which defines the change in the ownership interest (other than amounts of capital paid in or withdrawn). Under the duality principle, the profit and loss account typically articulates with a balance sheet containing an array of fixed assets, current assets, current and other liabilities and is both the broadest measure of performance and the least reliable, in that it seeks to explain the changes in all these items, some of which may have a value that is highly uncertain.

Before these various measures are applied to data from the archives of Vickers Shipbuilding, the circumstances concerning Vickers entry into shipbuilding and the subsequent expansion and decline of trade at the shipyard will be outlined.

3. Vickers entry into shipbuilding

The Barrow Shipbuilding Co Ltd had been formed in 1871 with an initial paid-up capital of £150,000. The bulk of their early work was the construction of commercial tonnage and a new company was formed in 1888, the Naval Construction and Armaments Co Ltd, to upgrade the facilities in an attempt to attract more naval business. This venture was helped by the passing of the Navy Defence Act of 1889, which committed the Royal Navy to maintaining its superiority as a fleet and to building much of the new tonnage necessary in private sector yards. The shipyard expanded considerably, with employment rising from 900 in 1888 to 5500 in 1897 and was operating profitably, but not to an extent that justified the considerable risks of the trade they were in; shipbuilding was an acutely cyclical trade in which the levels of demand for new tonnage and the prices that ship-owners were willing to pay could both change very quickly, while the demands of the Admiralty for new tonnage were even more unpredictable. Moreover, the main investor, the Eighth Duke of Devonshire, was at that time losing a great deal of money on his investments in Barrow and he decided to reduce his commitments, including his stake in the local shipyard.⁶

Vickers had been in the steel business in Sheffield since the late 1820s, becoming a public company, Vickers, Sons and Co. Ltd in 1867. In the early 1880s, as their markets began to decline, they decided to concentrate on armaments, successfully producing all-steel armour plate in 1888, an area of business whose prospects were improved considerably by the passing of the Navy Act the following year. When the Naval Construction Company shipyard became available in 1897, Vickers paid more than £425,000 to acquire it. Although this was above its book value, it would prove to be an enormously beneficial transaction. Vertical integration, the bringing together of once separate parts of the production process, had been beneficial in the shipbuilding trade since the late 1840s but Vickers acquisition of the shipyards at Barrow took this to a new level. The yard provided a secure buyer for heavy weaponry produced in the main works at Sheffield, gave the parent company the ability to build warships complete with engines, armour, machinery and guns and thereby established it as a major supplier of naval hardware to the British and several foreign governments.⁷

⁴ The main limitation affecting the second category of reversals is the necessary assumption (under most circumstances) that creditors, other than for profits taxes or proposed dividends, relate to the purchase of goods for resale.

⁵ In 1992, IAS 7 in its revised form required companies to publish cash flow statements in place of funds-flow statements. See also Kafer and Zimmerman (1979).

⁶ In the period 1889–97, returns on capital employed averaged 5.5 percent. Spencer Cavendish was Marquess of Hartington from 1858 to 91 and 8th Duke of Devonshire from 1891 to 1908; see Cannadine (1977) and Pollard (1953). See also PRO, BT31/4056/25911, Company files Naval Construction and Armaments Co Ltd; PRO, BT31/1592/5297 Company files Barrow Shipbuilding Co Ltd; Bowen (1947), Middlemiss (1995, pp. 87–91), Scott (1962, pp. 46–86), and Trebilcock (1977, pp. 26–51).

⁷ Vickers, Sons and Co. Ltd became Vickers, Sons and Maxim Ltd in 1897 and Vickers Ltd in 1911. See also PRO, BT31/4056/25911 Company files Naval Construction and Armaments Co Ltd; Bowen (1947), Middlemiss (1995, pp. 87–91), Scott (1962, pp. 46–86), and Trebilcock (1977, pp. 26–51).

4. Expansion and decline at Vickers Shipbuilding

Under new management, as a division of Vickers, even greater changes were made at the Barrow shipyard; the capital employed trebled and the facilities were greatly improved. During the Boer War, employment in the yard doubled to around 10,300. From 1902, with the main reconstruction work completed, the firm became the market leader for naval work and obtained orders for large and sophisticated vessels for the British, Japanese, Brazilian and Russian navies. Admiralty orders now represented 60.4 percent of gross tonnage and overseas naval contracts 22.5 percent and commercial orders fell back from 82.5 percent of gross tonnage in 1889–99 to only 17.1 percent (Arnold, 2001, p. 277). There is clear evidence that naval contracts were generally more profitable than commercial work if less reliable year-on-year (see Arnold, 1998, 2001; Peebles, 1987). The internal records show that the profit levels at Barrow varied significantly by type of contract; in the five years before the First World War, when ship and hull contracts represented more than half the naval work, Vickers made profits of seven percent of the contract price whereas on their gun mounting contracts, which represented 30 percent of their naval orders, they made profits of 20 percent on the contract prices concerned. Vickers also became a leading member of the ‘armaments ring’.⁸

The ability of the yard to concentrate, successfully, on higher value work, the major part of which was for the British government meant that profitability levels were transformed; before the acquisition by Vickers, net margins on turnover had averaged less than two percent, but now began to exceed 15 percent, an extra-ordinary margin that made Barrow a hugely profitable operation. This was helped both by Fisher’s adoption of an ‘all-big-gun’ policy at the Admiralty in 1904–07 and by their own decision to specialise in the production of submarines, which did not require additional changes to the Barrow yard yet provided a very wide margin of profit, particularly in 1908–11 when margins on other work were quite tight (Arnold, 2001, p. 277; Pollard, 1952, p. 108; Trebilcock, 1977, pp. 68, 76–77).

During the First World War, the demand for armaments of various types rose to extra-ordinary levels. Further investment was made in shipyard equipment at Barrow. Production at the works was switched to submarines and munitions work and turnover (which was, in 1915–19, three times the level of 1910–14), reached a peak in 1916 before declining quite steeply during the last two years of the war. Costs of course increased but, with higher contract profits, the profitability of the operations at Barrow was even higher than during the prosperous pre-war period (see Table 1).

The impact of the ‘false dawn’ of early post-war expansion (see Dowie, 1975) was particularly marked at Vickers shipyard, where output levels in 1919 were almost three times as high as the year before. Senior managers were optimistic and thought they were “practically assured of work for ten years at Barrow, at a profit of not less than say ten percent” but, the slump of 1920–21 proved a turning point as the world demand for shipping capacity collapsed. In the UK, naval orders fell even faster than commercial demand and many shipbuilding firms faced the most acute difficulties; of 153,000 jobs lost nationally between 1920 and 1938, 146,000 had gone by 1923. At Barrow, the decline and its effects on employment were particularly severe; the yard had employed 17,000 people at the outbreak of war, rising to 31,300 in January 1917 but this fell back to only 3150 in September 1922 (Geary, 1997, pp. 304, 318; Scott, 1962, p. 138).

The annual turnover figures (as set out in Table 3, below) indicate that the annual activity levels at the shipyard across the period 1910–24 were highly variable. Turnover rose from £2.5m in 1910–11, gradually expanding to a war-time peak of £12.2m in 1916. This was followed by a period of turbulent change that saw output fall to £5.9m in 1918, immediately followed by an unprecedented £17.1m of output in 1919. The decline thereafter was profound, to annual volumes of business in 1923–24 that were the lowest in living memory. The First World War was a time of unprecedented inflation and Fig. 1 shows the annual turnover figure in £’s and also in restated 1917 £’s (1917 being the midpoint of the period 1910–24). Although this restatement changed the relativities of the pre- and post-war periods it did not greatly change the average output, or the level of variability or even the general pattern to any great extent.⁹

Despite the high level of activity variations from year to year, the establishment of a shipyard division at Barrow had been a key strategic decision that helped to establish Vickers as one of the UK’s leading industrial companies.¹⁰ Table 1 sets out the main features of the relationship between Vickers and its shipyard division and shows that, while Barrow absorbed in the region of 16 percent of the parent company’s capital, it generated about 30 percent of its profits (see cols 7 and 8).¹¹

⁸ The acquisitions of the members of the ‘armaments ring’ gave them the ability to produce complete, armed warships and to quote far more tightly for contracts for ships and hulls, where they faced competition from firms outside the ‘ring’, making up for this through the profits made on the armament work in which the cartel was dominant. This policy strengthened their market position by concentrating naval orders into the hands of cartel members, the other members of which were Armstrongs, Beardmore, John Brown, and Cammell Bros. See also [Cambridge University Archives](#), Vickers papers, V1480 Annual reports 1910–24, V1503–35 internal accounts and schedules, 1910–24; Vickers Shipbuilding and Engineering Ltd (VSEL), Barrow Shipbuilding Works, items 2–31, annual accounts and internal schedules 1910–24; Trebilcock (1977, pp. 8–9) and Arnold (2001, 2011).

⁹ The average annual turnover was (in £s) £6.25m (with a standard deviation of 4.15) and in 1917£s, £6.68m (standard deviation 4.01).

¹⁰ Payne, for example, identified Vickers as the sixth largest company in Britain in 1905 (Payne, 1967, p. 533).

¹¹ Table 1 is based upon the published accounts for Vickers. Vickers did not publish annual accounts for 1916–19 but a composite account for the four-year period. More generally, the published accounts of the main company were misleading because of the use of secret reserves; the largest was a (publicly unrevealed) deduction from investments (that rose from £382,000 in 1910 to £2,200,000 in 1919) but smaller reserves (that reached £790,000 and £400,000 respectively) were also deducted from debtors and included in creditors. The covert reversal of these reserves masked the severity of the decline in profitability in the immediate post-war period, particularly in 1920, when a major new debenture issue was made. For more general aspects of secret reserve accounting during this period, see Arnold (1997).

Table 1
Vickers Ltd. main company and shipyard, 1910–24.

Year to	Vickers Main Co. Cap Emp £000 (1)	Vickers Main Co. PBIT £000 (2)	Shipyard Cap Emp £000 (3)	Shipyard Surplus £000 (4)	Vickers Main Co. ROCE % (5)	Shipyard Surplus/Cap Emp % (6)	Shipyard/Main Co. Cap Emp % (7)	Shipyard/Main Co. Surplus/PBIT % (8)
Dec 1910	8375	535	1351	370	6.4	27.4	16.1	69.2
1911	8377	641	1264	258	7.7	20.4	15.1	40.2
1912	8706	872	1954	323	10.0	16.5	22.4	37.0
1913	10,141	1111	2061	118	11.0	5.7	20.3	10.6
1914	11,919	1019	2389	302	8.5	12.6	20.0	29.6
1915	12,190	1115	4249	760	9.1	17.9	34.9	68.2
1916	n/a	2576	3878	833	8.8	21.5	n/a	32.3
1917	n/a	2577	3721	920	8.8	24.7	n/a	35.7
1918	n/a	2576	2410	−522	8.8	−21.7	n/a	−20.3
1919	29,429	2577	2913	2340	8.8	80.3	9.9	90.8
1920	31,286	695	4312	−293	2.2	−6.8	13.8	−42.2
1921	31,599	708	4250	159	2.2	3.7	13.4	22.5
1922	31,083	683	2216	412	2.2	18.6	7.1	60.3
1923	28,987	−1241	2385	68	−4.3	2.9	8.2	−5.5
1924	28,393	−693	2443	−149	−2.4	−6.1	8.6	21.5
Av 1910–14	9504	836	1804	274	8.7	16.5	18.8	37.3
Av 1915–24	27,567	1157	3278	453	4.4	13.5	13.7	26.3
Av 1910–24	20,040	1050	2786	393	5.8	14.5	15.8	30.0

In col (3) capital employed is as recorded in the divisional books.

In col (4) the annual surplus (or deficit) is as recorded in the divisional books.

5. Availability and nature of the data

From July 1897, when the shipyard at Barrow became a division of Vickers, the capital inputs, the initial purchase consideration, all subsequent cash transfers and the annual retained profits of the shipyard, were all channelled through a current account with the head office in London, which provided a flexible mechanism for the support and control of shipbuilding operations.

The archival sources on the commercial operations of Vickers are substantial. The major collection, detailing a wide range of aspects of the business of the main company and some of its subsidiaries, is held in Cambridge and has been widely used. The data includes the published financial statements of the company and a good deal of the internal support for those statements, including some material on the shipbuilding division.¹²

The main information on the latter is, however, contained in a small but very concise set of internal records held in the company shipyard at Barrow. These have received far less attention than the main collection but in fact contain unusually detailed internal records of the receipts, costs and profits of each contract, of the treatment of 'working charges' or overheads and of the linkages through from these to the internal profit and loss accounts and balance sheets and to the current account that was maintained with the head office and regularly reconciled with data for the shipyard as kept at Vickers head office.¹³

Vickers saw the shipyard as a division of the main company, with some degree of decision-making autonomy and they summarised the year's shipbuilding operations by means of an accruals-based profit and loss account that showed an annual surplus (or deficit) and which articulated with a fairly full year-end balance sheet.¹⁴

The internal balance sheets and profit and loss accounts produced by Vickers Shipbuilding for the period 1909–24 are accordingly shown in a consistent, summarised form in Table 2 (balance sheets) and Table 3 (profit and loss accounts). These provide a relatively orthodox view of the commercial operations. On the balance sheet, the unusual features concern the relationship with the parent company, reserves and the treatment of work in progress. The shipyard, as a division of Vickers, had no share capital of its own, although it did sometimes raise its own bank loans. The bulk of the funding came from the parent company and consisted of the initial purchase consideration, the subsequent investments, which took the form of cash transfers and the annual surpluses (or deficits) which were automatically added (or subtracted) to the Vickers account.

Until the 1940s, reserves were rarely distinguished from provisions by UK companies, with the term 'reserve' widely used to describe both types of accounting practice (see ICAEW, 1944–57). Vickers made use of three or four types of 'reserves'. Every year, amounts were set aside for possible further expenditures on a number of ostensibly completed contracts, on a specific basis; they were described as 'reserves' but were effectively provisions. The shipyard division's depreciation and asset

¹² Cambridge University Archives, Vickers papers, V1480 Annual reports 1910–24, V1481 Documents circulated to shareholders 1910–24, V1503–35 internal accounts and schedules, 1910–24.

¹³ Vickers Shipbuilding and Engineering Ltd (VSEL), Barrow Shipbuilding Works, items 2–31, annual accounts and internal schedules 1910–24. The main publication on the commercial affairs of Vickers is Scott (1962).

¹⁴ The division also maintained very detailed records of the shipyard operations and carried out high levels of analysis of the various figures in the summary documents.

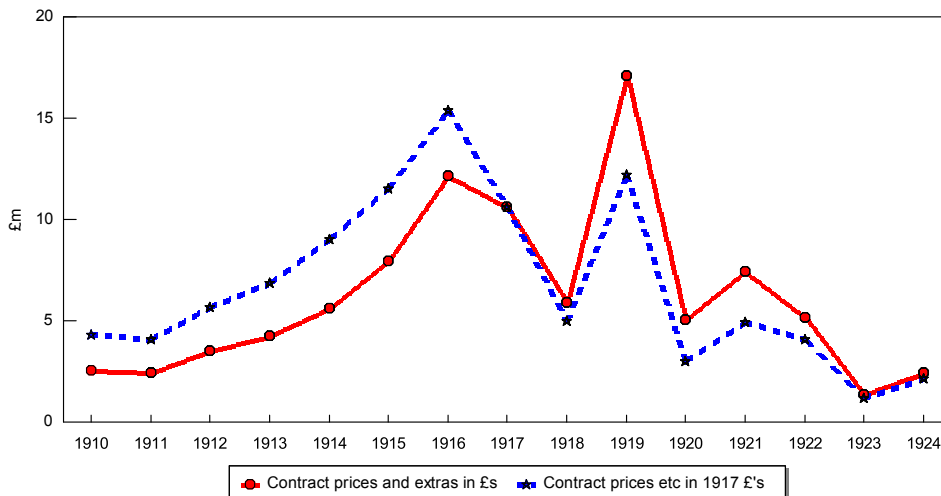


Fig. 1. Activity measures, 1910–24.

write-off practices on the other hand were quite inconsistent (see below) and at times functioned as a form of *de facto* reserve, although never classified as such. The company also set up a number of secret or 'inner' reserves during the war years, which were drawn upon during the period 1919–24.¹⁵

It is in the nature of shipbuilding that some contracts will be ongoing at the end of the accounting year, and work in progress was an important component of the Vickers shipyard balance sheet. Its valuation (as the total of the expenditures to balance sheet date, plus the allocated overheads or 'general charges' less the progress payments or instalments received and less a 'reserve' against the expected losses on some of those contracts) involved the final type of 'reserve', that was again in reality a provision.

Precise details were kept of shipyard operations.¹⁶ The major revenues came from contracts to build ships and other things, particularly munitions during the war years. The various departments at the shipyard also generated other revenues. The profits on the various contracts were quite variable. Commercial work was typically less rewarding than work for the Admiralty and munitions work for the government (see above) but even Admiralty orders could lose money and in some cases not even cover their direct costs.

In arriving at the annual surplus (or deficit) on shipyard operations, Vickers took into account four types of expenses; direct costs, general charges (or production overheads), other administrative or financial costs and London office charges or receipts. They also made a number of 'reserve' adjustments (see above).

Direct costs (for labour and raw material inputs) were the largest expense but could be readily related to the contract on which they were used. The general charges, which included such costs as maintenance, heating, rent, rates and water charges, administrative salaries, stationery and insurance could not, and were allocated on a highly differentiated basis to the various types of contract and, to a limited extent, to the departments that did other work.¹⁷ The allocation of general charges (or production overheads) was based upon an assumed level of throughput each year; since actual throughput inevitably differed from the expected level, there was an under- or over-charge of overheads every year.

The company also incurred 'other' costs or overheads, including directors' remuneration, interest charges, rental costs for buildings that were not used for productive purposes, special war-time insurance and depreciation. Until 1912 these overheads were all shown as a profit and loss type expenses but, from 1913 until 1920, they were instead classified as 'super charges' and a proportion charged against contracts completed during the year. Depreciation was generally less than four percent of turnover but from 1915 onwards it became much more variable. In the period 1915–18, in which the fixed assets were used more intensively than usual, the depreciation charges were much higher than previously but in most of the years from 1919 to 24 they almost disappeared. In some cases, assets written off during the war years were written-back. There were, however, substantial depreciation charges in 1922, as the crisis in asset values became apparent.

Although the yearly surplus was to be added each year to the Vickers account, the London office did deal with contracts in a relatively arms-length way and made other transfers that were treated as a part of the attributable costs to deal with the special circumstances of some of the contracts the company had negotiated centrally, or the special circumstances of particular years (particularly during the post-war slump).

¹⁵ Most of the 'inner' reserves related to future capital expenditures. The use of 'secret', or 'inner' reserves was made illegal in most UK industries in the 1948 Companies Act.

¹⁶ Vickers Shipbuilding and Engineering Ltd (VSEL), Barrow Shipbuilding Works, items 2–31, Annual accounts and internal schedules 1910–24.

¹⁷ More than twenty different absorption rates (ranging from 5 percent on direct cost for purchased machinery included in submarines to 265 percent of wages for shell production in 1917) were used to allocate the overheads to production.

Table 2
Vickers shipbuilding balance sheets, 1910–24 (£000).

31 Dec	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
<i>Vickers account:</i>																
Current account	1254	981	1006	1531	1806	1687	2686	2451	2006	2461	214	4309	3793	1654	2259	2536
Surplus (loss) for year	246	370	258	323	118	302	760	833	920	-522	2340	-293	159	412	68	-149
	1500	1351	1264	1854	1924	1989	3446	3284	2926	1939	2554	4016	3952	2066	2327	2387
Inner reserves							280	280	299	399	359	296	160	150	58	56
Vickers interest	1500	1351	1264	1854	1924	1989	3726	3564	3225	2338	2913	4312	4112	2216	2385	2443
Bank loans				100	137	400	523	314	496	72				138		
Capital employed	1500	1351	1264	1954	2061	2389	4249	3878	3721	2410	2913	4312	4250	2216	2385	2443
Creditors	132	151	175	223	230	354	1248	941	1361	2033	658	718	315	402	194	358
Est. losses on finished contracts	173	111	143	294	250	398	499	283	218	187	190	232	138	343	22	238
	1805	1613	1582	2471	2541	3141	5996	5102	5300	4630	3761	5262	4703	2961	2601	3039
Fixed assets	1082	1179	1208	1357	1438	1517	2469	2157	1762	1573	1237	2675	2533	2512	1746	1657
Less yrs deprec		-40	-42	-59	-62	-79	-491	-504	-507	-632	-8	-174		-754	-38	-3
	1082	1139	1166	1298	1376	1438	1978	1653	1255	941	1229	2501	2533	1758	1708	1654
Work in progress	207	-129	-247	108	342	282	2243	1531	2179	2115	387	777	422	66	62	98
Stock	188	218	211	267	275	266	452	568	719	514	390	483	239	139	196	215
Debtors	251	366	435	612	546	865	1303	1327	1077	909	1525	1363	1324	945	622	1045
Cash	77	19	17	186	2	290	3	14	46	94	155	53	185	53	13	27
Short-term investments							17	9	24	57	75	85				
	723	474	416	1173	1165	1703	4018	3449	4045	3689	2532	2761	2170	1203	893	1385
	1805	1613	1582	2471	2541	3141	5996	5102	5300	4630	3761	5262	4703	2961	2601	3039

The system in place thus provided some flexibilities on individual contract arrangements and gave central management the sort of summary information on the operations of the shipyard division, in the form of a profit and loss account and balance sheet, that would have been appropriate for a separate business together with very detailed support for the summary figures so that any problematic situations could be investigated as necessary.

6. Constructed alternative measures of financial performance for Vickers Shipbuilding

The intention in this section is to identify equivalent versions of funds, cash and accruals-based performance measures and to apply them to the circumstances of Vickers Shipbuilding across the period 1910–24, in order to identify the representational effects of accounting, with particular reference to differences between the periods of economic expansion and decline that the shipyard experienced. This will provide a basis for the discussion of these effects in the final section.

In most cases there is a need to consider general aspects of the suitability and compatibility of particular measures, such as whether they should be before or after interest charges or taxation but in this case the particular arrangements, as reflected in the divisional profit and loss accounts, that suited the needs of Vickers senior management can be taken as the starting point and as the defined accruals-based performance measure.

The issue is then how best to provide funds flow and cash flow measures that can properly be used for comparisons with the accruals-based profit measures in order to identify the representational aspects of accounting, as defined earlier in the paper. A summarised version of the transactional base is provided by a funds-flow statement, where 'fund' is defined as cash, short-term investments, debtors and creditors. The funds-flow statement can then be reconciled to its cash flow equivalent (which summarises the firm's cash transactions) by the adjustment of the credit components, debtors and creditors.

There is an additional matter to consider concerning the compatibility of the accruals, funds and cash-based statements. Most of the differences between the accruals-based surplus and funds or cash flows from operations are temporal and thus temporary, but there is an important definitional and thus permanent difference between the accruals-based surplus and the other two approaches; under funds or cash flow analysis, fixed asset costs and receipts are usually shown as investment cash flows and accordingly excluded from operational flows. Thus, over time, funds and cash flows from operations are likely to be greater than their accruals-based equivalent by the amounts of the depreciation charges, which in the case of Vickers shipyard division (and many other businesses) were substantial.¹⁸

The most satisfactory corrective for this in principle must be to extend the funds and cash flow measures so as to include both operations and the periodic expenditures on fixed assets. The aggregate depreciation charge over the life of an individual fixed asset will equal the difference between the amount paid for the asset and received from its eventual sale although, during shorter periods of time, there will be a disparity between the two measures.

Accordingly, Table 4 sets out the accruals-based surplus or deficit and the way that this connects with the funds and cash flow statements, using the indirect format that is normally used for this purpose. In this table, and the figures that are based upon it (see below), positive numbers indicate (cash or credit) inflows and negative numbers the reverse, e.g. expenditures on materials used in the shipbuilding process and on fixed assets. It is normal, in setting out cash or funds-flow statements, to

¹⁸ The average annual surplus at Barrow across the period was £393,000, after deducting depreciation averaging £226,000 p.a. (see Table 4).

Table 3
Vickers shipbuilding profit and loss accounts, 1910–24 (£000).

Ye 31 Dec	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Contract and other revenues	2558	2436	3514	4282	5636	7978	12,188	10,612	5936	17,097	5083	7424	5167	1384	2442
Direct expenses	-1774	-1716	-2461	-3614	-4312	-5312	-8854	-7397	-4344	-11,848	-3935	-6258	-4172	-1310	-1923
General charges allocated	-235	-222	-344	-357	-584	-713	-1553	-1595	-934	-2613	-967	-1307	-583	-135	-326
Other costs	-107	-204	-353	-159	-400	-862	-915	-687	-1005	-288	-736	161	-1023	-143	-254
Head office contributions/ (charges)	-72	-36	-33	-34	-38	-51	-33	6	-75	-48	199	3	1013	180	-90
Total costs	-2188	-2178	-3191	-4164	-5334	-6938	-11,355	-9673	-6358	-14,797	-5439	-7401	-4765	-1408	-2593
Transfers (to)/from inner reserves						-280		-19	-100	40	63	136	10	92	2
Surplus for year	370	258	323	118	302	760	833	920	-522	2340	-293	159	412	68	-149
Other costs include:															
Depreciation	-40	-42	-59	-62	-79	-491	-504	-507	-632	-8	-174	0	-754	-38	-3
Gen charges under/(over) charged	-68	-32	-26	-48	-38	8	-157	-91	-120	-40	-104	-148	-200	-238	-45

divide the main part into its operating, investment and financing sections. The shipbuilding division of Vickers did not, however, buy non-operating assets and the approach taken to depreciation and fixed asset expenditures means that this can be reduced to two sections, operating and finance.

Table 4, which also shows averages and standard deviations, begins with the annual surplus (or deficit) as shown at the foot of Table 3. There are eight adjustments that connect the accruals-based measure with the funds flows from operations (inc. fixed assets) and these are shown next. Adjustment of the change in the credit components then yields cash flows from operations (inc. fixed assets). Finally, after the financing flows are shown, the change in cash items is reconciled towards the foot of the table to its constituent parts.¹⁹ The average cash balance changed by only £3000, as the total change was £50,000 over the period (see Table 2).

Each of the adjustments (apart from depreciation and spending on fixed assets) was largely self-cancelling over the period and each had a far larger standard deviation than average (in Table 4, right-hand columns). The four adjustments with the largest effect on timing matters were depreciation, fixed asset expenditures, general charges allocated to WIP and changes in the other components of the WIP balance sheet valuation.²⁰

Depreciation charges represented just over 85 percent of the spending on fixed assets across the period but was, perhaps predictably, more regular in its incidence. Depreciation charges were high across the war years 1915–18 and also in 1922, when the potential impact of a severe downturn on asset values became apparent. Expenditures on fixed assets, on the other hand, were quite high during the boom of 1912–16 (spectacularly so in 1915 in order to properly support increased war-time output levels) and in 1918–20 (again notably so in 1920 as an aftermath of the misplaced optimism of 1919). The net effect was that depreciation charges were noticeably higher than the related expenditures in the downturns of 1916–18 and 1922 and lower during the growth periods 1910–15 and 1919 (and their aftermath in 1920).

The allocation of general charges, or overheads, to production was of course a major issue for Vickers. Overhead costs averaged 16 percent of contract revenues and, almost by definition, were 'sticky' costs that were slow to respond to volume changes; in the three major downturn years of 1918, 1920 and 1923 they were more than twice their normal level, relative to contract revenues. Most of the overhead costs related to completed work (92 percent) and were charged against profits, but the remainder was carried forward as part of work in progress. Each year there would be amounts over or unabsorbed by the allocations, that reflected the differences between expected and actual volume levels and these were charged or credited to the year's profit and loss. The general pattern was thus one of gradual enhancements of profits during years of expansion (e.g. 1912 and 1913) and vice versa in years of contraction although in four years of more sudden change there were major effects in the reverse direction; in the two main downturn years, 1918 and 1920, the proportions of overhead expenditure allocated to WIP were much higher than usual and resulted in very substantial profit enhancements and in two of the peak years, 1919 and 1921, the amounts carried forward were much lower than the year before and caused material reductions in the profit figures. The other components of the balance sheet figure for WIP were the direct expenditures thereon, less the instalments received for work certified (which would also have included charges for overheads). Both were very substantial, but largely netted off except during the war years when there were some delays in government payments.

The net result of changes in the various adjustments on the three main performance indicators is shown in Table 4 and, in graph form, in Fig. 2. The annual differences between the measures (as shown at the foot of Table 4) are also shown in graph

¹⁹ Debtors tended to rise during upturns, as in 1910–15 and 1924 and in the peak year of 1919 and to fall during periods of lower activity (1917–18, 1920 and 1922–23). Creditors rose in each of the peak years 1916, 1919 and 1921 and also fell in 1917–18 (but also in 1915). WIP rose (sharply) in 1915 (but not in 1916) and in 1920 and fell substantially in 1918 (but also in 1916).

²⁰ The transfers to and from inner reserve were important only in 1915, when the inner reserve was first established out of rising war-time profits. The adjustments for the estimated losses on finished (where some contractual obligations still remained) and unfinished contracts grew gradually as output rose up to 1916, became suddenly much larger in 1920 as a prudent approach was taken to the sharp downturn of 1920 and were then largely released during the slight upturn the following year. Stock valuation changes were largest as activity expanded across the war years and during the crisis of 1921.

Table 4
Vickers shipbuilding, summarised flow statements, 1910–24 (£000).

Ye 31 Dec	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	Ave	St dev
Surplus for year	370	258	323	118	302	760	833	920	-522	2340	-293	159	412	68	-149	393	646
Operations:																	
Spendings on fixed assets	-97	-69	-191	-140	-141	-1031	-179	-109	-318	-296	-1446	-32	21	12	51	-264	403
Depreciation	40	42	59	62	79	491	504	507	632	8	174	0	754	38	3	226	258
	-57	-27	-132	-78	-62	-540	325	398	314	-288	-1272	-32	775	50	54	-38	445
Transfers to inner reserves	0	0	0	0	0	280	0	19	100	-40	-63	-136	-10	-92	-2	4	90
Inc (dec) in:																	
Est. loss on finished contracts	-62	32	151	-44	148	101	-216	-65	-31	3	42	-94	205	-321	216	4	145
Est. loss on WIP contracts	2	2	3	7	23	19	157	-76	79	103	352	-281	-174	158	-40	22	142
O/head charges to WIP	-20	-96	-44	-58	93	-349	-46	-240	-1309	1450	-317	585	389	-48	-67	-5	555
Stock valuation	-30	7	-56	-8	9	-186	-116	-151	205	124	-93	244	100	-57	-19	-2	120
WIP valuation	354	212	-314	-183	-56	-1631	601	-332	1294	175	-425	51	141	-106	71	-10	598
Funds flow from Ops (inc FA)	557	388	-69	-246	457	-1546	1538	473	130	3867	-2069	496	1838	-348	64	369	1334
Credit components:																	
Debtors	-115	-69	-177	66	-319	-438	-24	250	168	-616	162	39	379	323	-423	-53	286
Creditors	19	24	48	7	124	894	-307	420	672	-1375	60	-403	87	-208	164	15	495
Cash flow from Ops (inc FA)	461	343	-198	-173	262	-1090	1207	1143	970	1876	-1847	132	2304	-233	-195	331	1035
Financing:																	
Bank loan finance			100	37	263	123	-209	182	-424	-72		138	-138			0	199
Vickers capital inputs	-519	-345	267	-48	-237	697	-995	-1278	-465	-1725	1755	-223	-2298	193	209	-334	953
Change in cash items	-58	-2	169	-184	288	-270	3	47	81	79	-92	47	-132	-40	14	-3	133
Cash (and near-cash) items:																	
Cash	58	2	-169	184	-288	287	-11	-32	-48	-61	102	-132	132	40	-14	3	138
Short-term investments						-17	8	-15	-33	-18	-10	85				0	36
	58	2	-169	184	-288	270	-3	-47	-81	-79	92	-47	132	40	-14	3	133
Surplus - FFO (inc FA)	-187	-130	392	364	-155	2306	-705	447	-652	-1527	1776	-337	-1426	416	-213	25	988
Surplus - CFO (inc FA)	-91	-85	521	291	40	1850	-374	-223	-1492	464	1554	27	-1892	301	46	62	911

form in Fig. 3. A (crude) indicator of changes in activity levels (20 percent of turnover) has been added to Figs. 2 and 3 to assist comparisons of the ways in which the three measures functioned during periods of significant expansion and decline. It is apparent from the two figures that the various performance measures tended to move in line with changes in activity levels, although to differing extents. There were also some exceptions to this general pattern. Table 4 indicates that the funds-flow measure (by about 10 percent) and the cash flow measure (by 15 percent) both gave lower aggregate signals of performance than the accruals measure and that the funds and cash flow measures were both far more variable year to year than the accruals-based surplus.²¹ Thus the accruals approach, as used internally by Vickers, provided a slightly more positive and generally smoother representation of the shipyard's performance than the other measures.

7. Conclusions

In this paper the observable representational effects of accounting have been seen as the differences between comparable measures as set out in the profit and loss, as the main flow statement in the financial statements, and the alternative cash and funds-flow statements.

In so doing, the 'fund' has been defined as cash plus credit items, so that the funds-flow statement can function as a summary of the firm's transactions (and the cash flow statement as the cash sub-set thereof).

Most of the differences between the accruals-based surplus and funds or cash flows from operations are temporal and thus temporary but there is an important definitional and thus permanent difference between the accruals-based measures and cash or funds-flow based measures, deriving from the differing treatment of depreciation and net fixed asset costs. This is important because, in many businesses, the key decisions concern fixed asset expenditures. It has been argued that the definitional difference means that comparisons of profit figures and operating cash or funds flows are essentially skewed and, in this paper, the funds and cash flow measures have been amended so as to include both operating effects and the net spend on fixed assets.²²

²¹ The standard deviations were, as a multiple of the annual average: surplus 1.64, funds flows 3.61, cash flows 3.13 (see Table 4, right-hand columns).

²² This also changes the layout of the cash and funds-flow statements; the usual subdivision of the main part of the statement into three sections, operations, investment and financing flows (which jointly explain the annual change in the fund items) is instead divided into two sections, operations (including investment flows) and financing flows.

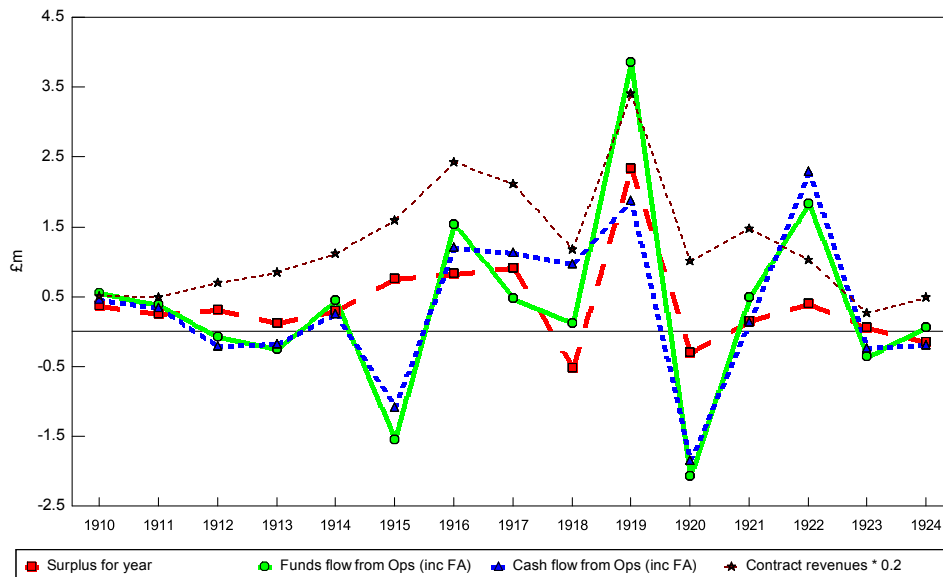


Fig. 2. Performance measures, 1910–24.

At Vickers shipyard, when operating funds and cash flows included the net spending on fixed assets, the three measures were then of broadly similar aggregate magnitude. This will occur whenever the changes in the defined 'cash items' (net of financing inflows or outflows), the defined 'funds items' (net of financing inflows or outflows) and in net assets, from the start to the end of the defined period, are similar.

The defined 'cash items' at Vickers consist of only cash and short-term investments. The latter were zero in both 1910 and 1924, over which period the cash balance fell from £77,000 to £27,000, or by an annual average of about £3000 (see Tables 2 and 4). The cash balance had been increased by operating (cash) surpluses that averaged £331,000 and reduced by transfers to Vickers head office that averaged £334,000 (bank loans were zero in both 1910 and 1924).

There were similar effects on the main funds-flow measure. The defined set of 'funds items' consisted of the cash items as well as debtors and creditors, both of which were larger amounts in 1924 than in 1910. The increase in debtors was somewhat larger (averaging £53,000 a year as against £15,000 for creditors) and, as a result, the funds-flow measure was a little larger than its cash flow equivalent (by 11.5 percent; again see Tables 2 and 4).

There would be, however, less expectation that aggregate profits would be a similar amount. At Vickers, the additional items that make up net assets, over and beyond the defined funds items, consisted of the estimated losses on finished contracts, work in progress, stock and fixed assets. The level of each could and would differ over a period of time, but the potential for change was greater for fixed assets than for the other items, partly because of its sheer size and partly because it was, by definition, the most long-term. Fixed assets will increase where the investment in them exceeds the depreciation write-offs and, at Vickers the excess of the former (which averaged £264,000 a year) over the latter (averaging £226,000 a year; see Table 4) was smaller than might often be the case, because of both the sharp fall in investment in fixed assets in 1921–24 and the very large depreciation write-offs in 1915–18 and 1922.

It is not necessary for the three measures to be of similar aggregate size although, where they are, the analysis of the various timing differences is simplified. The funds and cash flow measures were both far more variable year-on-year than the accruals-based surplus or profit, which provided a smoother (and slightly more positive) representation of outcomes.

The impact of individual accruals procedures on a single balance sheet are relatively easy to predict but the net effects of several such measures over longer periods of economic growth and decline are far more complex and less well understood. Different forms of performance measurement provide the basis for different explanations of business situation and approach and this paper applies these approaches to information on a wide range of accounting practices as set out in the archival holdings of one of Britain's most important manufacturing businesses, Vickers shipyard at Barrow, across periods of expansion, downturn and decline. The accruals adjustments as recognised in the profit and loss account were not chosen merely to comply with legal requirements but to inform central management on the progress of the shipbuilding division and four were of considerable importance to differences between the main performance measures, depreciation, fixed asset expenditures, changes in the allocation of overhead costs to production and changes in work in progress balances on the balance sheet.

Several parts of the paper have identified aspects of the accounting representation effects. In particular, Table 4 has shown the composition of equivalent accruals, funds and cash flow measures and, at the foot of the table the annual differences

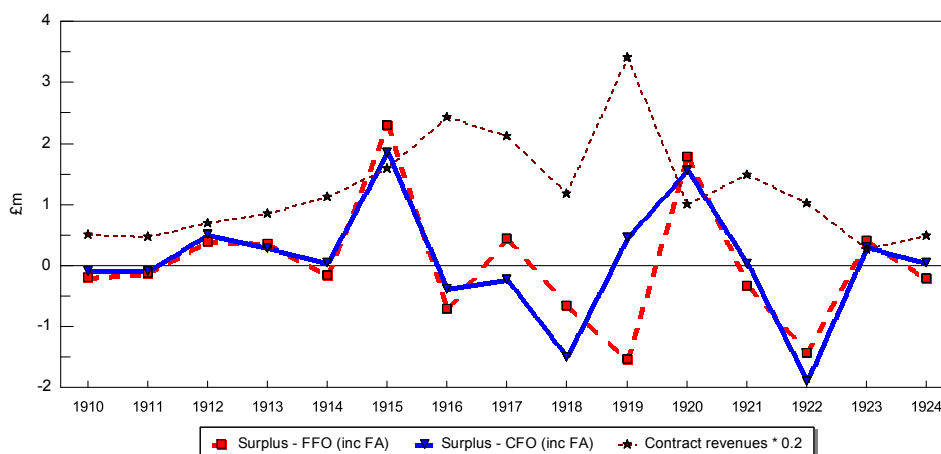


Fig. 3. Surplus and flow measure differences, 1910–24.

between them. The main measures have been graphed against revenues in Fig. 2 and the annual differences between the measures shown in graph form in Fig. 3.

The effects of the use of year-end adjustments, the accounting representation effect, at Vickers shipyard in 1910–24 can best be considered in three periods; the steady expansion from 1910 to 16, the downturn and marked but short-lived recovery from 1917 to 19 and then the unprecedented decline from 1920 to 24.

The period of gradual expansion did not produce the benefits to Vickers one might have expected, primarily because of cost increases during an unfamiliar inflation that reduced profit margins. Moreover, until 1916, cash flows under-reflected the business growth there was because of the build-up of resources in working capital in 1912–15. The three measures were very similar except in 1915, when there were marked delays in government instalment payments and substantial expenditures on fixed assets to meet war-time levels of demand (which inevitably ran ahead of any possible depreciation charge); both considerably deflated the two flow measures relative to the accruals figure.

The next three years were much more turbulent. None of the three measures kept pace with the increased business volumes, as costs were again squeezed by inflation. They were all quite similar in 1917, with accruals figures reduced by high depreciation charges and funds flows by the build-up in stock and WIP (including overhead allocations thereto) but in 1918 the accruals measure was the only one that was negative, partly because of high depreciation charges and despite extraordinarily high overheads charges to work in progress (which thus relieved the profit and loss account of £1.3m of charges). The flow measures were helped by the catch-up in work in progress instalment payments by the Admiralty and by an increase in credit provision by its suppliers. This was followed by the unprecedented and unsustainable boom of 1919, which took all three measures to new levels; the accruals surplus was the highest ever, helped by the sudden curtailment of depreciation charges but despite a reduction of £1.45m in the overheads carried forward on a sharply reduced volume of work in progress. Operating funds flows were materially higher, however, at £3.8m, twice as high as ever before and double the operating cash flows, which were held back by the catching up on obligations to creditors and a relaxation in credit provision to shipyard customers.

Profits collapsed in 1920 but the real tragedy for Vickers, the expenditure that year of £1.5m on fixed assets to support a boom that did not continue, was only really apparent in the two flow measures, which were the worst ever. Across the period 1920–24 period the accruals measure broadly reflected changes in activity levels, but the two flow measures were much more variable. All three were modestly positive in 1921 but the flows measures both improved sharply to 1922, before declining steeply again. The accruals surplus for 1922 was held back by very high depreciation charges that year in belated recognition of the excess spending on fixed assets two years earlier, by less overhead charges being carried forward (on a sharply reduced volume of work in progress) while the flow measures were helped by reductions in the credit extended to customers.

The effects of accounting during periods of industrial expansion and decline are not well understood. The evidence in this paper suggests that accounting processes had material but complex effects on the representation of success or failure at Vickers Shipbuilding across the extremely changeable period from 1910 to 24. The major effects derived from differences between spending patterns on fixed assets and production overheads (which had more rapid effects on the flow measures than on surpluses or losses) and the ways in which those costs were allocated to profit and loss; other forms of accrual adjustment were of much less importance. The differences between the accruals, cash and funds-flow methodologies can be objectively measured and this paper has put forward an exploratory methodology, a set of supporting arguments and the related measurements although the graphing of these differences in Fig. 3 reveals no simple relationship with activity levels. Further research, involving the use of a larger database, should enable the effects that are of more general application to industrial expansion and decline to be distinguished from those that were specific to the circumstances of Vickers shipbuilding operation and to the period 1910–24.

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