Costing for strategy development and analysis in an emerging industry: the Newcastle Upon Tyne Electric Supply Company, 1889 - 1914

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Abstract: This article examines the provision of strategic costing information in the context of the emergence and growth of the British electrical power industry and its pre-eminent exemplar, the Newcastle Upon Tyne Electric Supply Company (NESCo). A detailed case study of NESCo's costing for strategy development and analysis is presented. This research finds that NESCo's adoption of systematic, formal considerations of strategy and its use of costing for strategy development and analysis were related to a combination of three factors: first, the novelty, scale and complexity of the electricity supply industry; second, the regulated environment of the electricity supply industry; and third, the ability and drive of key individuals. The implications of this research for contemporary studies of strategic management accounting are considered.

Key words: strategic costing; strategic management accounting; Second Industrial Revolution; electricity supply industry; Charles Merz.

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1. Introduction

The historical literature dealing with the period from the First British Industrial Revolution through to 1914 incorporates analyses of the use of costing information in firms' one-off strategic decision making. These analyses deal largely with industries such as coal, iron and steel (e.g. Boyce, 1992; Boyns and Edwards, 1995; Boyns and Edwards, 1997; Edwards, Boyns and Anderson. 1995; Pitts, 2001) and shipbuilding and engineering (e.g. McLean, 2006; McLean, McGovern and Davie, 2015). Chandler (1992, p. 81) notes that whilst these 'old industries were transformed' during the late nineteenth - early twentieth century, also 'new industries were created.' In fact, this period 'saw the lusty childhood, if not the birth, of . . . (the) cluster of innovations that have earned the name of the Second Industrial Revolution' (Landes, 2003, p. 235). Boyns, Matthews and Edwards (2004, p. 4) state that 'the three generally accepted new industries [of the Second Industrial Revolution are] electrical engineering, vehicles and chemicals and allied trades.' They indicate the importance of researching these new industries, noting that 'examining a new industry outside of the [old] staple trades, such as coal or iron and steel, and mechanical engineering, provides a different perspective on the source of ideas surrounding certain costing techniques.'

There is a very limited costing literature on these new industries (Boyns et al, 2004, p. 5). For example, McKinstry (1999) examined costing and accounting development in a British vehicle maker and found, *inter alia*, that costing information did not play a significant role in strategic decision making. Matthews, Boyns and Edwards (2003) and Boyns et al (2004) researched the development of costing and accounting controls in the British chemical industry and found evidence of experiments with 'long-term profit forecasts' (2004, p. 18) and the use of costing information in one-off strategic investment decisions (2004, pp. 18 – 19). In the late nineteenth – early twentieth century, the engineering firm of Clarke Chapman, based in North East England, employed a limited amount of management accounting information in making strategic investment and disinvestment decisions in respect of both motor cars and electrical engineering (McLean et al, 2015). However, there is a dearth of research dealing with costing and strategy in the new industry of electricity supply. This represents a real gap in our knowledge of the development of costing, a gap that is both surprising and important to fill since 'the most revolutionary of the new technologies [of the Second Industrial Revolution] were those that generated and transmitted electricity for lighting, urban traction and industrial power' (Chandler, 1992, p. 81).

The aim of this research is to begin to address this significant gap in our knowledge by means of an examination of the provision of costing information for strategy development and analysis during the emergence of the pre-eminent exemplar of the British electrical supply industry, the Newcastle Upon Tyne Electric Supply Company (NESCo). NESCo was selected as a research site for three reasons. First, as a pioneer in the emerging electrical power industry, it developed and implemented innovative and unique technological and business strategies (Beard, 1918; Byatt, 1979; Hannah, 1979; The Statist, 1911). Second, it emerged as the only financially successful electrical power company in Great Britain, achieving exponential growth (Tables 1, 2 and 3), national economic importance and international standing (Byatt, 1979, pp. 114 – 115). Third, NESCo's extensive and under-explored public archive was available to the researchers. A limited amount of research on some aspects of NESCo's history has been undertaken previously (Byatt, 1979; Hannah, 1979), but this work was severely circumscribed since, as Hannah noted (1979, p. 365), 'The archives of NESCo do not appear to have survived'. Fortunately, in fact, the NESCo archives did survive and are now held in Newcastle Upon Tyne by Tyne and Wear Archives as part of the North Eastern Electricity Board Collection, catalogued as DU.EB.

The historical literature emphasises the important role of actors (Yamey, 1981), change agents (Boyns and Edwards, 1996) and key individuals and particular professions (McLean, 2013; McLean and Tyson, 2006) in accounting and costing. In the limited literature dealing with this topic in relation to the new industries of the Second Industrial Revolution, McKinstry (1999) notes that Albion Motors had an engineering-oriented culture and that the firm's costing system was based in the discipline of engineering rather than accounting; the research of Boyns et al (2004, p. 22) threw 'some light on the roles of certain individuals [but was] far from conclusive as to the role of different professional groups' in developing costing systems; McLean et al (2015, p. 188) found that '[strategic] management accounting information was not developed . . . but information from the routine management accounting system . . . was used explicitly in [one-off] strategic continue/discontinue decisions' and they recommended 'that future research should investigate the roles of the engineering and accounting professions in the development of management accounting in particular organisational contexts'. The current authors aim to provide insights into the roles played by individuals and professional groups in the development of NESCo's strategic costing and, thereby, provide a useful addition to the literature.

Thus, this research has two objectives:

- First, to add to the limited literature relating to costing in the new industries of the Second Industrial Revolution by means of the presentation of a detailed case study of NESCo's

costing for strategy development and analysis during the emergence phase of the company's life cycle, 1889 - 1914

- Second, to investigate the roles and importance of key individuals and professional groups in the generation of NESCo's costing information for strategy development and analysis.

However, this article will extend beyond historical research and analysis. There is an extensive contemporary, twenty-first century, literature dealing with strategic costing/strategic management accounting (SMA) (e.g. Bimani and Langfield-Smith, 2007; Cadez and Guilding, 2008; Guilding, Cravens and Tayles, 2000; Langfield-Smith, 2008; Lord, 2007; Naranjo-Gil and Hartmann, 2007; Nielsen, Mitchell and Nørreklit, 2015; Nixon and Burns, 2012a; Nixon and Burns, 2012b; Roslender and Hart, 2002; Seal, 2001, 2010; Tayles, 2011; Tillmann and Goddard, 2008). Nevertheless, contemporarily, 'there is still no agreed conceptual framework about what constitutes SMA' (Ma and Tayles, 2009, p.474) and it is beset by 'an inherent contradiction between the apparent decline of SMA and the sustained growth in the number of concepts, models, tools, theoretical perspectives, disciplines, academic and professional journals and consultancy practices that populate the SMA domain . . . [SMA is a] paradox' (Nixon and Burns, 2012a, p.229). Furthermore, there is little understanding about the engagement of accountants in strategic issues (Tillmann and Goddard, 2008). The authors will employ the historical findings of this study in the consideration of these contemporary issues.

The remainder of this article is organised into ten further sections: Methodology; The British electricity supply industry; NESCo: an electric lighting company, 1889 – 1898; NESCo: a regional power company, 1898 – 1914; Costing, Strategy and the emergence of NESCo as a power company, 1898 -1905; Costing, strategy and the growth of NESCo, 1906 – 1908; Costing, strategy and the growth of NESCo, 1908 – 1914; NESCo: Costing and management control; The regulatory-political environment and strategic costing; Discussion and Conclusions.

2. Methodology

NESCo survived as a business entity until 1st April 1948 when it was nationalised under the authority of the Electricity Act of 1947 (NESCo, 1948). However, the authors have employed an end date of 1914 for this research for three reasons. First, the First World War had a significant impact on national politics, economy and society and is generally regarded as being a natural break-point in historical analysis (e.g. Hobsbawm, 1985, 1987). Second, it is widely recognised that industries and markets were hugely distorted by the First World War (Slaven, 2013). Third, the year 1914 marks the end of a 'benchmark time period [for the electricity supply industry, since by] 1914 cities had

electricity, long-distance transmission had become established, and regional networks had begun to take shape' (Hausman, Hertner, and Wilkins, 2008, p. 30).

Based on the end date of 1914, the case was developed within two major, distinct time periods, as is explained fully in Section 5.1 below. The first period, 1889 – 1898, covers NESCo's formation and its emergence as a local electric lighting company; the second period, 1898 – 1914, encompasses the development and adoption of radical new strategies that heralded the emergence of NESCo as a regional electric power company of national significance.

Following the methodology advocated by Langley (1999) for the analysis of process data, the authors built a narrative of the emergence and growth of NESCo. This narrative is based on a detailed study of the firm's vast, albeit incomplete, archive (DU.EB), from inception in 1889 through until 1914, and the relevant literature (e.g. Beard, 1918; Byatt, 1979; *Engineering*, 1911; Hannah, 1979; *The Statist*, 1911). Separately and jointly, the researchers examined minutes of Directors' meetings, costing reports to Directors, minutes of management meetings, Directors' reports to annual general meetings, annual financial reports, and other documentation. These examinations were discussed and differences were resolved after joint re-scrutiny and re-assessment. The specific focus of this work is on the nature of costing information prepared for strategy development and analysis, hereafter termed as strategic costing, and on the people who prepared this information rather than on the strategic decision-making process itself.

3. The British electricity supply industry

Following Faraday's experiments in electromagnetic induction in 1831, engineers developed small dynamos for the generation of electricity (Byatt, 1979, p. 1). It was not until the late 1870s that improved dynamo design led to reductions in generating costs and the belief that electricity had arrived as a viable competitor to gas for the provision of lighting. The Electric Lighting Act of 1882, which eased the legal requirements for the formation of electricity supply companies, coincided with a short period of recovery within the great British depression of 1873 – 1896 (Hughes, 1962, p.33) and there was a boom in applications for company formation, including eighty three in the first month after the passage of the Act: 'private enterprise had the opportunity of risking capital in an area of the economy on the technological frontier' (Hughes, 1979, p.31).

The Brush Electric Lighting Company was at the forefront of developments and there was a mania in its shares which came to be known as the 'Brush Bubble' (Hughes, 1962, p. 29): in May 1882, the company's £10 shares rose to a market price of £68 (Byatt, 1979, p.18). However, the industry soon began to experience technological problems (Hughes, 1962, p. 33). Moreover, 'the success of the

boom depended crucially on the supposition that electric lighting cost no more than gas lighting . . . [but] hopes about the extent of economies of scale proved . . to have been greatly exaggerated, and soon all the companies found their installations losing money. Many of them collapsed fairly soon. The year 1883 was calamitous' (Byatt, 1979, p. 18). There were only four successful applications to form electricity supply companies in 1883, none at all in 1884 (Byatt, 1979, 9. 21) and in 1884 the Brush Electric Lighting Company 'had to devalue the £10 share by a half' (Hughes, 1979, p. 33). From 1882 onwards, the British electrical supply industry suffered from 'circumspection and caution' together with 'a confluence of [adverse] legislative, technological, and economic [factors]' (Hughes, 1962, p. 39).

In 1888, the 1882 Act was amended in order to enable companies to extend their tenure of central power stations from twenty-one to forty-two years in order to make investment in the industry more attractive. However, many local authorities hindered or blocked such investment in order to protect their own municipal gas undertakings (Hannah, 1979, p.8) and the electricity supply industry was restricted by this competition from gas (Shiman, 1993, p. 320 - 324). Thus, through until the 1890s, the British electrical supply industry consisted of a multiplicity of organisations operating on a small scale within a small market (Wilson, 1988) and it was 'little more than a collection of huts and basements with clanking reciprocating steam engines supplying lamps within a relatively small radius, providing challenges to the intellect of the engineer and an expensive, luxury illuminant for consumers, but with few spin-offs affecting the life and work of the nation in any significant way' (Hannah, 1979, p. 10).

4. NESCo: an electric lighting company, 1889 – 1898

Taking advantage of the 1888 legislation, NESCo was incorporated in January 1889, at the instigation of Robert Spence Watson, a Newcastle solicitor, and his brother-in-law Dr Theodore Merz, a Newcastle chemist and industrialist, in order to supply electric lighting (Beard, 1918). In February 1889, Monkhouse Goddard, the Newcastle firm of Public Accountants, presented a Report (DU.EB/1/1) to the Directors of NESCo detailing estimates for the new company: initial capital expenditure requirements, £5,000; annual revenue, £2,500; annual operating costs, £1,400; and annual profit, £1,100. Working papers for this Report do not show any bases for these estimates or any calculations underlying them but do set out details of NESCo's proposed prices, as indicated by its Board of Trade Licence application, in relation to consumers' quarterly usage of units of electricity: 5 shillings up to 10 units; 4 shillings and 2 pence between 11 – 20 units; 2 shillings and 9.3 pence over 20 units, and it was noted in this case that the equivalent price of gas was 2 shillings and 8.4 pence. The working papers also show that NESCo's estimated cost of electricity was 1 shilling

and 6.5 pence per unit whereas the equivalent cost of gas was 1 shilling and 5.75 pence. The Report and its working papers do not provide any strategic commentary, but they do indicate an awareness of the need for external as well as internal data and for comparisons with gas, electricity's major competitor in the lighting market.

A subsequent report (DU.EB/1/1), in April 1889, reveals that NESCo had gathered pricing data from two other electricity supply firms. The prices of a Chelsea firm were seen as irrelevant because of the 'expensive conditions' pertaining there but when it was pointed out that a company in nearby Sunderland 'proposed to charge twice the price of gas, it was proposed by Dr Watson and carried unanimously that the . . . following rates [should be charged by NESCo]:- 3/6 (3 shillings and 6 pence), 1 up to 10 units; 3/3 (3 shillings and 3 pence), 10 up to 20 units; 3s [3 shillings]for all over 20 units; with 10% discount for cash payments as in the case of gas . . . Upon this decision, the Canvass for Customers was directed to be proceeded with immediately'. Thus, NESCo's pricing strategy was not determined by its License prices or by detailed cost calculations but, rather, it was decided on the basis of market-based strategic information.

In October 1889, a Report (DU.EB/1/1) to the Directors by F.R. Goddard, of Monkhouse Goddard, noted that NESCo's estimated initial capital expenditure requirements had been revised to £9,115. Goddard also presented revised estimates of profit for the first 12 months of operations, based on three different scenarios: 'First Scheme, 2,000 lights working 750 hours . . Loss per annum £720. Second Scheme, 2,500 lights working 1,000 hours . . Profit per annum £96. Third Scheme, 4,000 lights working 750 hours . . . Profit per annum £484.' This Report consists simply of the financial numbers and does not contain any narrative detail or commentary, strategic or otherwise. However, also in October 1889, NESCo's engineers, Messrs Heaviside and Jackson, presented the Directors with a comprehensive, eleven pages, 'Engineer's Report on the Financial Position of the Company' (DU.EB/1/1) in which they provided a detailed analysis of the capital expenditure and the work underlying it. Furthermore, the three potential 'Schemes' reported by Goddard were subjected to extensive and detailed re-analysis from financial, engineering and business perspectives and a clear strategic conclusion was stated,

. . . the course recommended is to push the business so as to quickly overtake No. 1 Plant [Scheme], bring No. 2 [Plant/Scheme] into use and provide a third plant [Scheme] as a stand by, then the standing charges will be divided over twice the area, and not only economical , but safe working ensured . . . The success of the Company as an immediate dividend earning undertaking depends much upon the area of distribution [and Scheme No. 3 provides the greatest area of distribution at 2,823 yards of cable].

Subsequent to these deliberations, NESCo opened its first electricity generating station in 1890, at Pandon Dene in Newcastle. At this time, Charles Parsons, the brilliant Newcastle-based engineer, began the operation of his Newcastle and District Electric Light Company (DISCo). The two companies made a supply agreement whereby NESCo limited its operations to the eastern part of Newcastle whilst DISCo was confined to the western part (Beard, 1918). Under this non-competition agreement, and with the consent of Newcastle Corporation, NESCo began the supply of electricity for lighting and continued with this business on a small scale through to 1898 (Tables 1,2 and 3).

The archive contains no further strategic analyses for this period of very limited activity and development. Beyond the calculation of unit costs (DU.EB/1/1), there is no evidence at all of the use of costing for management control purposes. However, from 1898 NESCo undertook a critical change in strategic direction that led to its transformation from a local street lighting company to a regional power company of national and international importance (Tables 1, 2 and 3). This fundamental strategic change and its consequences are explored in the following sections.

INSERT TABLES 1, 2 AND 3 HERE

5. NESCo: a regional power company, 1898 - 1914

5.1 Introduction: strategic change

1898 marked a clear break-point in the history of NESCo. From its base as a very small company that simply provided street lighting in Newcastle, in 1898 NESCo made a strategic change of direction with the intention of becoming a regional player (Beard, 1918, p. 2) in 'the most revolutionary of the new technologies [of the Second Industrial Revolution] . . . those that generated and transmitted electricity for lighting, urban traction and industrial power' (Chandler, 1992, p. 81). In March 1903, a NESCo Report (DU.EB/36/1, p. 14) stated that,

[In 1898] the Company decided to become a Power Company . . . it is only necessary to look at the progress of the business . . . to realise that *for all practical purposes the Company was beginning again* (emphasis added).

NESCo's strategic decision to become a power company was a response to developments in the market-place. In 1898, Newcastle Corporation received Parliamentary approval for the construction of a power station for the purpose of supplying electricity to its own tramway system. This carried with it the potential threat of the Corporation's intrusion into the entire electricity supply market, therefore 'the use of electricity for general power purposes in the whole district became the only practicable important development' (Beard, 1918, p. 4) for electricity supply companies operating in

the area. A new enterprise, the Tyneside Electric Power Company, headed by Charles Parsons, applied to Parliament for permission to develop a scheme for the whole district. Simultaneously, the Walker and Wallsend Union Gas Company was keen to diversify into the supply of electricity throughout the district. The Gas Company's involvement in electricity was spearheaded by a director, J. Wigham Richardson, who was a brother-in-law to NESCo's founders, Robert Spence Watson and Theodore Merz. Also at this time, NESco's directors realised that 'they must seriously consider their policy' and understood that it was 'necessary for us either to go in for a much larger scheme or to merge our small undertaking into [a] larger organisation' (Beard, 1918, pp 2 - 3). NESCo's family 'connection' (Beard, 1918, p. 4) with the Gas Company enabled the two firms to join forces in a joint enterprise to fulfil the 'larger scheme'. However, Beard (1918, p.2) states that

None of the experts or directors . . . possessed either the knowledge or the ability to lay down the lines upon which a large undertaking, meeting all of the requirements of the whole district, should be constructed. We had, indeed, all of the elements of success in our hands, but we had no personal representative who could grasp the whole situation and devote himself exclusively and continuously to the development of a well-considered scheme . . . Fortunately in Charles [Merz] such a person was found.

Charles Merz was the son of Theodore Merz and had recently formed the consulting electrical engineering partnership of Merz and McLellan. Given the legal expertise of Robert Spence Watson and the expert witness evidence provided by Charles Merz, Parliament threw out the Parsons scheme and the joint enterprise of NESCo and the Gas Company 'gained the statutory powers to develop that large scheme of [electric] power-supply which Charles [Merz] had worked out in his mind as the right course and aim for our company' (Beard, 1918, pp. 4-5): 'for all practical purposes the Company was beginning again' (DU.EB/36/1, p. 14). Charles Merz acted as consulting electrical engineer to NESCo from its change of strategic direction in 1898 until his death in the London Blitz of 1940.

Acting on Merz's advice, between 1898 – 1914 NESCo adopted strategies that led to its transformation from a local street lighting company to a regional power company of national and international importance (Byatt, 1979, pp. 114 – 115). The company experienced rapid and exponential growth and the extent of NESCo's achievements must be viewed in the context that it was the only financially successful electricity supply company in Great Britain during this period. In 1898, net profit was £5k with a return on shareholders' equity of 8%; by 1914, these figures were £132k and 13% respectively (Tables 1 and 2). The growth in total assets was remarkable, from £259k in 1898 to £7,795k in 1914 (Table 3).

5.2 Charles Merz: the 'British Edison'

The historical literature depicts the importance to accounting and costing of 'actors' (Yamey, 1981), 'change agents' (Boyns and Edwards, 1996), and key individuals and networks (McLean, 2013). During the Second Industrial Revolution, key players from different bodies of expertise, such as engineering and accounting, played significant roles in costing (Fleming, McKinstry and Wallace, 2000; McKinstry, 1999; McLean, 2013; McLean et al, 2015; McLean and Tyson, 2006).

Charles Merz was the 'British Edison' (Hannah, 1979, p. 33) and he was the key player in the emergence and growth of NESCo as a power company. Moreover, he was the dominant figure in NESCo's production and use of costing information for strategy development and analysis. Charles Merz was born in 1874 into a wealthy Quaker family and during his career he worked with and extended its strong and influential family, business, financial, social and political networks throughout the North East of England, the United Kingdom, Europe and the United States (Byatt, 1979; Hannah, 1979; Hughes, 1993). He attended Bootham School in York before spending 1891 at the Durham College of Science, now part of Newcastle University. Merz's father, J.T. Merz, and uncle, R.S. Watson, were founding director-shareholders of NESCo and in 1892 he became an engineering 'pupil' (Beard, 1918, p. 2) with NESCo and then with Robey's of Lincoln, after which he joined the British Thompson-Houston Company. However, in 1898, at the age of 24, Merz rejected the opportunity of direct employment by NESCo, as he 'did not wish to be tied up to only one concern or scheme' (Beard, 1918, p. 5), in order to set up the consulting engineering partnership of Merz and McLellan.

Charles Merz was appointed as Consulting Engineer to NESCo (Beard, 1918, p. 7) and 'He was to become the engineering brain behind the whole scheme; a man with just the right combination of vision, optimism, and technical skill' (Byatt, 1979, p. 117). At this time, most of the strategic decisions undertaken in the emergence and development of the electrical industry required 'a mixture of engineering and economics' but there was a shortage of 'good commercial engineers' in Great Britain (Byatt, 1979, p.184). However, Merz was not found wanting in this respect; he was more than a technological 'lone genius' like Ferranti, his contemporary; he 'was much shrewder commercially . . . [and] made careful inquiries about potential demand . . . [and] undertook fairly elaborate . . . market research' (Byatt, 1979, pp. 185 – 186).

Merz had the confidence and backing of NESCo's newly expanded and strengthened Board of Directors. He justified the Board's high opinion of him and in 1918 a NESCo Director stated that to 'Charles (Merz) . . . is mainly due the unexpected successful development of the North-East coast

supply of electrical energy to all kinds of purposes which at this date is considered as a unique instance and a model of enterprise in the United Kingdom' (Beard, 1918, p. 2). Merz wrote or oversaw the writing of NESCo's strategy documents. Supported by NESCo's engineers and accountants and his partner McLellan, Merz was a key figure in the production of strategy Reports in 1903 and 1906. These Reports were hybrids of internal and external costing, accounting, engineering, business, legal and market data and are the only extant strategy documents in the NESCo archive for the period up to 1914. The researchers have used these Reports and other primary and secondary sources in their examination of the use of costing in the development and analysis of NESCo's business and technological strategies, in the sub-periods of 1898 -1905; 1906 – 1908; and 1908 – 1914. The nature of the construction, content and presentation of the Reports has obliged the current authors to undertake considerable analysis in order to present NESCo's strategies and strategic costing in a manner that is coherent yet true to the original Reports.

6. Costing, strategy and the emergence of NESCo as a power company, 1898 -1905

This section deals with the period which began in 1898 with NESCo's stated aim to undertake the radical change in strategic direction required to transform itself from a local street lighting company to a regional power supplier and which ended in 1905, the end of the planning period covered by a major comprehensive strategic Report (DU.EB/36/1) prepared at the request of the Directors in order to set out and analyse 'the general position and prospects of the Company' (DU.EB/36/1, p.3).

In March 1903, Merz presented this Strategy Report to NESCo's Chairman and Directors. The Report shows the 'Position of the Company at the end of 1902' and also sets out its 'prospects' (DU.EB/36/1/p. 3) through to 1905. The Report was marked 'STRICTLY PRIVATE AND CONFIDENTIAL' and was signed by Charles Merz, as NESCo's Consulting Engineer, and J.S. Watson, NESCo's General Manager who was an engineer and, possibly, a relative of NESCo's founder-Director R.S. Watson. The Report reviews NESCo's historical performance from 1899 - 1902 and sets out strategies, plans and estimates for 1903, 1904 and 1905.

The 1903 Report consists of 19 pages of text supported by 11 schedules, some of which are several pages in length, and a series of tables and 'curves' (graphs) plus three maps; all documents are printed except for the curves which are hand-drawn; hand-written narratives and data have been added to the printed maps. In handwritten 'Notes' written for his family, Merz states (Beard, 1918, p. 7) his views on the presentation of information:

It was at the commencement of our connection with [NESCo] that we made [our] first plant capacity report . . . I had inherited from my father, I think, a liking for clearly thought out reports and we

illustrated the first one by curves of growth which were not so commonly used in those days as they have been since: in fact they are now a feature of every journal report or publication.

Merz's views were put into effect in the preparation of the supporting schedules for the 1903 Report (DU.EB/36/1, p.14):

Attached to this Report are estimates for the next three years. These estimates are given in the form of curves, firstly, because we think it is easier to get a grasp of the situation by looking at curves, and secondly, because in making the estimates their accuracy is much more easily seen . . . . . Tables of the figures corresponding to and taken from the above curves are also attached.

It is apparent that Merz and Watson took pains to communicate complex information in a form that they felt was amenable to understanding by NESCo's Directors.

6.1 Markets and power stations

The North East of England provided its power companies with significant locational advantages. Domestic and public lighting consumers were concentrated in densely populated conurbations and the 'industrial importance of the North-East Coast is best shown by the fact that whereas its population is less than 5 per cent of that of the United Kingdom, it yields 20 per cent of the total coal, 35 per cent of the ships, 36 per cent of the coke, 37 per cent of the pig iron and 40 per cent of the ironstone produced in the Kingdom' (Newcastle and Gateshead Chamber of Commerce, 1911, p. 136). Thus, as a power company, NESCo had ready access to significant markets. However, despite these locational advantages, NESCo faced challenges. At this time, many potential customers used alternative energy sources such as gas and steam and had to be persuaded that electricity, and NESCo, were viable options. Furthermore, 'much of the electricity used [in industry] before 1914 was generated by users' (Byatt, 1979, p. 95) themselves rather than by specialist electricity supply organisations and these were new markets, still accounting for 60 per cent of British electricity generation in 1907, that had to be won (Byatt, 1979, p. 95). Moreover, NESCo faced competition in supply from municipalities and other electrical supply companies and 'had an antiquated system of supply [which was] difficult to extend and one from which it was impossible to supply motive power' and which experienced 'constant faults and interruptions of supply' and required the 'laying [of a new] distribution system' (DU.EB/36/1, p.13). NESCo tackled these problems between 1898 and 1903 with some financial success (Tables 1, 2 and 3), and in 1903 it noted (DU.EB/36/1/p. 14) that '*what the company has really been doing [since 1898] has been to get ready to supply electrical energy on a large scale'* (emphasis added).

In particular, “getting ready” meant the construction of power stations. NESCo’s emergence and success as a large-scale power company was based on its key resource of power stations: specifically, Merz and McLellan’s design and construction of revolutionary new power stations which employed innovative steam turbine technology in unprecedented ways and on an unrivalled scale. The work of Merz and McLellan as consulting engineers ensured that, compared to other British electrical supply companies, NESCo’s power stations were built at low capital cost and they had low operating cost, enabling NESCo to adopt a business strategy based on cost leadership. Given these significant competitive advantages, NESCo developed and captured markets not only in lighting for domestic, public and business purposes, but in power for industry and for transport systems (Byatt, 1979, p. 118 - 122; DU.EB/36/1, pp. 4 - 6 and 13 – 17; *Engineering*, 1911; *The Statist*, 1911). A comparison (Tables 1, 2 and 3) of NESCo’s financial results for 1902 and those for 1897, its last year as a local lighting company, indicates the impact and success of the strategies adopted in its emergence as a power company: revenue, £45k (£13k); net profit, £18K (£5K); dividend, 7% (8%); share capital plus debentures, £551k (£76k); total assets, £659k (£90k).

From 1898 - 1901, Merz and McLellan worked as NESCo’s consulting engineers on the design and construction of a new power station that NESCo opened in 1901 and, thereafter, they oversaw its operation. Merz notes (Beard, 1918, pp. 5-6) that he ‘drew up a scheme for the establishment of a power station at Neptune Bank in Newcastle’ and enlisted the help of McLellan, his partner, on this project. A NESCo Advisory Committee accepted the design proposed by Merz and McLellan (Byatt, 1979, p.117; DU.EB 36/1, pp. 4-6), and Merz and his partner ‘worked all hours, frequently going down to the office after dinner from 9 p.m. till midnight’. There were many technical problems involved in the design of the Neptune Bank Power Station and Merz and McLellan provided technologically innovative solutions founded on commercial awareness. For example, going against conventional wisdom, they opted to provide the first British public supply of three-phase current and employed induction motors, these being ‘the best suited to deal with the supply [of power] to shipyards’. Whilst in the throes of power station design and construction and the supply of electricity, Merz and McLellan also paid careful attention to market considerations and the development of a demand for NESCo’s electricity. Merz commented (Beard, 1918, p. 6) that,

Because of the reliability of marine engines and as we thought marine engineers were to be our principal consumers we decided to install marine engines in the power station. We also wanted to get the engines made on the [River] Tyne . . . All this time Mac and I had an eye to the commercial side, viz., the necessity of getting customers, and we had long discussions with the various engineers and shipbuilders. There were some prejudices to be overcome; they all wanted to know how much it

would cost them compared with the numberless steam engines they used, though actually as it turned out this was not by any means the most important point for them; the really important point about adopting electricity was that it made available for their operations a much more easily adaptable form of power; so much did this prove to be the case that within a very few years the different firms we connected up to the system were spending two or three times as much on electric power as they had ever spent on steam power – not because electric power was more expensive, but because they applied it to so many uses for which, before, they had not used power at all.

Merz and McLellan were so successful in their dealings with Tyneside shipbuilders that in 1908 Merz (Merz, 1908, p. 629) was able to claim that there was not "a single firm of shipbuilders or engineers on the north bank of the Tyne inside (NESCo's) area of supply which does not take 95 per cent of its power from the company, the remaining 5 per cent being produced from small gas engines or from boilers fired with scrap wood".

Charles Parsons, the Newcastle-based engineer, had developed turbines in the 1880s and they had become established amongst shipbuilders as a means of providing electric lighting on board ships (McGovern and McLean, 2013, p. 7). Merz and McLellan undertook a series of trials and investigations and Merz notes that they became convinced that turbines were 'the possible coming prime mover' (Beard, 1918, p. 7) even though 'there was not a single large Turbine Unit in operation' in the country (DU.EB/36/1, p. 4). Merz commented (Beard, 1918, p. 8) that he and McLellan adopted turbines throughout the Neptune Bank Power Station which opened in 1901 and noted that subsequent actual operations 'proved and justified the principle of the turbine even if we had a good deal of trouble with the details of the design'.

Having successfully launched the Neptune Bank power station, in 1902 NESCo obtained Parliamentary approval for its plans to extend northwards into the colliery districts of Northumberland (Beard, 1918, p. 8). It also planned a series of joint ventures with other power suppliers and made further plans to take over the power supply function of several local authorities (DU.EB 36/1, pp. 9-12) and to enter into contracts to supply electricity to the North Eastern Railway (NER) and the Tyneside Tramway Company (DU.EB 36/1/12 – 13). Overall demand from NESCo's consumers led to an increase in the firm's output of electricity from 1 million kilowatt hours in 1899 to 17 million kilowatt hours in 1904 (Byatt, 1979, p. 118). Confident in the growing demand for electricity, NESCo needed to develop additional generating capacity and in 1902 Merz and McLellan began the planning of a new power station which opened in 1904, at Carville, near Newcastle (Beard, 1918 p.86).

It was estimated that Carville added 'plant capable of working up to some' 11,000 KW to Neptune Bank's capacity of c. 5,000KW (DU.EB/36/1, p. 6). The 1903 Report (DU.EB/36/1/Schedule "O", Table 2) notes that in previous years actual demand had been: 1899, 1,050 KW; 1900, 1,300 KW; 1901, 2,825 KW; and 1902, 4,993 KW. The Report (DU.EB/36/1/Schedule "O", Table 2) anticipated that extensions to Carville would be necessary to meet sharply increasing demand after 1902: 1903, 6,410 KW; 1904, 9,540 KW and 1905, 10,670 KW, with maximum demand being between 50 – 60 per cent of KW installed (DU.EB/36/1/Schedule "O", Table 2).

Whilst the archive does not contain any evidence that financial strategic investment analysis was undertaken in respect of the construction of Neptune Bank or Carville, cost considerations lay at the heart of the engineering planning and design process (DU.EB/10/4). Merz considered that the design of Carville was a considerable improvement on any design ever employed by anyone previously (Beard, 1918, p. 8). In this design, Merz and McLellan worked on the fundamental principle that 'all other considerations are made subservient to the commercial success of the Undertaking as a whole' and noted that the 'commercial success of [the] undertaking is absolutely dependent upon the cheapness and reliability of supply . . . there is a limit in price below which a Supply Company must keep if it is to get consumers at all' (Merz and McLellan, 1904, pp. 696- 697). In their design, Merz and McLellan ran counter to the current conventional wisdom by focusing on limiting and controlling capital costs rather than running costs. They noted that other engineers employed complex designs for power stations in order to enable ease of repair in the eventuality of any and every type breakdown but they stated their view that this led to inordinate increases in complexity and capital costs. Merz and McLellan adopted a simpler design based on independent units which could be isolated for repair in the event of breakdown; moreover they employed an innovative cladded steel-frame building instead of the conventional brick building. Their design delivered low capital and operating costs, together with ease of repair and expansion of capacity. Carville's capital cost was £16 per KW, compared to £20 - £26 per KW for other contemporary power stations in England and, moreover, its running costs were as low as or lower than any other (Byatt, 1979, p. 120).

In addition to the construction and operation of power stations at Neptune Bank and Carville, NESCo's expansion necessitated the building of four sub-stations, the laying of new cables and the stabilisation of current, which required a considerable amount of free wiring and installation for domestic and industrial consumers (DU.EB/36/1, pp. 6 – 9). However, the end product of this work was regarded with great satisfaction in the 1903 Report (DU.EB/36/1, p. 15):

With regard to the efficiency and economy of the system which has been put down we may remark that while the cost of apparatus is continually being reduced we could not, if the whole system had to be reconstructed . . . suggest, even with the experience gained, any alteration in the apparatus used which would give greater security against breakdown or lessen the cost of operation. The Company now have a system which is capable, with comparatively little extension beyond that of the Generating Station, of dealing with any increase in the consumption of electricity in Newcastle itself for a very long time to come.

Thus justifications for the construction of Neptune Bank or Carville were framed around a strategy of cost leadership rather than on financial strategic investment appraisal but they were based on an underlying assumption that the demand for electricity would continue to increase. However, a warning note was sounded in 1903: NESCo had built its generating capacity in anticipation of increasing demand but the present level of output was 'comparatively small for a power scheme. It is necessary to increase output to three or four times its present value if the system is to be used to its greatest advantage' (DU.EB/36/1, p. 16): economies of scale were required. As indicated in the following sub-sections, NESCo sought to obtain the increase in output necessary to support its power stations by moving to capture and extend markets by means of joint ventures and business links; developing its business in traction and in the Northumberland coalfield; and extending its base of industrial and domestic consumers.

6.2 Costing and strategy

6.2.1, Introduction

With the help of Watson, in the 1903 Report (DU.EB/36/1) Merz set out the strategy that had begun, and would continue, to shape the emergence of NESCo as a regional electric power company. The fundamental strategy of constructing and operating power stations of innovative and radical design has been discussed in Section 6.1 above. After careful analysis of the 1903 Report and other primary and secondary sources, the researchers conclude that Merz's strategy for NESCo was based on four further main elements: joint ventures; the development of new markets in traction; geographical extension to new markets in the Northumberland coalfield; and the extension of its consumer base in industrial and domestic markets. Next, this research examines the implication of costing in the development and analysis of each of these elements of strategy.

6.2.2, Joint Ventures and business links

In 1902, NESCo made a contract with Walker Urban District Council to take over the Council's electricity supply functions (DU.EB/36/1 pp. 10 – 11). Financial analysis of the contract

(DU.EB/36/1/Schedule D) indicates that NESCo estimated that it would incur a loss of £733 per annum for the first eight years of this contract after which time the contract was estimated to generate a small annual profit. On the face of it, the acceptance of this contract does not seem to be a particularly astute move. However, it was actually part a wider strategy in which NESCo purchased the electrical shares of the Walker and Wallsend Union Gas Company (Beard, 1918, pp. 4 – 5), its joint venture partner in the construction of the Neptune Bank Power Station. The 1903 Report provided an estimate of the increased profit for 1903 resulting directly from this acquisition (DU.EB/36/1/Schedule C) and noted (p. 10) that, while in financial terms,

this particular transaction cannot be considered a very great acquisition so far as 1903 is concerned . . . [it] has been considered necessary from the Company's point of view more as a question of policy . . . to obtain entire control . . . and thus avoid any risk of the progress of electricity supply being prejudiced due to the Gas Company having both a Gas and Electricity Department.

Merz's networks enabled him to initiate business links in pursuit of NESCo's strategy of expansion to obtain increases in output. He knew W.L. Magden who was a director of the Durham Electric Power Distribution Company and, through this contact (Beard, 1918, p. 8), NESCo entered into an 'Agreement' (DU.EB/36/1, p. 12) with the Durham Company in order to utilize that company's plant and cables during the period that NESCo's own system was in process of development.

It was agreed that NESCo would supply electricity to the Durham Company and the financial details were set out in the 1903 Report (DU.EB/36/1/Schedule E). It was planned that for each of 1903, 1904 and 1905, NESCo was to invoice the Durham Company on the basis of a three part scheme consisting of a fixed annual charge, a fixed rental charge and a variable charge based on electricity consumed. The variable price per unit of electricity was planned to be 35d [35 pennies] in 1903 and 1904. The 1905 variable price per unit was planned to be 35d per unit if Durham's annual 'consumption is less than 1,000,000 Units', falling to 30d per unit if Durham's annual 'consumption exceeds 1,000,000 Units'. For each of 1903, 1904 and 1905, Schedule E details NESCo's planned revenue from each of the three parts of the charging scheme and calculates planned total annual revenue. Although it was planned that the agreement for the supply of power would end in the next four to six years, it was envisaged (DU.EB/36/1, p. 12) that, there would continue to be

a permanent connection between the two Companies' Systems, which, from an engineering point of view, we consider advantageous. We have succeeded in getting the Durham Company to adopt the same standards with regard to voltage and periodicity as we have adopted on this side of the river.

We consider it probable that before the agreement expires some further agreement may be come to.

Thus, Merz drew upon family and business networks and engineering and pricing expertise in order to formulate NESCo's strategies and the strategic analyses relating to the Walker and Wallsend Company and the Durham Company.

6.2.3, New markets: traction companies

In 1902, NESCo promoted a Parliamentary Bill for the development of electric tramways on Tyneside but was opposed by the NER which felt that its business would be damaged (Byatt, 1979, p. 117). However, Merz met with George Gibb, General Manager of NER, and, having convinced him of the benefits of electrification, a contract for tramway electrification was made between the two companies. The 1903 Report (DU.EB/36/1, pp. 12 -13) lauded this contract as being beneficial to NESCo and noted that the company was not required to incur any capital expenditure beyond the construction of another 'unit' to extend the capacity of the Carville Power Station. The 1903 Report (DU.EB/36/1/Schedule F) presents the following details of the contract: NER would cover the capital cost of the sub-station and cables required whilst NESCo would pay an annual rental cost of 5 per cent of capital cost; NER would take a minimum of 5 million units of electricity per annum; NESCo's pricing structure was to be: 1.0d per unit for the first 3 million units, 0.75d per unit for the next 3 million units and 0.55d per unit for all consumption over 6 million units; caveats specified allowed price reductions in the event of future actual running costs being lower than planned costs. In obtaining this contract, NESCo offered a very keen pricing structure. Its prices to NER were the 'minimum' (DU.EB/36/1, p. 17) to be offered to any consumer buying electricity in bulk. Whilst actual unit costs for this period are not available in the archive, estimated contract profit statements (DU.EB/36/1/Schedule F) reveal that NESCo estimated that its 'Station and General Expenses' on the NER contract would be 0.3d per unit and that it anticipated making a loss on the NER contract in 1903 but that it planned a return on investment of 7.33% for 1904 and 11.2% for 1905.

The 1903 Report also contains a detailed 'Statement of Estimated Revenue and Profit from the Tyneside Tramways Contract' (DU.EB/36/1/Schedule G) which indicates an expected annual profit of £1,979 on capital expenditure of £21,000. It notes that the c. 10% return on capital was 'not as large as it should be, but the consumption [of electricity] may be expected to increase as the district develops, and this will not entail any increase in capital expenditure'. Once again, Merz combined costing with engineering expertise, business networks and commercial astuteness in order to develop NESCo's expansion strategies.

6.2.4, New markets: the Northumberland coalfield

In 1902, with a view to expanding electricity supply into the Northumberland coalfield, NESCo gained Parliamentary approval for its Northumberland Electric Power Bill (Byatt, 1979, p.117), having

impressed the Parliamentary Committee by its careful estimation of demand, its excellent record of technical skill and good management – as revealed by its very low costs, and the way in which it anticipated demand in its investment planning.

However, the 1903 Report noted (DU.EB/36/1, p. 17) that little progress had been made in pursuing this strategy of expansion due to difficulties with a rival company. Nevertheless, Merz understood the great potential of this market and continued his efforts with it. On 21st December 1903 he submitted a detailed 41 page report (Merz, Specification Number 31.1/23) to NESCo presenting an analysis of every colliery in the Northumberland coalfield and indicating its potential for electrification, together with a statement of the estimated annual profit that each colliery would bring to NESCo.

6.2.5, Industrial and domestic consumers

The 1903 Report indicated (DU.EB/36/1, p. 17) that 'It will be seen from Curve No. 4 that it is estimated that the average price per unit received from [industrial consumers] will gradually decrease'. The curve depicts actual and estimated prices per unit between 1899 and 1905, showing falling prices for NESCo's different industrial categories, lighting, small motors and manufacturers, and for the average of all categories.

The development of a pricing strategy was a troublesome exercise for NESCo and the process was not eased by the fact that manufacturers expected 'an excessively low price for power . . . [and] to get their lighting thrown in at the same price' (DU.EB/36/1, pp. 17 – 18). NESCo found it difficult to apply separate charges for power and lighting since the same circuits were used for both. Proposals for new tariffs were drawn up (DU.EB/36/1/Schedule M) but it is apparent that, in 1903, NESCo was struggling to develop its pricing strategy and had not yet found solutions that 'will not entail a considerable drop in revenue to the Company and yet will meet the manufacturers' wishes' (DU.EB/36/1, p. 18).

In contrast, NESCo saw its domestic customer pricing strategy as being very straight forward and the 1903 Report required (DU.EB/36/1, p. 18) that

no expenditure be incurred for the extension of mains . . . unless a return on Capital, including House Service and Meter, of 15 per cent can be assured . . . these small extensions of a few hundred

pounds may amount (in total) to a considerable sum in the year and should not be incurred unless it is quite certain they will eventually give the requisite return on capital.

No reason is given for the selection of 15 per cent as the required rate of return on capital and no underlying calculations are provided. However, the later Report in 1906 (DU.EB/36/2, p. 20) states that NESCo's required rate of return included '8 per cent interest on capital', the firm having paid an ordinary dividend of 8 per cent since 1898 (Table 1). It is probable that the figure of 15 per cent was designed to cover interest on capital and to contribute to profit.

Thus, the 1903 Report envisages micro-level planning and control in relation to its capturing of domestic consumers.

6.2.6, Capital expenditure

From a low base in the 1890s, NESCo's annual capital expenditure grew rapidly in the early 1900s as its expansion strategies were enacted: 1899, £29k; 1900, £127k; 1901, £243; 1902, £170k (DU.EB/34). The 1903 Report (DU.EB/36/1, p. 16) commented that 'it is essential that further capital expenditure be kept as low as possible' now that its power stations had been constructed and it had 'completed the main work outside the station in the present distribution area for some time to come'. It is apparent that accountants were to have an important role in this process of financial control, although, in fact, their performance came in for some criticism (DU.EB/36/1, pp. 16 – 17):

a special endeavour was made to get into working order proper Capital Expenditure Return Sheets which would actually shew the commitments of the Company from time to time and the increase in Capital Expenditure. These Returns, while they have been regularly before the Directors have not proved of as much use to the Management as was hoped, due chiefly to the apparent impossibility of getting them out sufficiently quickly after the Expenditure had been incurred.

It has been realised for some time that as the Company have got their main system completed, small extensions to Capital [expenditure] should be most carefully dealt with as these amounts may gradually run up . . . to a large extent. To guard against this an entirely new form of Capital Expenditure Returns has been got out. These returns will be filled in weekly instead of monthly and will merely consist of a list of the wages and invoices paid during the preceding week. All new work will be allocated to the various Works Order Numbers which are from time to time approved . . . This refers to all extensions in Newcastle or in the distribution area, but does not refer to large works such as the [Carville Power] Station as it is impossible to deal with such on this basis.

Even in the case of the Carville [Power] Station, however, revised Return Sheets have been drafted, which it is hoped will enable a more careful check to be kept upon the commitments of the Company than has hitherto been possible.

As an additional precaution against any unnecessary debits to Capital Expenditure we have proposed and the Directors have sanctioned that all expenses in connection with the Newcastle Office should be charged to Revenue, that Capital Expenditure should be dealt with separately at Carville, and that only Expenditure at Carville should be charged to Capital.

7. Costing, strategy and the growth of NESCo, 1906 – 1908

This section deals with the period beginning in 1906, the end of the planning period set out in the previous Report (DU.EB/36/1), and ends in 1908, the end of a new planning period covered by a major comprehensive strategic Report (DU.EB/36/2) that dealt with all areas of company activity.

7.1 Introduction

In 1906, NESCo adopted strategies and systems that enabled it to achieve significant growth (Tables 1, 2 and 3) and were detailed in a 'Report on the Position of the Company at the end of 1905 together with estimates for 1906 to 1908' (DU.EB/36/2), covering all aspects of the company's operations including capital expenditure (Schedule No. 8), revenues (Schedule No. 11), costs (Schedule No. 12), costs and profits (Schedule No. 13) (Table 4).

INSERT TABLE 4

The Report was presented to the Chairman and Directors and was marked 'STRICTLY PRIVATE AND CONFIDENTIAL'; it noted (DU.EB/36/2, p. 2) that 'As the period covered by the previous Report [DU.EB/36/1] presented to the Directors in 1903 has now expired, it has been considered advisable to prepare a further Report [DU.EB/36/2] along similar lines, dealing with the present position of [NESCo] and also with the prospects of the Company' up to the end of 1908. The Report had three signatories: R.P. Sloan, General Manager; J.S. Watson, Technical Director; and M. Short, Company Secretary.

R.P. Sloan had been one of the first engineers to join the Merz and McLellan partnership of consulting engineers. Given the close relationships between the consulting engineers and NESCo, Sloan moved to NESCo as General Manager (Beard, 1918, p.6), with J.S Watson stepping down from that position to become Technical Manager. As noted above, in connection with the 1903 Report, J.S. Watson was an engineer. These engineers were joined as Report preparer and signatory by the Company Secretary, M. Short. Biographical details of Short are not available but the Report

(DU.EB/23/2/Schedule 5) indicates that he had responsibility for the Secretary and Accountant's Department in NESCo and, furthermore, he did initial some financial schedules appended to the Report (DU.EB/36/3/17). The three signatories recognised Merz's contribution to the Report(s) and, perhaps, also acknowledged that his *imprimatur* added authority to it, when stating (DU.EB/36/2, p. 24) that,

this Report has not been signed by Mr Charles H. Merz, as was the case in the [1903] Report, owing to the fact that he was abroad while it was being drafted, but its contents are, to a great extent, the results of discussions we have from time to time had with him, and he generally approves the conclusions come to, and the estimates we submit for the next three years.

The Report consists of 24 pages of printed text plus a further 28 pages of supporting documents, including 22 pages of printed schedules, 5 pages of hand-written schedules, and 1 hand-drafted organisation chart. The Report is based on a draft Report (DU.EB/36/3) which consists of 5 pages of text and 39 pages of schedules; of these 44 pages, 6 pages are hand-written and the remainder are printed or typed. Both the draft and the final Reports are hybrids of internal and external financial, costing, engineering, business, legal and market data but there is a distinct shift in content between them: in the final Report, engineering and engineering-based costing content is reduced and accounting, accounting-based costing and business content is increased. This shift may have been due to several factors: the absence of Merz, the direct involvement of the Company Secretary as a Report author, and an increasing need to communicate with the Chairman and Directors who were drawn from non-electrical engineering backgrounds. Neither the draft nor the final Report contains any 'curves', thought by Merz to be so vital to communication and so much a part of the 1903 Report. The current researchers have examined the 1906 Report (DU.EB/36/2; DU.EB/36/3), other primary documents and the secondary literature and have analysed NESCo's costing for strategy development and analysis under four headings: Business Review; Expansion; Costs and Prices; and Power Stations.

7.2 Costing and strategy

7.2.1, Business Review

The final 1906 Report reviewed NESCo's existing business position and organisation structure as of 1905. Although the joint venture between NESCo and the Durham Electric Power Distribution Company was examined in the 1903 Report (DU.EB/36/1; Section 6.2.2, above), the Report notes (DU.EB/36/2, p. 2) that 'the [closer] arrangement which now exists between the Newcastle and Durham Companies was not contemplated' at that earlier time. On 1st January 1905, a formal

'association' (DU.EB/36/2, p.11) was agreed between these companies. However, this association only came into effective operation during the latter part of 1905, resulting in a reorganisation and integration of staff and the preparation of an organisation chart (DU.EB/36/2/Schedule 5) showing the overlapping structures of these companies and, also, those of Merz and McLellan, the Consulting Engineers. The delay in restructuring meant that 'the economies resulting from this combination were materially less than anticipated' (DU.EB/36/2, p. 11). Nevertheless, a comparison (DU.EB/36/2/Schedule 1) of 'the actual results for 1905 as per the balance sheet (and) the estimated results as presented in the [1903] Report' (DU.EB/36/2, p. 2) indicates favourable differences in respect of all key financial and non-financial performance indicators except for average selling price per unit (Table 5). The 1906 Report (DU.EB/36/2) analysed this strong performance and noted the favourable impact of new pricing strategies, higher sales volumes and longer contractual periods with the Durham Company, manufacturers, the NER, the Tyneside Tramways and Tramroads Company and several local authorities. However, it was noted (DU.EB/36/2, p. 30) that 'energetic' competition from gas companies had caused difficulties in the lighting market; nevertheless, the recommendation of the 1903 Report that NESCo should seek a return of at least 15 per cent on capital expenditure for lighting 'had been adhered to as strictly as possible'.

INSERT TABLE 5 HERE

Thus, in 1906, it is apparent that NESCo was at pains to clarify and control its organisation structure and costs and that it operated a form of strategic financial planning and control: actual and estimated results were compared; variances were analysed and explained. In 1906, accountants and their symbols, artefacts and language (Carter, Clegg and Kornberger, 2008) were moving towards more central roles in the provision of information in NESCo.

7.2.2, Markets and power stations

The final 1906 Report (DU.EB/36/1/2, pp. 11 – 14) detailed NESCo's strategy to extend its geographical area of operation and to increase its business with local authorities, collieries and the NER. In relation to some of these customers, this Report also provided detailed estimates of revenues, costs and profits for 1906, 1907 and 1908 (DU.EB/36/2/Schedules 2 and 3). A further major expansion strategy was envisaged to enable the use of 'waste heat' from manufacturing companies in order to generate electricity and relevant costing analysis was presented (DU.EB/36/2, pp. 21 – 22). It was noted (DU.EB/36/3, p. 22) that this highly technical project for 'waste heat'

may be considered perhaps the most important which the Newcastle Company has to look forward to and one which must be allowed for if the Company is to improve its position, or even maintain its present position.

Detailed schedules were presented indicating the analysis of NESCo's corporate revenues, costs, dividends and retained profits: actual results were presented for 1905, along with estimates for 1906, 1907 and 1908 (DU.EB/36/2/Schedules 11, 12, 13 and 15). Furthermore, the capital expenditure required to facilitate this expansion was examined (DU.EB/36/2, pp. 14 – 15) and analysed by category in respect of actual figures for 1905 and estimates for 1906, 1907 and 1908 (DU.EB/36/2/Schedule 8), these figures and estimates being a direct transfer from the draft 1906 Report (DU.EB/36/3/Schedule 1).

The final 1906 Report (DU.EB/36/2, p.3) noted that the 'recommendation [regarding distribution systems] made in the [1903] Report, that no Capital Expenditure should be incurred unless the estimated results therefrom shewed a Revenue return on Expenditure of at least 15 per cent has been adhered to as strictly as possible'. Such a return on investment may have been deemed necessary given the needs of ordinary and preference shareholders and debenture holders who had invested heavily in the company (Table 2).

In order to meet market demand for electricity, NESCo undertook extensions of the Carville Power Station. By 1906, Carville had a peak capacity of 33,000 KW but also had spare plant with a capacity of 8,000 KW and it was planned to increase peak capacity by a further 15,000 KW (DU.EB/36/2, p. 14). The NESCo archive (DU.EB) does not contain any strategic costing justification or analysis regarding extensions at Carville, but, between 1904 and 1910, Carville's output cost only £10 per kilowatt and with 'Carville as the lowest-cost power station in the country, the [NESCo] system grew rapidly' (Byatt, 1979, p. 120). The 1906 Report analysed load factors (DU.EB/36/2/Schedule 14) and noted (DU.EB/36/2/p. 20) that 'If the load factor at Carville could be brought up to 60 per cent, we anticipate there will be a reduction in cost . . . which . . . would mean a saving of £5,000 per year'. Carville provided the foundation for NESCo's emergence and rapid growth (Tables 1, 2 and 3) as a power company and in the years 1906 – 10 it provided, on average, 64 per cent of NESCo's electricity supply capacity (Byatt, 1979, p. 122).

7.2.3, Costs and prices

Gas companies were in direct competition with NESCo for lighting customers and they also competed in the supply of electricity as a motive power by offering the consumer a free 'gas engine and electric generator of sufficient capacity to supply his requirements, the charge made by the Gas

Company not being on the basis of gas supplied, but so much per unit [of electricity] generated by this plant and used by the consumer – these prices being under ¾ d per unit' (DU.EB/36/2, p. 17). Until 1905, NESCo had responded to this 'acute' competition simply by lowering its own prices to 'numerous existing consumers' (DU.EB/36/2, p. 17) but now, in the context of increasingly diverse groups of customers with different requirements for electric supply, it was deemed necessary to instigate specific pricing strategies that were based on NESCo's own costs rather than on responses to competitors' prices; this enabled NESCo to develop competitive and attractive pricing structures for particular consumer groups that took account of demand and load factors in order to allocate variable costs, apportion fixed costs and fix prices accordingly (DU.EB/36/2, pp. 17 – 20).

The 1906 Report authors were confident that Merz's radical and innovative design of the Carville Power Station had provided NESCo with a strategic competitive advantage in the cost of generating electricity and they noted that 'After our fully considering the matter with our Engineers, we do not anticipate . . . very much further reduction of cost at Carville except due to an improvement in the load factor' (DU.EB/36/2, p. 20). The Report authors thought it necessary to explain that load factor 'is a technical term and gives the ratio between units actually consumed and those which would be consumed if the consumer used his load continuously throughout the period under consideration' (DU.EB/36/2, p. 18). Against this background of satisfaction with the costs of generating electricity, the Report (DU.EB/36/2, p. 22) changed the focus of attention to,

whether we cannot revise our costs in such a way as to readily ascertain the accurate cost of supplying any consumer and what the probable variation of this cost will be in the future, since, as the Company now take on so many long term contracts, an accurate forecast of the cost in succeeding years is as important as the present cost.

Industrial consumers were listed (DU.EB/36/2/Schedule 7) and categorized (DU.EB/36/2, pp. 18 – 20) according to their business type and resultant load factor. The Report realised that the distinction between fixed and variable costs was crucial in the calculation of the unit cost applicable to each category of consumer and hence the price to be charged (DU.EB/36/2, pp. 22 – 24). Definitions of fixed and variable costs were set out as 'it may be useful to clearly define what are meant by these two expressions'. However, in addition to normal operating costs, the company sought to include '8 per cent interest on capital' (DU.EB/36/2, p. 20) as an addition to its fixed cost. Thus, it was noted that

We have always considered, for the purpose of calculating results, that no profit is really made unless the Company first of all obtain a return of 8 per cent on all capital expenditure absorbed by the particular supply.

It was considered that the fixed cost of supply would be constant between each category of consumer and that the 'only increased cost will be the cost of generating the additional amount of electrical energy – variable running charges'. The importance of load factor and an understanding of cost behaviour in cost calculation and pricing strategy may be seen in the comment that '½d per unit at 60 per cent load factor pays [NESCo] better than 0.85d per unit at 30 per cent load factor' (DU.EB/36/2, p. 20).

Based on their considerations, the authors of the 1906 Report submitted a four-page 'Analysis of Costs and Revenue' (DU.EB/36/2/Schedule 14). The first page of this schedule contains calculations of four constants required to allow for the impact of *'Diversity Factors'* : K^1, between Generating Station and Substation loads; K^2, in Loss in Transmission between Generating Stations and Substations and Transformation in Substations; K^3 , between Substations and Direct Current Consumers' and K^4 , Loss in Distribution between the Substations and Direct Current Consumers' Terminals. These constants were then employed in the second, third and fourth pages of the schedule in the calculation of actual figures for 1905 and estimates for 1906, 1907 and 1908, depicting costs per kilowatt for: capital charges, fixed costs, variable costs and total costs at load factors of 10 per cent, 25 per cent, 50 per cent and 100 per cent, and, also, revenues per kilowatt. The 1906 Report acknowledged that this was a 'revised way' of analysing costs and revenue but argued that 'it is essential that costs should be made out in this way' (DU.EB/36/2, p. 23).

Although the authors of the 1906 Report did not make any recommendation regarding pricing strategy, they did itemise (DU.EB/36/2, p.24) alternative cost-based methods of charging consumers for the consideration of the Chairman and Directors:

(1) Fixed charge per annum *plus* unit charge
(2) Fixed sum per "Unit of Output of Manufacture"
(3) Fixed lump sum per annum – the "Output of Manufacture" being taken at some definite quantity
(4) Fixed charge per annum per horse-power or per kilowatt of motors installed – independent of number of units consumed
(5) Fixed charge per horse-power or per kilowatt demanded – independent of number of units consumed.

Low capital and operating costs were key elements underlying NESCo's competitive and pricing strategies, as is indicated by its advertisement of 'Cheap Electrical Power' and 'Electric Power supplied at Cheap Rates' (Newcastle and Gateshead Chamber of Commerce, 1911, xxviii) in a bid to attract industrial consumers. Also, in pursuit of industrial consumers, NESCo agreed 'to let on hire or hire-purchase the whole of the electric machinery required for a new works'; it bought land 'to lease such sites for long terms at very cheap rates'; and it provided a consulting service of 'a specially trained staff of experts [in order to advise customers on] the engineering and financial problems incidental to the establishment of new works . . . and to give information regarding such matters as general traffic facilities, labour, and the obtaining of raw materials etc.' (Newcastle and Gateshead Chamber of Commerce, 1911, p. 137).

8. Costing, strategy and the growth of NESCo, 1908 – 1914

The NESCo archive (DU.EB) does not contain any strategic Reports or strategic costing analyses for the period 1908 – 1914, and the authors have not discovered any references to such Reports or analyses in the archive. It is possible that such documents were produced but that they have not survived the vagaries of time. However, the authors judge that it is probable that they were not produced at all, simply because they were not needed: NESCo's strategies and *modus operandi* remained unchanged during this period and were simply the continuation of what had gone before. In terms of planning, NESCo's focus was the same in this period as it had been in the years immediately after its change of strategic direction in 1898, that is on the engineering planning and design of a power station and the development of markets. NESCo was the one exception to the norm that British electricity power companies had power stations that were, essentially, scaled-up versions of lighting stations from the turn of the century (Byatt, 1979, p. 96). Having established itself with the design, construction and operation of the Neptune Bank and Carville Power Stations, the design and use of safe power stations with low capital and operating costs continued to be the fundamental strategy underlying NESCo's success, as evidenced by a new power station that opened in 1910 in Dunston, near Newcastle. Each NESCo power station 'marked an advance on the previous one technically and from the standpoint of economy' (Beard, 1918, p. 10); the Dunston Power Station had 23,000 KW capacity, was built at a cost of £11 per KW, 'well below the national average' (Byatt, 1979, p.122), and it provided the basis for NESCo's continued growth through to 1914.

By 1914, NESCo was the one successful British power company and it had developed a 'grid extending from the Northumberland coalfield to the Cleveland iron ore field. In 1912 it had 42 per cent of total [British] generating capacity . . . and accounted for 12 per cent of total sales of electricity [direct to end-use consumers] in Britain' (Byatt, 1979, p. 114), the apparent discrepancy

between these numbers being accounted for by the bulk electricity supplies that NESCo provided to municipalities and other power companies (Byatt, 1979, p. 122).

9. NESCo: costing and management control

From its inception, NESCo had calculated power station unit costs on a routine basis but the 1903 Report (DU.EB/36/1, p. 19) noted that, to date, perhaps too much attention had been focused on 'the cost per unit at the Power Station, which for the present has reached the lowest practical point'. Now, it was necessary to re-focus in order to pay attention to 'standing outside expenses and to the general expenses in the offices' which were a large proportion of total production cost. This issue was to be dealt with by two means: first, increasing output; second, 'proper organisation and the saving of duplicate work'. The 1903 Report (DU.EB/36/1, p.19) ended by stating:

In the reduction of routine expenditure we attach considerable importance to the increased assistance and attention which can now be given to and by the Accountants Department and the returns which they get out. It is hoped that, in the future more than in the past, the combined and united efforts of all departments may be directed towards a reduction both of Costs and Routine Capital Expenditure.

In making this statement, the Report authors simply emphasised the need to develop and employ appropriate financial controls in the management of NESCo as a rapidly growing but financially sound company. However, although the 1903 and 1906 Reports (DU.EB/36/1; DU.EB/36/2) set out detailed annual financial plans covering the period 1903 – 1908, there is no evidence that NESCo developed a routine budgetary control system on a departmental or organisational basis. Nevertheless, tight managerial and financial control was exercised directly over capital expenditure projects and over contracts with individual consumers. Moreover, documentation dating from 1898 (DU.EB/1/5) and 1900 (DU.EB/5/1) indicates that NESCo prepared weekly cost sheets, fuel accounts and output sheets that were used for managerial control purposes but, unfortunately, these records have not survived in the archive.

In 1903, Short, the Company Secretary, undertook a re-organisation of NESCo. He produced a comprehensive 'Staff List' (DU.EB/43) which presented not only the activities or 'duties' performed in each and every staff job within the firm but also named the individual people performing those activities, together with a note of their earnings. NESCo employed a total of 90 members of staff: 30 were categorised as 'Technical'; 25, including the Accountant, Bookkeeper and two cost clerks, were listed as 'Secretarial'; 14 were employed at the Neptune Bank Power Station; and 21 were employed at Carville Power Station. The archive does not contain any record of non-staff employees. By 1906,

NESCo had a clear organisation structure depicted in a formal organisation chart (DU.EB/36/2, Schedule No. 5). The organisation chart (DU.EB/36/2/Schedule 5) and the 'Staff List' (DU.EB/43) indicate that NESCo employed clear lines of responsibility and accountability. In line with other firms of the Second Industrial Revolution (e.g. McLean et al, 2015), it is probable that NESCo exercised direct, personal control over staff although there is no direct evidence to confirm this.

10. The regulatory-political environment and strategic costing

In the early nineteenth century, there was little Government regulation of utilities. However, after 1850, gas and water companies were required to obtain Government franchises in order to operate. The Tramways Act of 1870 required intending 'tramway operators . . . to apply for a Provisional Order from the Board of Trade [in order] to operate under the general conditions of the Act' and it 'provided for the compulsory purchase of a tramway by the local authority twenty-one years after the granting of the Provisional Order' (Byatt, 1979, p. 198). The Electric Lighting Act of 1882 was modelled on the Tramways Act of 1870. Intending suppliers of electricity were required to obtain from the Board of Trade either a Licence, giving rights of supply for seven years, or a Provisional Order, giving rights of supply for twenty-one years after which time it could pass into the ownership of the local authority by compulsory purchase. However, 'many people felt that this Act had hindered [the emergence] of electricity supply too much' and in 1888, the compulsory purchase 'clause was amended to forty-two years' (Byatt, 1979, p. 199). This amendment of 1888 stimulated Robert Spence Watson and Theodore Merz to instigate the incorporation of NESCo in January 1889 (Beard 1918). NESCo obtained the necessary support from Newcastle Corporation and, on 7th March 1889, applied to the Board of Trade for a Licence to operate in Newcastle. The Licence was granted and NESCo operated under it for three years until it applied for Provisional Orders. Newcastle Corporation opposed this application and, in order for the Corporation to drop this opposition, NESCo was obliged to accept a compromise term under Provisional Orders of thirty-one years rather than the usual forty-two years.

Hannah (1979) notes that there were tensions between electricity industry regulators and supply organisations but Byatt (1979, p. 197) indicates that although legislation was 'a significant factor' in the emergence of the electricity supply industry, 'it should be put in its proper context – as part of an attempt to regulate natural monopolies in the public interest in an economic atmosphere still dominated *by laissez-faire* views'. Nevertheless, as Hausman, Herner and Wilkins (2008, p. 23) note the very nature of electricity led to political involvement in the emerging electricity supply industry,

Because energy cannot easily be stored . . . it becomes possible for a utility to engage in price discrimination, charging different prices to different consumers, a practice that could well lead to higher profits. This situation could pit groups of consumers against one another, and the tensions this produced could be played out in the political arena. As electricity became more ubiquitous and more essential . . . the requirement that utilities have government approval at least for their distribution systems made them dependent on politicians, and made their behaviour an object of political concern.

Thus, the electricity supply industry did have a demanding regulatory-political environment; every formation of a municipal or corporate electricity supply organisation required Parliamentary consent and every extension of supply required the consent of local and/or national government. NESCo required multiple Acts of Parliament and Provisional Orders (PA 122) in order to develop its business and, moreover, the company engaged in frequent disputes and negotiations resulting in legal agreements with municipalities and landowners regarding the granting of wayleaves for its distribution systems (DU.EB/47, DU.EB/156/4). The strategic Report of 1906 (DU.EB/36/2) devoted pages 11 – 14 to discussions of NESCo's plans for the promotion of Bills and Provisional Orders in Parliament. As a solicitor, Spence Watson provided NESCo with legal expertise in its submissions to Parliament and local corporations (Beard, 1918). Moreover, as an original convenor of the National Liberal Federation in 1874, its President from 1890 – 1902, and the most prominent Liberal leader outside of Parliament (Corder, 1914), Spence Watson had political expertise and networks to bring to bear in NESCo's regulatory-political environment, both nationally and locally. Nationally, for example, Sir James Kitson, Spence Watson's predecessor as President of the National Liberal Federation, 'sat as Chairman of the Select Committee of the [House of] Commons which dealt with many of the Power Bills of 1900 and 1901' (Byatt, 1979, 203). Rather laconically, Beard (1918, p. 7) notes that NESCo was 'fortunate in having as Chairman of the Committee that considered all the Power Bills . . . Sir James Kitson' as these Bills enabled the company's expansion by providing it with the authority to supply power over large areas. Locally, for example, T.G. Gibson, J.P. was a Newcastle businessman and Alderman who Spence Watson recruited to supply finance to NESco and to become Company Director and Chairman, 1889 – 1911, whilst also providing the firm with an influential ally in the political arena (Beard, 1918; NESCo, 1948).

In 1898, Parliament gave approval for Newcastle Corporation to construct an electricity power station. In response to this entry into the market, NESCo and a competitor company each applied to Parliament for permission to develop a scheme for the whole district. The strengths of Spence Watson combined with the expert witness testimony of Charles Merz were key factors in a

Parliament Committee headed by Sir James Kitson giving it, rather than a rival company, approval to develop a district scheme. In dealing with another proposed NESCo scheme in 1902, a Parliamentary Select Committee [dealing with NESCo] commended Merz on his careful estimation of demand and the way in which he linked his investment plans to estimates of demand' (Byatt, 1979, pp. 185 – 186). Furthermore, as Hughes (1993, pp. 453) notes, Merz was

believed by many to be the most effective expert witness in the engineering world. In presenting his case he used highly imaginative statistical tables, graphs and charts . . . [In NESCo, he] articulated and disseminated the economic and technological principles of regional [electric power] systems. He took into account the technological and economic givens and forged strategy and tactics for NESCo.

NESCo's emergence and expansion as a successful power company and its dominance over its competitors may be explained, in part at least, by the manner in which Robert Spence Watson and Charles Merz in particular dealt with the regulatory-political environment. NESCo had no legal or regulatory obligation to produce costing information but Charles Merz's expert witness testimony to Parliament, in which he presented convincing business strategies based on sound strategic costing information, was fundamental to NESCo's ability to operate successfully in the regulatory-political environment of the emerging electricity supply industry. In turn, the Reports (DU.EB/36/1; DU.EB/36/2) were pivotal in giving full expression to NESCo's business strategies and strategic costing.

11. Discussion and Conclusions

The research literature on the 'old' industries of coal, iron and steel (e.g. Boyce, 1992,; Boyns and Edwards, 1995; Boyns and Edwards, 1997; Edwards et al, 1995; Pitts, 2001) and shipbuilding and engineering (e.g. McLean, 2006; McLean et al, 2015) provides evidence of the implication of costing in the production of strategic reports. In contrast, the limited literature on the 'new' industries of the Second Industrial Revolution (McKinstry, 1999; McLean, 2006; McLean 2013; McLean et al, 2015) notes an absence of thoroughgoing strategic reviews, although it does indicate the role of costing in one-off strategic decisions. The current article represents a valuable addition to this limited literature; it presents a detailed case study of NESCo's costing for strategy development and analysis, 1889 – 1914, and it provides evidence that, in 1903 and 1906 , NESCo produced Reports that were comprehensive in their considerations of business and technological strategies and that employed costing information in the development, analysis and review of these ongoing strategies. Thus, the current research indicates the existence of a continuity, rather than a break, in the

implication of costing in strategy development and analysis from the First to the Second Industrial Revolution.

This research finds that a combination of three major factors underlay NESCo's adoption of systematic, formal considerations of strategy and its use of costing for strategy development and analysis. First, the novelty, scale and complexity of the electricity supply industry and the firm were such that strategy was best thought through from first principles in a formal manner and costing was an essential aid to the formulation of strategic plans and analyses. Second, NESCo operated in a regulated environment; its effective, formal submissions to Parliament of its strategy and strategic costing were essential elements in gaining the required approval for expansion and had natural corollaries in its strategic Reports (DU.EB/36/1; DU.EB/36/2). Third, and crucially, Charles Merz had the ability and the drive to develop NESCo's strategy and to formulate and enact an appropriate approach to the provision of costing information for strategy development and analysis; moreover, NESCo's electrical engineers and accountants were able to extend and develop his work. This third finding confirms the importance of key players in accounting and costing as noted in the historical literature (McLean, 2013; McLean et al, 2015; McLean and Tyson, 2006; Yamey, 1981).

Many studies (e.g. Hopwood, 1987; Napier, 2006; Quinn, 2014) have validated the use of history in the study of contemporary accounting and costing. Carnegie and Napier (2012, p. 329) argue that 'History can inform our appreciation of contemporary accounting thought and practice through its power of unifying past, present and future . . . history provides a framework for evaluating accounting's impacts on individuals, organisations and society not just in the past but also today'. As an accounting historian, Jones (2008, p. 1053) provides a cautionary note by indicating that 'when interpreting the past through the lens of the present, it is necessary to beware anachronisms'. However, the issue of anachronism has long been debated within the wider historical community (e.g. Jardine, 2000; Poe, 1996; Tosh, 2003) and, although the dangers are recognised, an accepting, nuanced approach has developed. Hoskin and Macve (1996, p.337) argue for the adoption of a balanced approach that recognises 'the dangers of anachronism when considering the accounting practices of earlier times, and the importance of allowing modern intent in such accounting only after the most stringent scrutiny of the evidence'. Thus, the researchers have proceeded cautiously and have employed stringent scrutiny in employing history in order to develop an analysis that has both historical and contemporary relevance. Therefore, next, the authors consider the implications of their historical findings for contemporary research in four areas of strategic costing/strategic management accounting (SMA).

First, the contemporary SMA literature may be viewed in the light of the orientation of NESCo's strategic costing. Nixon and Burns (2012a, p. 229) argue that much of the SMA literature is based on 'Michael Porter's industry analysis model and generic competitive strategies' and, for example, they note that Simmonds (1981, p. 26) defined SMA as 'the provision and analysis of management accounting data about a business and its competitors, for use in developing and monitoring business strategy'. However, they state (2012a, p. 229) that whilst strategic management has moved to a 'more internal, resource-based view of the firm and competitive advantage [this] has been mostly neglected by the extant SMA literature'. The NESCo case indicates that, throughout its emergence as a regional power company, 1898 – 1914, the firm's strategies were based on complementary understandings and analyses of its internal resources as well as its external competitive market environment. Thus, the NESCo case explores the strategic implications of internal, resource-based assessments of the firm and, thereby, provides a useful counterpoint to the contemporary SMA literature, an addition to our very limited knowledge of SMA in practice and a complement to the few studies which relate accounting, strategic management and the resource-based view of the firm (e.g. Bowman and Toms, 2010).

Second, the equations of SMA simplicity-complexity and cost-benefit must be considered. In relation to contemporary SMA, Guilding et al (2000, p.117) list 12 SMA techniques and Cadez and Guilding (2008, p. 839) extend this list to 16 techniques represented in the SMA literature: attribute costing; life cycle costing; quality costing; target costing; value-chain costing; benchmarking; integrated performance measurement; strategic cost management; strategic pricing; brand valuation; competitor cost assessment; competitive position monitoring; competitor performance appraisal; customer profitability analysis; lifetime customer profitability analysis; valuation of customers as assets. Nevertheless, Guilding et al (2000, p. 113) acknowledge that 'Most of the SMA [techniques in their list] are not widely used'. Historically, firms of the late nineteenth – early twentieth century were very aware of the costing cost-benefit equation and took great care to limit the costs of costing by operating simple systems that produced information that was beneficial and readily understood (McLean, 2013; McLean et al 2015). NESCo's strategic costing covered important areas of internal and external analysis; conceptually, it was based on an understanding of the nature of fixed and variable costs and it presented information to the reader in a straightforward manner, without the accompaniment of a wide range of terminologies. Moreover, NESCo did not attempt to undertake strategic costing on a continuing, ongoing basis; it produced only two Reports (DU.EB/36/1; DU.EB/36/2) based on strategic costing and these Reports were produced at times when there were distinct needs for strategic information. After 1906, when strategies remained constant, no further Reports were produced. Nixon and Burns (2012a, p.229) note that there is 'an inherent contradiction

between the apparent decline of SMA and the sustained growth in the number of concepts, models, tools, theoretical perspectives, disciplines, academic and professional journals and consultancy practices that populate the SMA domain . . . [SMA is a] paradox'. This SMA 'paradox' may be related to the equations of simplicity-complexity and cost-benefit that were well understood by NESCo and other firms operating in the late nineteenth-early twentieth century.

Third, is a consideration of the 'role of accountants in the adoption and implementation of SMA' Langfield-Smith (2008, p. 219). Powell (2014, p. 201 - 3) notes that, 'it pays to remember that the empirical world of strategy and organization is more personal than impersonal . . [but] few traces of personalism remain in contemporary theories of competitive advantage . . . People have vanished almost completely from the story', and Fauré and Rouleau (2011, p. 169) argue that 'organization strategy cannot be reduced to the formal discourse authored by top management and disseminated through . . . the official organizational communication system'. The current historical research brings people back into the story but indicates clearly that a key individual and a small group of top managers can employ a formal discourse in order to have a profound influence on strategy and the production of strategic costing information. The NESCo case emphasises the importance of non-accountants, specifically electrical engineers, in the provision of strategic costing information and indicates that the contribution of external consultants, as experienced in the 'old' industries of coal, iron and steel industries (Boyns and Edwards, 1995; Brackenborough, McLean and Oldroyd, 2001; Pitts, 2001), continued to be relevant in the electrical supply industry of the Second Industrial Revolution. It may be noted that costing textbook author (Garke and Fells, 1887) Emile Garke was an electrical engineer who 'specialised in retrenchment and financial management' (Byatt, 1979, p. 189) and worked in both the Brush Electric Lighting Company (Section 3. above) and the Durham Electric Power Distribution Company (Section 6.2.2, above). It is suggested that future research should examine the contrasting roles of key individuals and others, and of formal and informal discourses in the processes of costing for strategy development and analysis.

Nixon and Burns (2012a, p.241) recognise that contemporary SMA 'belongs to the [management] team' but they argue that 'accountants are likely to have a competitive advantage in compiling and using financial numbers . . .and ensuring a consistent application of financial criteria in decisions'. However, in NESCo, engineers were key figures who played crucial roles in both the development of strategy and in the preparation of underlying strategic costing information. Nevertheless, the 1906 Report (DU.EB/36/2) does provide evidence of an increasingly important strategic role for accountants and accounting-based costing and it must be recognised that the boundaries of accounting are in a constant process of definition and redefinition as a body of expertise is created:

'accounting is *permeable to other bodies of expertise.* Accounting has been made and re-made by borrowing calculative technologies and rationales from a disparate range of knowledges and associated ideals . . . The criteria for what can count as accounting are historically contingent and only temporarily stabilized' (Miller, 1998, pp. 618 - 619; italics in original). As in the case of NESCo, interaction between accounting and other bodies of expertise, such as electrical engineering, can lead to hybridisation where 'new phenomena [are] produced out of two or more elements normally found separately' (Miller, Kurunmäki and O'Leary, 2008, p. 943). Moreover, it is through 'a specific class of hybrids . . . formed at . . . intersections such as those between financial calculation and technological dreams . . . that a particular modality of intervening to manage uncertainty emerges and is made possible'(Miller et al, 2008, p. 945). NESCo's strategic costing represents such an intersection. However, Miller et al, note (2008, p. 942) that the' existing literature . . . has largely neglected the hybrid practices, processes and expertises that make possible lateral information flows and coordination across the boundaries of organisations, firms and groups of experts or professionals'. NESCo's strategic costing was the hybrid outcome of the work of consultants and company personnel who applied electrical engineering-based costing and accounting-based costing; the researchers suggest that the further study of hybrids has much to offer the historical and contemporary strategic costing/SMA literatures.

Fourth, this article presents a view of strategic investment appraisal that augments the contemporary literature (e.g. Carr, Kolehmainen and Mitchell, 2013; Haka, 2007; Miller and O'Leary, 2007; Skærbaek and Tryggestad, 2010). Hausman et al (2008, p.19) note that 'With the exception of steam railways during that industry's formative years, no other public utility or manufacturing industry came close to approaching the capital intensity of the electric power industry from its inception in the late nineteenth century up to World War I'. However, NESCo did not apply formal financial investment appraisal techniques to its most significant large scale, long term, strategic projects, that is to the building of new power stations. Instead, NESCo investment strategy was based on detailed market research allied to an exponential growth in demand for electricity together with innovative power station design, leading to cost leadership in the market place; formal financial investment appraisal techniques were used only for more limited, smaller scale, shorter term, capital projects. Thus, NESCo's use of strategic investment appraisal techniques was more limited than that presented in the contemporary literature but, nevertheless, its strategic investment strategies were very effective in the context of its time and circumstances.

In conclusion, the authors find that, essentially, NESCo's costing was a 'strategic and commercial technology' (Ahrens and Chapman, 2007, p. 3) employed to underpin strategy development and

analysis. The current study confirms the validity of undertaking further archive studies in order to extend our historical knowledge of costing in emerging industries and to employ these historical findings in the analysis of contemporary costing issues. Of particular interest to the current authors is the work of Kraus and Lind (2007, p. 295) who indicate the need for further research in the field of control and control systems in contemporary inter-organisational relationships. Given the close personal and business links that existed between NESCo and, for example, Merz and McLellan, the Walker and Wallsend Union Gas Company, the Durham Electric Power Distribution Company, and the NER, the current authors feel that the NESCo archive offers rich opportunities for further research in order to extend our historical and contemporary knowledge of control and control systems in inter-organisational relationships in emerging industries.

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Table 1 NESCo Profit and Loss Account Extracts (£000), 1891 - 1914

Year	Revenue	Gross Profit	Net Profit	Ordinary Dividend	Preference Dividend	Debenture Interest
1891	4	2	1	4%	-	6%
1892	6	3	2	4%	-	6%
1893	7	2	1	4%	-	6%
1894	8	3	2	4%	-	5%
1895	9	4	2	5%	-	5%
1896	10	5	3	5%	-	5%
1897	13	7	5	7%	-	5%
1898	15	8	5	8%	-	-
1899	17	9	6	8%	-	-
1900	20	9	9	8%	5%	-
1901	23	13	11	8%	5%	4%
1902	45	27	18	8%	5%	4%
1903	76	43	28	8%	5%	4%
1904	109	61	41	8%	5%	4%
1905	140	69	50	8%	5%	4%
1906	177	81	52	8%	5%	4.50%
1907	241	82	57	8%	5%	4.50%
1908	-	69	44	5%	5%	4.50%
1909	-	95	65	4%	5%	4.50%
1910	-	98	64	4%	5%	4.50%
1911	-	107	70	4.50%	5%	4.50%
1912	-	115	76	5%	5%	4.50%
1913	-	134	105	5.50%	5%	5%
1914	-	156	132	5.50%	5%	5%

Sources: compiled from NESCo Annual Reports, DU.EB/34

Notes:

a. Gross Profit is calculated after tax but before interest
b. Net Profit is calculated after interest but before dividends
c. Annual Reports were not published in 1889 and 1890
d. Revenue figures were not reported in and after 1908.
e. Preference dividend data are not available for 1889 - 1899
f. Debenture interest data are not available for 1898 - 1900

Table 2 NESCo Summary Capital and Liabilities (£000), 1891 - 1914

Year	Ordinary Share Capital	Reserves	Total Equity	Preference Share Capital	Debentures	Loans	Current Liabilities	TOTAL
1891	19	1	20	-	15	-	6	41
1892	26	1	27	-	15	-	3	45
1893	29	2	31	-	17	-	4	52
1894	34	1	35	-	20	-	5	60
1895	39	2	41	-	20	-	4	65
1896	46	2	48	-	20	-	16	84
1897	46	5	51	-	25	-	14	90
1898	53	11	64	-	25	-	17	106
1899	90	25	115	-	-	18	7	140
1900	93	47	140	52	-	47	39	278
1901	124	80	204	125	-	158	36	523
1902	203	38	241	170	140	62	46	659
1903	266	143	409	245	250	79	92	1,075
1904	371	179	550	357	250	55	60	1,272
1905	375	229	604	375	250	61	137	1,427
1906	417	100	517	400	381	31	176	1,505
1907	438	121	559	438	438	182	95	1,712
1908	688	120	808	688	439	13	55	2,003
1909	688	153	841	688	688	1	91	2,309
1910	688	157	845	688	688	1	56	2,278
1911	688	182	870	688	688	3	106	2,355
1912	688	173	861	688	688	146	93	2,476
1913	738	199	937	688	1,088	8	82	2,803
1914	798	224	1,022	912	1,088	66	108	3,196

Sources: compiled from NESCo Annual Reports, DU.EB/34

Note:

a. Annual Reports were not published in 1889 and 1890

Table 3 NESCo Summary Assets (£000), 1891 - 1914

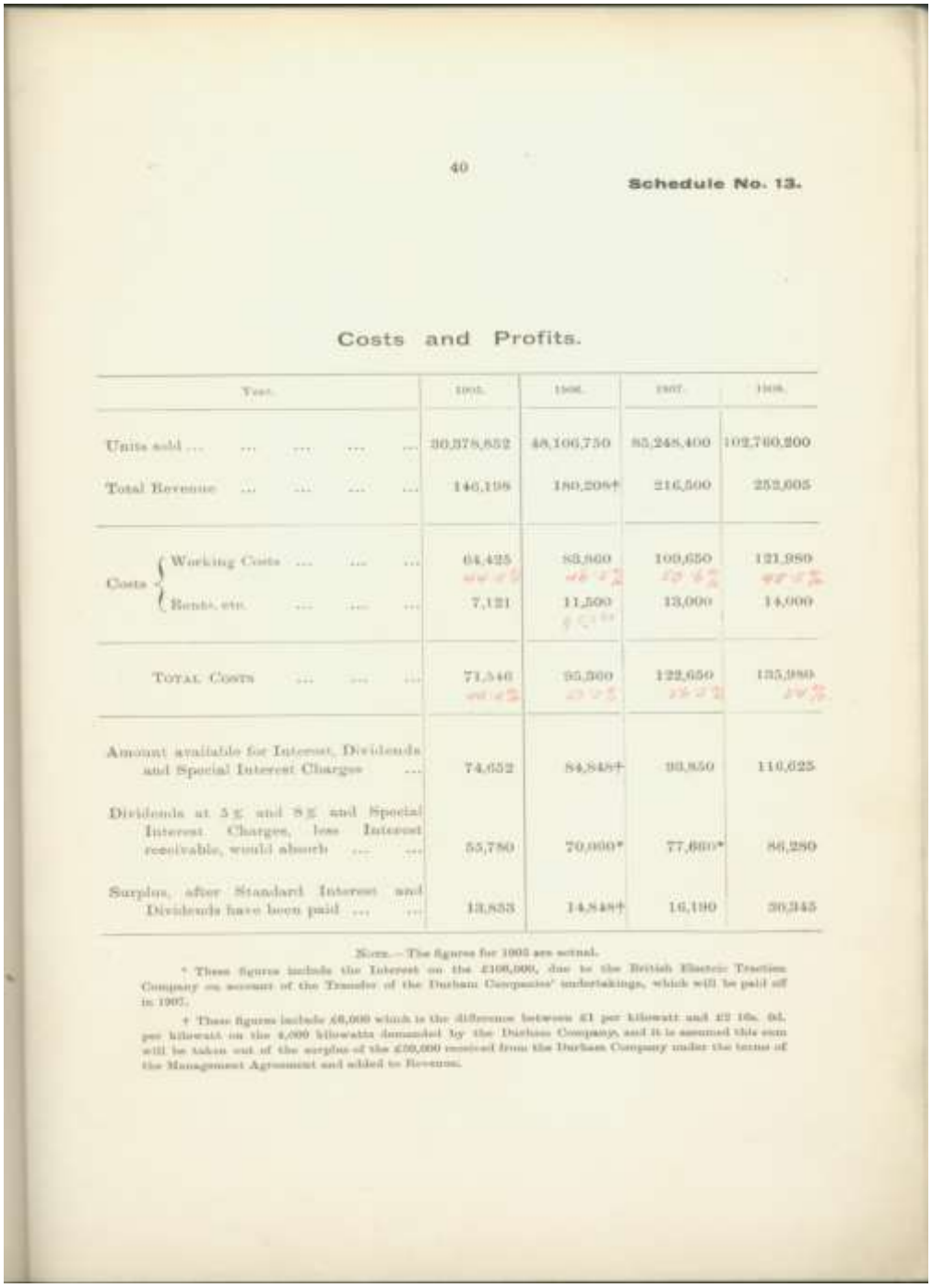
Year	Fixed Assets	Investments	Current Assets	TOTAL	Total Assets Index
1891	35	-	6	41	100
1892	41	-	4	45	110
1893	46	-	6	52	127
1894	54	-	6	60	146
1895	60	-	5	65	158
1896	77	-	7	84	205
1897	82	-	8	90	234
1898	98	-	8	106	259
1899	127	-	13	140	341
1900	256	-	22	278	678
1901	499	-	24	523	1,276
1902	569	-	90	659	1,607
1903	1,025	-	50	1,075	2,622
1904	1,166	26	80	1,272	3,102
1905	1,216	115	96	1,427	3,480
1906	1,239	109	157	1,505	3,671
1907	1,458	87	167	1,712	4,176
1908	1,641	158	204	2,003	4,885
1909	1,787	163	359	2,309	5,632
1910	1,898	139	241	2,278	5,556
1911	1,975	105	275	2,355	5,744
1912	2,122	73	281	2,476	6,039
1913	2,337	59	407	2,803	6,677
1914	2,448	366	382	3,196	7,795

Sources: compiled from NESCo Annual Reports, DU.EB/34

Note:

a. Annual Reports were not published in 1889 and 1890

Table 4



Schedule No. 13.

Costs and Profits.

Year.	1905.	1906.	1907.	1908.
Units sold	30,378,852	48,106,750	85,248,400	102,760,200
Total Revenue	146,198	180,208†	216,500	253,605
Costs — Working Costs	64,425	83,860	109,650	121,980
Costs — Rents, etc.	7,121	11,500	13,000	14,000
Total Costs	71,546	95,360	122,650	135,980
Amount available for Interest, Dividends and Special Interest Charges ...	74,652	84,848†	93,850	116,625
Dividends at 5% and 8% and Special Interest Charges, less Interest receivable, would absorb	55,780	70,000*	77,660*	86,280
Surplus, after Standard Interest and Dividends have been paid	13,853	14,848†	16,190	30,345

Note.—The figures for 1905 are actual.

* These figures include the Interest on the £100,000, due to the British Electric Traction Company on account of the Transfer of the Durham Companies' undertakings, which will be paid off in 1907.

† These figures include £6,000 which is the difference between £1 per kilowatt and £2 10s. 0d. per kilowatt on the 4,000 kilowatts demanded by the Durham Company, and it is assumed this sum will be taken out of the surplus of the £50,000 received from the Durham Company under the terms of the Management Agreement and added to Revenue.

Table 5

Schedule No. 1.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY LIMITED.

Comparison of Actual with Estimated Results for Year 1905.

Throughout the following table the figures in—

Column No. 1 shews the actual results obtained in 1905.

Column No. 2 shews the results as estimated for 1905 in the Report of 1903.

In Column No. 3 the actual results have been modified to what they would have been had the Durham Company continued on the Old Agreement.

Column No. 4 shews the differences between Columns No. 2 and 3.

	Actual Results.	Estimated Results.	Estimated Results on modified basis.	Estimated differences on modified basis.
Kilowatts Installed*— Power and Lighting ...	18,533	14,400	18,533	+4,133
Maximum Demands ...	15,300	10,670	15,300	+4,630
Units Sold	30,378,852	20,210,000	26,188,143	+5,978,143
Average Price Obtained ...	1·16d.	1·46d.	1·225d.	−·235d.
Capital Expenditure‡ ...	£1,211,285	£1,118,000	£1,211,285	+£93,285
Revenue	£146,198	£123,815	£133,569	+£9,756
Total Costs	£71,546	£53,800	£55,200	+£1,400
Interest, Dividends, &c. ...	£60,798	£59,000	£60,798	+£1,798
Surplus	£13,854	£11,013	£17,571	+£6,558

NOTES.—*Power in this case includes Manufacturers and Small Motors only.

‡ No allowance is made on account of Depreciation Fund, which stood at £156,000 at the end of 1905.