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Management accounting, engineering and the management of company growth: Clarke Chapman, 1864–1914

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ABSTRACT

This research examines the relationship between management accounting and engineering in the processes of strategic decision-making and managerial control underlying the management of growth in Clarke Chapman, 1864 – 1914. The research finds that strategic decisions to invest in new technologies were grounded in the engineering ethos of the firm, market awareness and information derived from the firm's extensive business networks. Decisions regarding the (dis)continuance of existing strategic directions were based on management accounting information and product and market awareness. The management and control of costs were important factors underlying significant re-organisations of the firm. Managerial control was exercised on a direct, personal basis and was undertaken in conjunction with the use of routine and ad hoc management accounting reports.

The current research makes two major contributions to our knowledge of the development of management accounting. First, it finds that Clarke Chapman's management accounting system evolved incrementally to match the growth requirements of the firm. The research finds no evidence of periodic fluctuations in demand having a significant impact on the development of the management accounting system. Second, the current research indicates that there is no evidence of conflict between professional groupings of engineers and accountants over the ownership of the management accounting system which was rooted in the accounting function. In this respect, it is considered significant that engineering and accounting were both represented at very senior levels in the firm.

1. Introduction

For much of the twentieth century, histories of British costing (Edwards, 1937; Pollard, 1965) held that little meaningful development took place until the 'costing renaissance' of the late nineteenth century. However, detailed archival research (e.g. Boyns, 1993; Boyns & Edwards, 1995, 1996, 1997a, 1997b, 2007; Edwards, Boyns, & Anderson, 1995; Fleischman & Parker, 1991, 1992) has led to the formation of a "new conventional wisdom" (Boyns & Edwards, 1997a, p. 2) which demonstrates the long use of sophisticated costing systems in the provision of information for managerial decision-making.

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It is acknowledged that more archive-based research is required in order to increase our understanding of the development of costing (e.g. Boyns & Edwards, 1995; Fleischman & Tyson, 2000; Fleming, McKinstry, & Wallace, 2000; McKinstry, 1999). However, the current authors consider that it is appropriate to use the term 'management accounting', rather than costing, in this paper. The authors follow Boyns and Edwards (1997a) in adopting the Institute of Chartered Accountants in England and Wales' (ICAEW) view of management accounting as being the provision of 'accounting information which is of direct assistance to the management in the formulation of policy and in the day-to-day control of a business' (ICAEW, 1954, para. 3). Thus, in terms of Chandler's analysis (Chandler, 1990), management accounting is engaged in both the strategy and structure of organisations: 'on the one hand it is synonymous with the provision of information for strategic decision-making and on the other with information for everyday managerial control purposes' (Boyns & Edwards, 1997a, p. 22). The research literature (Boyns & Edwards, 1996; Edwards et al., 1995; McLean, 2006) indicates that the main motivation for management accounting innovation in Britain 'was not to enable the control of labour…but to aid the provision of performance indicators considered relevant for a range of routine and strategic business decisions' (Boyns & Edwards, 1996, p. 17).

The current paper builds upon and extends previous studies (Fleming et al., 2000; Hopper, Cooper, Lowe, & Capps, 1986; McKinstry, 1999; McLean, 2013; McLean & Tyson, 2006) which have analysed the impact of engineering environments on the development of management accounting and, in particular, have scrutinised the notion that engineers and accountants were 'fighting for turf' (Boyns & Edwards, 2007, p. 980) in a battle for the control of the management accounting function. In their study of cost accounting in the shipbuilding, engineering and metals industries of the West of Scotland, c.1900–1960, Fleming et al. (2000) found that an inhibiting engineering culture was a factor underlying the non-development of standard costing and budgetary control in these industries. Mcinstry (1999, p. 219) noted that the engineering-oriented culture of a Scottish vehicle manufacturer in the twentieth century led to the company's preference for 'control systems of a non-financial kind'. Similarly, McLean and Tyson (2006, p. 413) concluded that standard costing and budgetary control were not widely employed in the post-Second World War North East England shipbuilding industry because 'the engineering culture of the shipbuilding industry promoted the use of 'alternative', non-accounting measurement systems'. Hopper et al. (1986) noted that although standard costing and budgetary control systems were installed in the National Coal Board during this period, their proper operation and use were undermined by the organisation's engineers and dominant engineering culture. However, McLean (2013) researched the activities of a shipbuilding company during the period 1886–1915 and found that its engineers and accountants were not 'fighting for turf' (Boyns & Edwards, 2007, p. 980) in a war of the professions. Rather, in this company, separate disciplines of cost engineering and costing were developed to serve very different functions. Cost engineering provided information for cost management and for cost estimation, pricing and tendering while costing provided information for performance measurement and for the operation of managerial accountability and managerial reward systems.

The particular objective of the current paper is to examine the relationship between management accounting and engineering in the processes of strategic decision-making and routine managerial control, including the control of labour, underlying the management of growth and fluctuations in demand in Clarke Chapman, 1864–1914. In pursuing this objective, the current research examines 'the complexity of the nature and process of (management) accounting change' (Boyns & Edwards, 2013, p. 23). This article makes two major contributions to our knowledge of the development of management accounting. First, it indicates that Clarke Chapman's management accounting system developed in a gradual, evolutionary manner related to the general growth trend of the firm; it did not change significantly and suddenly in the context of fluctuations in demand and organisational shock. Second, this research finds that there is no evidence of conflict between engineers and managers over the ownership of Clarke Chapman's management accounting system. The fact that engineering and accounting professions were both represented at very senior levels of the firm is considered to be significant in this respect. This article is presented in five further sections: Clarke Chapman, the context; accountants and engineers: actors and change agents; management accounting, engineering and strategic decisions; management accounting, engineering and managerial control; and conclusions.

2. Clarke Chapman, the context

2.1. The research site

The current research is based on an examination of the extensive but incomplete Clarke Chapman collection (DS/CC) held by the Tyne Wear Archive Service in Newcastle Upon Tyne. Although the firm was founded in 1864, the vast bulk of the archive dates from after 1883, when a partnership re-configuration took place. A further increase in documentation occurred after 1893, when Clarke Chapman was formed as a limited company. A study of the archive collection (DS/CC) of this British engineering company and a reading of the related literature (e.g. Manders, 1980) indicate several factors which justify the selection of Clarke Chapman in the period 1864–1914 as a valuable site for the research of management accounting and the management of company growth. First, from its foundation in 1864 the firm grew to become the United Kingdom's leading supplier of auxiliary machinery for the shipbuilding industry and the largest manufacturing employer in its home base of Gateshead. Second, Clarke Chapman instigated and experienced profound organisational changes, including the transitions from partnership to limited company and from entrepreneurial to managerial control. Third, during this period known as the Second Industrial Revolution (Landes, 2003, p. 235), Clarke Chapman was at the forefront of technological change and was permeated by engineering values and capabilities. Fourth, the firm managed the problems of risk and uncertainty, which were particularly pronounced in its market sectors and its strategic cum technological decision-making, whilst maintaining financial stability and providing adequate financial returns to investors.

2.2. Company growth and fluctuations in demand

In the latter part of the nineteenth century, the British shipbuilding industry experienced rapid technological and organisational transformation as wooden sailing ships were replaced by metal steam ships. Metal shipbuilding was a new industry based on engineering and the assembly of component parts purchased from networks of suppliers (Pollard & Robertson, 1979, p. 89). In 1864, William Clarke founded an engineering partnership in Gateshead, on the River Tyne in the North East of England, to act as a manufacturer and supplier of small hand winches to the shipbuilding industry. Clarke was astute in his choice of location and industry. Gateshead was located in a region with strong comparative advantages in terms of developed metals industries and related skilled labour forces (Lorenz, 1991, pp. 25–26; Slaven, 1980, p. 107). Moreover, it was ideally placed to serve the growing British metal shipbuilding industry which was concentrated largely on the River Clyde in Scotland and on the Rivers Tyne, Wear and Tees in the North East of England. During the research period, Britain was the world's leading shipbuilding nation and merchant tonnage built in Britain increased by 545% whilst Admiralty tonnage also increased significantly (Pollard & Robertson, 1979; pp. 250–253).

However, other radical developments were being carried through in British industry during this period. The late nineteenth - early twentieth century 'saw the lusty childhood, if not the birth, of electrical power and motors; organic chemistry…the internal combustion engine and automotive devices; precision manufacture…(the) cluster of innovations that have earned the name of the Second Industrial Revolution' (Landes, 2003, p. 235). Clarke Chapman was at the forefront of many of the technological developments of this era and in the manufacture and sale of the resultant products, whilst continuing to develop and diversify its original core business as an engineer of auxiliary equipment for the shipbuilding industry. From a small-scale start-up in1864, by 1914 Clarke Chapman had grown to employ 2262 people (DS/CC1/129/3), and had annual sales of over £512,000 and total fixed assets of c. £310,000 at book value (DS/CC1/77/3). However, Clarke Chapman did not experience constant, steady growth but rather a series of sharp downturns and rapid growth spurts within the overall growth trend (Table 1), the downturns being due largely to depressions within the shipbuilding industry and labour disputes in engineering and shipbuilding (DS/CC1/2/1).

Thus, in examining the relationship between management accounting and engineering in the processes underlying the management of growth in Clarke Chapman, the current paper pays due consideration to the impact of periodic fluctuations in demand.

Table 1
Clarke Chapman, growth and fluctuation statistics 1883–1914 (£000).

Year	Sales general	Sales electric	Total sales	Dept'l profit general	Dept'l profit electric	Dept'l total profit	Company net profit	Partners' capital	Ordinary share capital	Preference share capital	Fixed assets (Net)	Number of Employees
1883	n.a.	n.a.	195	n.a.	n.a.	n.a.	32	64	–	–	79	n.a
1884	n.a.	n.a.	185	n.a.	n.a.	n.a.	34	112	–	–	95	n.a
1885	n.a.	n.a.	82	n.a.	n.a.	n.a.	(2)	108	–	–	98	n.a
1886	n.a.	n.a.	86	n.a.	n.a.	n.a.	3	105	–	–	108	n.a
1887	n.a.	n.a.	99	n.a.	n.a.	n.a.	2	100	–	–	110	n.a
1888	n.a.	n.a.	106	n.a.	n.a.	n.a.	11	112	–	–	110	n.a
Gap in the archive data												
1893	179	28	207	15	(1)	14	0	–	90	50	132	n.a.
1894	160	24	184	15	1	16	0	–	90	50	131	1205
1895	184	29	213	15	4	19	0	–	90	55	133	1409
1896	211	65	276	11	13	24	0	–	90	63	138	1680
1897	157	55	212	5	7	12	(4)	–	92	64	144	1227
1898	232	75	307	24	6	30	2	–	92	65	148	1878
1899	248	84	332	32	10	42	13	–	92	65	149	1809
1900	247	87	334	25	10	35	6	–	92	65	178	1818
1901	270	111	381	32	12	44	16	–	123	66	182	1820
1902	277	127	404	22	16	38	13	–	125	66	206	2019
1903	254	126	380	18	14	32	5	–	125	66	223	1721
1904	234	95	329	21	8	29	2		125	66	226	1784
1905	300	139	439	35	18	53	20	–	125	69	229	2105
1906	361	102	463	33	5	38	4	–	125	69	247	2247
1907	334	98	432	25	5	30	0	–	127	69	248	2095
1908	200	87	287	5	5	10	(4)	–	127	70	251	2099
1909	258	97	355	18	5	23	(2)	–	127	70	249	1849
1910	249	61	310	15	(2)	13	(2)	–	127	70	252	1717
1911	366	70	436	26	(1)	25	2	–	127	70	255	n.a.
1912	387	92	479	39	7	46	25	–	127	70	251	n.a.
1913	403	87	490	57	8	65	45	–	153	70	249	2268
1914	427	85	512	55	8	63	45	–	153	70	247	2262

Source: Extracted from DS/CC1/74/1-2, DS/CC1/77/1-2-3, DS/CC1/129/3. Fixed Assets were revalued in 1900. Bonus Shares were issued in 1913.

3. Accountants, engineers and networks: actors and change agents

Although Clarke Chapman was founded by an engineer and was always permeated by engineering values, throughout its history considerable attention was also paid to building and maintaining a management accounting infrastructure and to building business networks. In order to understand this state of affairs, it is important to consider the role of individual ‘actors’ (Yamey, 1981, p. 131) and ‘change agents’ (Boyns & Edwards, 1996) in organisational and accounting change (Antonelli, Boyns, & Cerbioni, 2008, p. 76). Thus, brief information on some of Clarke Chapman's key figures is presented below.

William Clarke was educated in the North East of England and undertook his engineering apprenticeship with the noted Newcastle firm of Armstrong, Mitchell and Company. Clarke became a prominent Gateshead businessman but, as Boswell (1983, p. 237) has indicated, Victorian businessmen often had social as well as business motivations. Clarke was active in his social and philanthropic endeavours in Gateshead and was, variously, a Justice of the Peace, a town councillor, Organiser for the Volunteer Corps, Treasurer of the Children's Hospital, Supporter of the Northern Counties Institute for the Deaf, Methodist Church Treasurer and provider of reading rooms and science education for the local population (www.localhistorygateshead.com). From the inception of his firm in 1864 and his initial strategic choices of location and industry, William Clarke focused on the functions of engineering and technological development and production. In 1870 Clarke took a new partner, Joseph Gurney, a Quaker and a member of the Gurney banking family, who had strong links with Quaker financial institutions such as Friends Provident which eventually became a major debenture holder in Clarke Chapman (KIndleberger, 1987; *The Times*, 11 May, 1866, p. 11). Gurney took on the role of accounting and financial management in his partnership with Clarke (Openshaw, 1989, p. 3) whilst Clarke continued to focus on engineering and product development.

In 1874, Captain Abel Henry Chapman joined the firm to form the partnership of Clarke, Chapman and Gurney and the firm moved to a larger site in Gateshead (Manders, 1980, p. 73). Chapman was Gurney's nephew and was closely related, through both his mother and his father, to the Barclay banking family. Furthermore, both the Chapman and Gurney families were inter-married with prominent Quaker banking families in the North East of England (Durham University Special Collections). It is possible that Captain Chapman's introduction of capital provided or facilitated the input of funds required to finance this expansion, although no evidence can be offered to support this contention. On joining the engineering partnership, Captain Chapman worked alongside Gurney in the accounting and financial management functions until Gurney left the partnership in 1884 and Chapman took overall responsibility for these roles (DS/CC1/1; Openshaw, 1989, p. 3).

In 1884, Captain Chapman arranged for the purchase and conversion of a local manor house in order to accommodate the firm's accounting, clerical and management staff (Manders, 1980, p. 130). After Clarke's death in 1890, Captain Chapman instigated a series of changes in organisational structure and in accounting staff and systems, including, in 1893, the conversion of the firm from partnership to limited company status. In the draft prospectus for the limited company, Captain Chapman described himself as an ‘engineer’ (DS/CC1/11). This was an interesting choice of word because he was not a trained or professional engineer. He may have thought of himself as an engineer, as he was the head of an engineering company, or he may have used the term in order to inspire confidence amongst investors but his background lay far from engineering. Captain Chapman had served in the Bengal Cavalry between 1856 and 1874 but, rather unusually for an Army officer, his parents were Quakers. In fact, the Chapmans were a Quaker banking family and, moreover, Captain Chapman's mother was related to the Barclay and Gurney banking families (Phillips, 1894). Thus, Captain Chapman provided Clarke Chapman with further access to financial and administrative expertise to complement its existing strengths.

Captain Chapman's eldest son, Henry, an engineer who had served a premium engineering apprenticeship, was named as a Director of the newly formed limited company in 1893 along with J.B. Furneaux, another engineer who was appointed as Managing Director (DS/CC1/11). On his father's death in 1902, Henry Chapman succeeded to the role of Chairman of Clarke Chapman; later that year he instituted an extension and reorganisation of the firm's premises and facilities and, in the process, abolished the post of Managing Director. At this point J.B. Furneaux resigned from Clarke Chapman (DS/CC1/1/1) leaving Henry Chapman as the dominant figure. However, in 1908, Henry Chapman resigned due to ill health and was succeeded by Henry Walker, one of the firm's senior engineers, who developed the firm along the trajectory set by the Chapmans (Florence, 1953).

Although Clarke Chapman was an engineering firm, from its very early days the key figures of Joseph Gurney and Captain Chapman occupied important roles in accounting and financial management, giving these disciplines authority and status within the firm. Further specialist accounting staff members were developed by the firm. Robert Scope, originally employed by Gurney as office boy in 1864, was promoted to the position of Company Secretary of the newly formed limited company in 1893 and became a Company Director in 1901. William Taylor, who had been recruited as a clerk in the counting house in 1892, rose through the accounting ranks to become manager of the London office and, in 1901, he succeeded Robert Scope as Company Secretary (DS/CC1/1/1; Openshaw, 1989). Thus, Clarke Chapman had real strength in both accounting and engineering within the firm.

Moreover, Clarke Chapman had significant strength in industrial and financial networks outside of the firm. Networks based on personal relationships and trust underlay Clarke Chapman's core business in the shipbuilding and marine engineering industry (Boyce, 2003; McLean, 2013; Pollard & Robertson, 1979). At the very inception of his business, William Clarke engaged the Quaker solicitor Robert Spence Watson to act for him. Robert Spence Watson was an amazingly well-connected and active man, and Clarke Chapman derived great benefit from his vast banking, financial and industrial networks (Corder, 1914; DF.SPW; Newcastle University Special Collections; Watson, 1969).

On incorporation in 1893, members of the Chapman family held 80 per cent of the ordinary shares of the limited company (DS/CC1/31) and continued to be majority shareholders throughout the research period (DS/CC1/28/2). Whether the company was headed by an engineer or an accountant, Clarke Chapman adopted conservative policies in respect of dividends and Directors' salaries. The prospectus (DS/CC1/11) specifically limited the ordinary share dividend to a maximum of 5 per cent in each of the first five years and limited the salaries of the three Directors to a combined total of £3000 per annum for the same period. In fact, the firm followed conservative policies in respect of salaries and dividends throughout the research period. Directors' salaries were always modest by contemporary standards (McLean, 2013) and ordinary dividends were not paid in four of five years immediately following the incorporation of the firm. Thereafter, dividends were never more than c. 6 per cent of ordinary share capital and no dividends were paid in 1908, 1910 and 1912–14, despite 1912–14 being the most profitable years in the firm's history to date (DS/CC1/74/2).

It is apparent that the Chapman family and the firm's Directors took a long term view of the company and were not in the engineering business simply for short term financial gain, and so their strategic decisions and managerial controls must be assessed in light of this. Moreover, despite its incorporation as a limited company, Clarke Chapman remained a family owned firm which, in effect, was managed as a partnership by a small group of family members and long-serving managers. In this context, decision-making is often personal and informal: it is based on face-to-face discussions rather than formal information systems (Boyce, 2003).

Furthermore, contemporary engineering attitudes must be borne in mind when assessing the roles of Clarke Chapman's management accounting system in strategic decision making and managerial control. For example, Edwin L. Orde, Vice President of the North East Coast Institution of Engineers and Shipbuilders, and his fellow engineers were clearly appalled by the case of the Woolwich Arsenal, where in 1906 'clerical administrative labour' had amounted to 4 per cent of the total wages bill. Orde declared (Transactions, 1916, p. 51) that 'the elaboration of detail is only too apt to increase to a point where the cost of working the (management accounting) system becomes too high'. The managers of Clarke Chapman were well aware of the difficulty of covering the fixed costs of 'establishment charges' during economic downturns (DS/CC1/2/1) and it is probable that, like their contemporaries (McLean, 1996), they undertook implicit cost-benefit analyses of their management accounting system and were sparing in the authorisation of developments of it. Clarke Chapman's cautious attitude to management accounting development may be inferred from the tight restrictions it placed on increases in clerical labour. For example, between 1904 and 1914 sales increased from £329,000 to £512,000 (Table 1), an increase of 56 per cent, yet during this period the number of clerks remained static at 45 whilst junior clerks increased only by 7, from 19 to 26 (DS/CC1/129/3). In this environment, it is likely that there were strict controls on the extension of the management accounting system and it is unlikely that the firm would have borne the cost of producing information that was not useful.

In examining the development of Clarke Chapman's management accounting system, it may be noted that the research literature (Edwards, Hammersley, & Newell, 1990; Fleischman & Parker, 1992; McKendrick, 1970; McLean, 1995; 2013; Wells, 1977) indicates that technological change and pressure on selling prices in competitive markets during periods of falling demand are important factors in stimulating demand for change and development in management accounting systems. However, in the period 1864–1914, Clarke Chapman experienced both rapidly declining demand, e.g. the mid to late 1880s, 1902–1904 and 1907–1908, and rapidly increasing demand, e.g. 1897–1898 and 1911–1914 (see Table 1). Thus the relationship between these fluctuations in demand and management accounting development is an important factor for consideration in the current research.

4. Management accounting, engineering and strategic decisions

In the business strategy literature, much of the research on company growth is concerned with 'how much' companies grow rather than on 'how' they grow (McKelvie & Wiklund, 2010; pp. 261–262). Moreover, this literature tends to deal with relatively short time periods (e.g. Garnsey, Stam, & Heffernan, 2006; Mishina, Pollock, & Porac, 2004). However, as the economist Edith Penrose has noted (Penrose, 2009, p. 237) in this context, 'history matters' and, thus, it is useful to examine how companies grow over time. Using long time frames, business histories (e.g. Coleman, 1969; Payne, 1979; Reader, 1970) have examined the development of large-scale British companies and management accounting histories (e.g. Boyns & Edwards, 1997a) have explored issues related to accounting systems, organisational structure and management decision making in expanding British companies.

Up to 1914, Clarke Chapman's management accounting system was developed to include annual management accounts, analyses of trading results, a product costing system, monthly analyses of sales and orders by product group, comparative output tables, weekly reports of numbers employed, weekly returns of wages and output, weekly and monthly salaries analyses and profit forecast statements. Clarke Chapman's management accounting system was employed largely for management control purposes (see Section 5. below) but it produced information that fed into some areas of strategic decision making. The current section of this article presents an analysis of the strategic choices underlying Clarke Chapman's development and examines how management accounting and engineering were engaged in the firm's strategic decision making processes (McKelvie & Wiklund, 2010; pp. 261–262).

Operating within a generally expanding shipbuilding and marine engineering industry, by the 1870s William Clarke's firm had grown to employ 350 men in the manufacture of a growing range of shipbuilding components including steam winches, windlasses, capstans, pumps, deck and dockside cranes and boilers. Building upon its engineering expertise but diversifying its market sectors, the firm also began to design and produce locomotive boilers (Openshaw, 1989, p. 4). In 1874, Clarke was joined in partnership by Captain Abel Henry Chapman. In the 1880s, advised and aided by their solicitor, Robert Spence Watson, Clarke and Chapman took two crucial, inter-linked strategies that were to shape the future of their firm through to 1914 (Corder, 1914; DF.SPW; Watson, 1969).

First, the partners refrained from involvement in the forward or backward integration of the late nineteenth century 'amalgamation movement' (Pollard & Robertson, 1979, p. 96) whereby shipbuilders sought to capture markets and component suppliers and, in turn, component suppliers sought to secure their shipbuilding markets. In developing this strategy, Clarke and Chapman were aided both by their general awareness of the market environment of shipbuilding and engineering and by their annual management accounts (DS/CC1/74/1), which presented them with a very clear view of the fluctuations in demand within this market and the potentially disastrous financial consequences of continuing dependence upon their traditional, core technologies and products.

However, in a major strategic development of the 1880s, Clarke and Chapman tapped into and acted upon Spence Watson's knowledge and networks and chose to diversify into electrical engineering. Spence Watson was the brother-in-law of J.T. Merz, a leading electrical engineer and entrepreneur and, furthermore, through his contacts with Lord Armstrong, the armaments, engineering and shipbuilding magnate, he had encountered the brilliant young electrical engineer, Charles A. Parsons (Corder, 1914; DF.SPW; Watson, 1969). Spence Watson helped to make Clarke and Chapman aware of the boom in demand for electric lighting systems (Shiman, 1993) and in 1884 he facilitated the entry of Parsons into the partnership as Chief Electrical Engineer in their newly established Electric Works (Scaife, 2000, p. 150). Parsons focused on the development and manufacture of electric lighting systems and turbine generators for both marine and land-based markets (Scaife, 2000; pp. 177 and 190). Historic management accounting information formed a backcloth to these strategic decisions to diversify Clarke Chapman's technologies, products and markets but, crucially, the decisions were informed by networks and informal assessments of market potential.

In 1889, Parsons proposed that the firm should move into the production of larger turbines designed for use in land-based power stations. However, Clarke and Chapman approached these proposals with caution. They knew that Clarke Chapman was Gateshead's 'only large engineering firm to survive the trade depression of…the 1880s' (Manders, 1980, p. 73). Furthermore, their annual management accounts (DS/CC1/74/1) provided clear evidence of their firm's lack of resources for expansion. Based on their experience and assessments together with the management accounting evidence, Clarke and Chapman took the strategic decision to reject Parsons' proposals and he left the partnership. This decision had significant strategic implications for the firm. Without Parsons, Clarke Chapman was unable to exploit the increase in demand from private firms for power generation turbines that resulted from the 1888 amendment to the Electric Lighting Act of 1882; this amendment had lengthened firms' tenure of central power stations from 21 to 42 years, thus making capital investment conditions more favourable (Hughes, 1962). In this instance, the strategic caution of Clarke and Chapman caused the firm to miss the opportunity to participate in new and dynamic technologies and markets: the operation of the Electric Works depended upon Parsons' personal expertise and, on his departure, it was closed down.

After Clarke's death in 1890, Captain Chapman instituted major changes in both the administrative and technical management of the firm in order to build a firm capable of surviving and prospering in the Second Industrial Revolution (Landes, 2003, p. 235). This was a period of rapid development in world trading patterns, shipyard equipment and in ship design, technology and auxiliary equipment (Pollard & Robertson, 1979). The Suez Canal had opened in 1864, expanding trade with the Far East and, from the 1880s particularly, the meat trade with Australia and New Zealand and the fruit trade with tropical regions. The 1880s saw the installation of electric lighting and some electrically driven machinery in shipyards and by 1902 factory inspectors reported that 'electric power was general in all up-to-date shipyards' (Pollard & Robertson, 1979, p. 121). Bigger ships were constructed in a growing variety of designs, increasing the size and range of auxiliary equipment required; refrigeration equipment was required for ships in the meat and fruit trades. Furthermore, the arms race with Germany began c.1900 and when John Fisher was appointed First Lord of the Admiralty in 1904 the process of naval reform and warship construction began in earnest.

Seeking protection from the impact of economic recession and market fluctuations which had caused widespread bankruptcies in the shipbuilding and engineering industries in the 1880s (Manders, 1980; Pollard & Robertson, 1979) and aware of the rapid changes in the business environment and his core and other markets, in 1893 Captain Chapman led the conversion of the partnership into a limited company. The draft prospectus declared that 'The Firm are manufacturers of Steam Auxiliary Machinery for Steamships – such as Windlasses, Capstans, Cargo Winches, Cranes, Standing Gear, Feed and Ballast Pumps, Donkey Boilers…and for such articles we occupy first position in the kingdom' (DS/CC1/11). Captain Chapman was appointed Chairman of the new company; J.B. Furneaux, an engineer, became Managing Director and Henry R. Chapman, Captain Chapman's eldest son, was appointed as a Director. Furthermore, Captain Chapman extended and developed the firm's strategy of recruiting talented engineering staff able to make important contributions to its knowledge base with a view to bringing new products to market. Woodeson (1890), Butler (1891), Horne (1893) and Walker (1894) were prominent amongst the staff brought into Clarke Chapman in order to enhance and develop the firm's capabilities and product ranges in mechanical and electrical engineering. Building on Clarke Chapman's established knowledge base, and with varying degrees of commercial success, each of these men developed many products for which they took out joint worldwide patents with the company and received royalties on production (DS/CC1/1/1; Openshaw, 1989).

During the brief operations of the Electric Works under Parsons, the firm's management accounts (DS/CC1/74/1) had made Chapman aware of the profitability of this technology and he had had ample time to make informal assessments of its potential. On these bases, in 1892 Chapman took the strategic decision to re-open the Electric Works and begin the manufacture and installation of both marine and land-based lighting and power-generation systems; land-based work was carried out in both industrial and domestic premises. Other developments of new technology were, of necessity, based on the firm's engineering ethos and its market awareness rather than formal management accounting analysis. Clarke Chapman began to manufacture searchlights employing patented mirrors and lenses and, by 1898, was added to the Admiralty and War Office lists of approved suppliers (DS/CC1/2/1). In a further strategic move, a later recruit, Robert Harris, developed technologies and products in the fields of electrical resistance, electrical control gear, solenoids and electro magnets. Furthermore, another new recruit, John Robson, was employed to design and construct apparatus for use in vaporising ammonia. Robson's work was successful and, under worldwide patent, was employed in applications for ship refrigeration equipment in the long-haul meat and fruit trades (DS/CC1/1/1).

Thus, engineering ethos and market awareness rather than historic, internally-orientated management accounting provided the basis for strategic decisions to move into new technologies and products. However, Clarke Chapman did employ its management accounting system to check on the success or failure of its various ventures and to make strategic decisions as to whether to continue or discontinue them. This may be illustrated by examining strategic decisions relating to engines developed by William Butler, who had been recruited by Chapman in 1891. Before joining Clarke Chapman, in 1888 Butler had developed the first British velocycle, or motor car. Clarke Chapman recruited Butler to strengthen its capabilities in the building of oil and gas engines to power machinery and electric lighting. The management accounting system (DS/CC1/1/1) revealed that by 1897 the firm had invested £8000 in the development of Butler's engines and J. B. Furneaux noted (DS/CC1/2/1) that '…one of the earliest babes of the Company…the Motor Car Engine has brought us a certain return (on) our outlay…and will more than cover all our Experimental Expenses beside leaving us in full possession of the patents of Oil, Gas and Launch Engines.' By 1898, the Directors were expressing reservations about this work but, when efforts to sell the patents failed, they decided to invest a further £500 in development. In 1900, the outcome of all of this investment was described as the best engine on the market because of its 'silent working, quick starting and absolute control of the speed for driving electric dynamos where steadiness of action is of paramount importance', and the company viewed the patent as 'a most valuable asset' and expected to generate 'large returns from it' (DS/CC1/74/1). However, there were technical problems with the design of Butler's engines and production was discontinued in 1902, although Clarke Chapman continued to employ Butler to develop patented gas engines and pumps. In a further example of the use of management accounting information in strategic continue/dis-continue decisions, in 1907 Harry Chapman stated (DS/CC1/2/1) that '(regarding) our Water Tube Boiler…we are fully in hopes of obtaining a good return from it though it has been an expensive business so far.' Thus, Clarke Chapman's business strategy often involved the risk and uncertainty of working at the cutting edge of technological development and, in this context, the firm's Directors used management accounting information in making strategic continue/dis-continue decisions.

As indicated above in relation to the refusal to accept Parsons' plans to produce large turbines, there was an element of caution in Clarke Chapman's strategic decision making. There was good reason for this caution: the firm was a rare Gateshead survivor of the economic depression of the 1880s (Manders, 1980, p. 73) and its annual management accounts (DS/CC1/74/1) presented a clear picture of the impact of this depression on the firm's financial performance and financial position. Nevertheless, Penrose (2009, p. 56) has argued that enterprise includes 'the willingness to search for ways of avoiding risk and still expand.' Clarke Chapman took several interlinked decisions which enabled expansion whilst limiting fixed costs, risk and uncertainty. First, the firm centralised all production at its Gateshead factory rather than setting up further manufacturing facilities at home and overseas. Second, from 1894 onwards, rather than employing sales staff directly, the firm established networks of sales agents throughout the United Kingdom and on a world-wide basis (DS/CC1/1/1; DS.HL/5/2/13). Third, Clarke Chapman generated further growth in world-wide sales by granting licences to overseas firms to manufacture its patented products (DS/CC1/1/1). Fourth, the firm began to act as agent for products which other firms had developed and patented and, also, Clarke Chapman manufactured patented products under licence from firms such as the Peterson Water Tube Boiler Company and Westinghouse Electric (DS/CC1/1/1). Although the management accounting system was not employed to present explicit analyses for any of these strategic decisions, it may be inferred that it underlay them all. In face-to-face discussions (Boyce, 2003) regarding these decisions, it is apparent that the Directors of Clarke Chapman acknowledged and acted upon the general experience of the shipbuilding and marine engineering industry that it was necessary to limit fixed costs and build flexibility into organisational and business structures (McLean, 1996, 2006).

The above analyses indicate that, over an extended period of time, Clarke Chapman made a series of very complex and highly important strategic decisions that were integral to the firm's management of growth. Historic information derived from the management accounting system provided a backcloth to these decisions and was used explicitly in continue/discontinue decisions. There is a long history of the use of management accounting information in strategic decision making in British industry, for example, from firms of the first Industrial Revolution (Fleischman & Parker, 1991), through to the Dowlais Iron Company (Boyns & Edwards, 1997a) and the Consett Iron Company (Boyns & Edwards, 1995) in the mid-nineteenth century. However, management accounting information was not always a significant factor in strategic decision making (McKinstry, 1999, p. 209). In his analysis of strategic decision making in a Tyneside shipbuilding and engineering firm between 1886 and 1914, McLean (2006, pp. 116–118) states that 'although financial information was introduced into strategic decision making processes, it could be outweighed by non-financial considerations' such as 'personality and influence, together with the weight of history, tradition and loyalty, underlain by the hope that "something would turn up sooner or later"'. Furthermore, in his consideration of Albion Motors, 1900 – c. 1970, McKinstry (1999, p. 209) notes:

> It is clear that the founder-directors saw the business as primarily an engineering undertaking where engineering knowledge and a 'scientific' approach to problem solving represented the path to prosperity…Consistent with this interpretation is the fact that the board minutes are devoid of any thoroughgoing or abstract review of strategy, which simply evolved as a result of decisions concerning the introduction or withdrawal of models (of truck) for particular markets in the face of generally buoyant demand.

Although Clarke Chapman possessed management accounting and business expertise as well as technical engineering capabilities, and employed this expertise in specific continuation/discontinuation decisions, its archive is also entirely devoid of 'abstract' strategic analysis, accounting or otherwise. The only available evidence containing a note of general strategic intent is a statement made by Henry Chapman in 1902: he indicated the element of caution that underlay the firm's strategic decisions by noting that efforts to 'increase our connection more particularly in Land Work (rather than Marine Work)…will save us putting our eggs all in one basket' (DS/CC1/2/1). The current research argues that in Clarke Chapman, as in Albion Motors (McKinstry, 1999), the fundamental organisational culture was derived from the firm's founder (Brown, 1995, p. 19) and, essentially, the firm's strategic decisions to move into new technologies were expressions of its engineering-based organisational culture as informed by market awareness and networks rather than formal management accounting analyses.

In examining the relationship between the engineering-based organisational culture and strategic decision-making in Clarke Chapman, it is useful to note the view of Penrose (2009, pp. 37–38) who differentiates between the 'objective' productive opportunities that a firm is able to pursue with the resources at its disposal and the 'subjective' productive opportunities that it thinks it can pursue based on the entrepreneur's knowledge and perception of the world. In essence, this view maintains that the firm's strategic decisions are grounded in its 'capability to build up images, not on its ability to process information' (Ravix, 2002, p. 170). The current research argues that these insights of Penrose and Ravix enable further understanding of Clarke Chapman's strategic philosophy as reflected in Harry Chapman's statement in 1907 that '(we) are looking forward for the future, not only keeping up to date but even going beyond present knowledge' (DS/CC1/2/1). Buoyed by generally increasing demand from the shipbuilding industry and the growth generated by the developments of the Second Industrial Revolution, Clarke Chapman was able to proceed with a broad but implicit growth strategy and a strategic decision making process based on an 'image' or vision of technological development grounded in its engineering culture. In this sense, management accounting information played no explicit, formal part in the analysis or development of Clarke Chapman's strategy and strategic decision making with regard to new technologies and organisational structures. Thus, the current research finds that Clarke Chapman's management accounting system did not change abruptly because of, or in response to, these technological and organisational changes but evolved gradually over time. Moreover, the current research indicates that there was no conflict between engineers and accountants in respect of this. It is probable that the financial expertise available in the firm, backed by routine management accounting information, was significant in the face-to-face discussions (Boyce, 2003) between engineers and accountants where these strategic decisions were made and in forming the cautionary element that underlay them. Furthermore, management accounting information was used explicitly in strategic continue/discontinue decisions.

5. Management accounting, engineering and managerial control

This section examines how management accounting and engineering were employed in the managerial control of Clarke Chapman. This examination is undertaken in the context of a statement made in early 1896 by J.B. Furneaux, the Managing Director:

> The year before us is full of promise & in order to (obtain the) best results both those inside the Works and our representatives outside must unitedly combine to make the most of the present. The time has come when every effort must be made to book orders at improved prices, and whilst cultivating our connections the aim of all in the Works should be to (1) adhere to promised dates for deliveries (2) reduce costs (3) prevent waste (4) improve and advance the soundness of our works and maintain the good reputation of the products of the company (DS/CC1/2/1).

The current authors consider the above statement to be a good representation of Clarke Chapman's approach to management throughout the research period, dealing with the implications of both the market and the engineering-based manufacturing function. The following sections examine Clarke Chapman's annual management accounts and the roles of routine and ad hoc management accounting in the firm's managerial control of its market and manufacturing operations.

5.1. Annual management accounts

The earliest partnership profit and loss accounts and balance sheets available in the archive are those covering the period 1883–1888 (DS/CC1/74/1). A six month accounting period was employed in 1883 and 1884 before settling down to an annual basis, this particular archive series coming to an end in 1888. These are significant dates, representing Charles Parsons' entry into the partnership and exit from it. The accounts appear fully formed in 1883 and are probably based on the system of the pre-Parsons partnership, simply amended to include Parsons. The balance sheets indicate that Captain Chapman and William Clarke were the senior figures in the new partnership. In 1884, for example, respective capital balances were: Captain Chapman, £52,000; William Clarke, £46,000; and Charles Parsons, £14,000 (DS/CC1/74/1).

There is no extant subsidiary accounting document or statement of accounting policy on which to base a technical consideration of the partnership accounting system (DS/CC1/74/1). Thus, for example, policies and practices relating to the calculation of cost of goods sold, research and development costs, depreciation and profit on work in progress cannot be ascertained. The profit and loss account measured the overall profit performance of the firm and the profit measurement system was formed around the firm's organisation structure: within the company profit and loss account, elements of profit were attributed to manufacturing departments, such as the metal foundry, brass foundry, copper shop and forge, before company sales and general costs were considered. This indicates that Clarke Chapman used a transfer pricing system, as did firms in the contemporary coal, iron and steel (Boyns & Edwards, 1997b), and engineering and shipbuilding industries (McLean, 2006; Transactions, 1899).

Annual financial reports (DS/CC1/26) were published after the formation of the limited company in 1893. These published reports were limited to a short summary of the application and appropriation of company profit and were extracted from the internal annual accounts (DS/CC1/74/2). Profit and other data reported externally and internally were consistent in agreement in each year of the research period. The current researchers consider that the internal annual accounts were more than simply the basis for external financial reporting but were, in effect, constructed as management accounts. These management accounts were the development and extension of the partnership accounts produced previously and portrayed a significant amount of information on the functioning of the firm.

The construction and format of the management profit and loss account was developed in response to the change in organisational structure on the re-opening of the Electric Department in 1902. The company profit and loss account (DS/CC1/74/2) indicates that separate profit and loss accounts were prepared for the Electric Works and the General Works although, unfortunately, these do not survive in the archive. Profits from these two Works were transferred to the company profit and loss account where company expenses and dividends were deducted. Between 1893 and 1901, product development expenses and Electric Works development expenses were capitalised and subsequently written off, although the archives do not contain any explanation of this policy. In the period up to 1914, depreciation was not provided routinely each year and the Directors did not feel the need to apply consistent depreciation rates or to take heed of adverse comments from the auditors. For example, in 1910, Mr H. Walker, then Managing Director, noted (DS/CC1/2/1) that

> …the Auditors Report…points out that we did not provide depreciation in 1908 and for this year only 3% off Plant and 2.5% off Buildings (but) in our opinion the amount already depreciated in previous years amply justifies us in the amount we have depreciated this year.

Furthermore, Robert Scope, the Company Secretary, emphasised (DS/CC1/2/1) that the company's depreciation policy was based on its desire to build a 'solid' balance sheet,

> (regarding) depreciation…Since the year 1900 we have written £61,360 off Plant and £16,990 off Buildings making a total of £78,350, the average percentage off old plant since 1900 being 5.53. I have not worked out the average on old buildings but the total since 1900 is 22.5%. The old plant stood in 1900 at £88,000 (and) we have added since the £109,000 making £197,000 but only stands in the Books at £136,000 and… (the) Directors have been endeavouring to make the assets as solid as possible.

In 1912, fixed assets were re-valued and Clarke Chapman decided not to provide depreciation, being supported by the auditors in that decision (DS/CC1/2/1).

Although both the partnership and limited company annual accounts provided much potentially relevant management information, there is no archival evidence of their direct use in the management of Clarke Chapman. However, these accounts did serve as a database for the production of other routine and ad hoc management accounting reports.

5.2. Management accounting and the market

The current research argues that Clarke Chapman sought to deal with its market environments in three ways. First, in reacting to downturns in sales by undertaking fundamental re-organisations of the sales function. Second, by exercising direct, personal control where appropriate. Third, by developing and employing market-related information.

In 1893, Clarke Chapman opened a London office in order to provide the company with a base close to the centres of national power, especially the Admiralty (DS/CC1/1/1). Subsequently, branch offices were established in London, Glasgow, Manchester, Cardiff and Sheffield. Beginning in a sales downturn in 1894 (Table 1), a national network of sales agents was developed, agents being appointed in South Wales, Liverpool, Argyleshire and the Western Isles, Northumberland, Edinburgh, Lancashire, Cheshire, Portsmouth, Southampton, the Isle of Wight, Sunderland, Hartlepool, Barrow-in-Furness, Birmingham, Hull, Dublin and Belfast (DS.HL/5/2/13). An international network of sales agents was established in 1894. Ultimately, the firm had overseas sales agents in Antwerp, Bergen, Buenos Aires, Christiana, Constantinople, Copenhagen, Gothenburg, Helsinki, Heraklion, Johannesburg, Melbourne, Nantes, Odessa, St. Petersburg, Stockholm, Sydney, Trieste and in areas of Canada, Greece, Egypt and the Sudan, New Zealand, and, in the East, India, Burma, China, including Hong Kong and Manchuria, Korea and Japan (DS/CC1/1/1; DS.HL/5/2/13). Furthermore, in response to a depression in the shipbuilding industry and a drop in their own sales (Table 1), in November 1903 the Directors of Clarke Chapman held a meeting with their United Kingdom sales agents and it was agreed that these agents would focus on the marine market and the company would focus on the land-work market. Moreover, Clarke Chapman appointed a 'thoroughly practical engineer' (DS/CC1/1/1) as a national land-sales representative. Thus, it may be seen that Clarke Chapman instigated significant organisational change in order to deal with adverse market conditions.

Some new routine management accounting reports were produced in response to these changes. For example, reports were produced to monitor sales and orders by product group (DS/CC1/7/1/2/3). Alongside these new reports, the product costing system and the annual management accounts (DS/CC1/74/2; DS/CC1/77/1/2/3) were employed to scrutinise selling prices and sales values, costs and profit margins. Furthermore, ad hoc management accounting reports were produced to examine particular issues. For example, a report covering the period 1901–1910 analysed the performance of a particular agent, detailing the sales that he generated and the salary, commission and general expenses that he incurred (DS/CC1/199(4)). However, all in all, there is an apparent paucity of management accounting information given the extent and complexity of Clarke Chapman's sales organisation and product lines. It is apparent that once the company had set in place what it felt was the appropriate organisational structure, then it exercised direct and personal control where appropriate and carried out only a limited amount of routine and ad hoc management accounting to supplement these structural and direct control mechanisms. There is no evidence at all of any of Clarke Chapman's managers, engineers or accountants expressing any dissatisfaction with these managerial control arrangements or of them developing their own personal, informal systems as their contemporaries did in other Tyneside firms (McLean, 2013).

As noted above, the Clarke Chapman collection (DS/CC1/2/1) does indicate that a product costing system under-pinned the annual management accounts and provided information for managers. Unfortunately, this system has not survived in the archive and, therefore, it is not possible to trace its technical development. Nevertheless, in all of the surviving, voluminous managerial archive covering the period up to 1914, there is no evidence of any dis-satisfaction with the product costing system, no calls for change or development in it and no evidence of 'fighting for turf' (Boyns & Edwards, 2007, p. 980) over it between accountants and engineers. Although Clarke Chapman's product costing system is not available for examination, a contemporary writer, himself an accountant and Company Secretary and General Manager of a shipbuilding and engineering company, has provided some useful insights into the design and use of such systems, noting (Burton, 1900, pp. 1–2) that

> Well-organised engineering firms in the present day keep elaborate accounts of the cost of all work they perform, and these, when framed on a correct basis and carefully worked out, form the most reliable data for future tenders; indeed, one of the principal services to which they can be applied is this of future estimating…Of course, our readers will understand that we do not refer to (the pricing of) standard types of machines, such as are described and priced in the catalogues of firms. The convenience of fixed prices for such articles as can be manufactured and delivered from stock, or can be proceeded with in anticipation of orders, is so great commercially as to outweigh any advantages to be obtained by individual estimating and tendering. These prices must indeed be from time to time revised, but the revision should be based on an average of actually obtained costs of manufacture, combined with considerations on the course of the market and competition.

The research literature indicates that the need to set selling prices in competitive markets drove firms to make improvements in cost information (e.g. McKendrick, 1970; McLean, 1995; 2013), but there is no documentary evidence of any such impact on costing systems in Clarke Chapman. This firm undertook one-off contract work and also manufactured a huge variety and volume of standard catalogue products for stock. Thus, as Burton (1900) indicates, Clarke Chapman had to undertake both tendering for contracts and the setting and review of catalogue prices in competitive markets. Although no direct calculations of tenders or catalogue prices survive in the firm's archive, it is apparent that Clarke Chapman's managers were alert to changing market conditions and that their product prices and profit margins were very sensitive to such changes. The Directors' commentaries on market conditions, prices, costs and profit margins were presented in all of the surviving company annual reports, for example:

- (in 1903) a heavy fall in prices took place owing to keen competition to secure the orders which were felt to be decreasing. Orders have to be booked in many cases at and below cost…New shipbuilding orders are now very scarce, when in the market a great effort is made by all to secure the work at such prices as can be obtained (DS/CC1/26/3).
- (in 1905) the Directors have to report that the Works are well supplied with orders, the prospects for the year seem encouraging, and although the costs for labour and material are considerably increased this year, efforts are being made to cover these as fully as possible (DS/CC1/26/1).
- (in 1906) The very sharp rise in prices of material has largely increased the cost of production, but care is being taken, as far as possible, to obtain corresponding increases in prices for orders booked during the year (DS/CC1/26/2).
- (in 1911) the present year has opened much more hopefully, the orders in hand are greater than a year ago, the enquiries are more numerous, and it will be the aim of your Directors to take the fullest advantage of the improved conditions (DS/CC1/26/4).
- (in 1911) the output for 1911 was the largest on record, but the prices obtained were exceedingly bare…Prices are improving and (we have) a large volume of orders on hand (DS/CC1/26/5).
- (in 1912) the volume of work done…exceeded that of any previous year, the prices also improved, and in consequence the results are more satisfactory (DS/CC1/26/6).

Thus, the surviving annual reports, spanning 1903–1912, indicate that Clarke Chapman operated in a highly competitive environment in which prices were sensitive to changing market conditions. Whilst the firm monitored costs, the tasks of tendering and pricing in competitive markets did not lead to any pressure for the change and development of the firm's product costing system.

5.3. Management accounting and manufacturing

In this section of the article, the current authors examine the implication of management accounting and engineering in Clarke Chapman's development of managerial control in its manufacturing function. The firm's management control was based on three linked elements. First, the analysis and re-organisation of the manufacturing function and manufacturing methods. Second, the use of direct personal controls. Third, the employment of management accounting information.

Although the archive (DS/CC) does not contain a detailed description of the organisation of Clarke Chapman's manufacturing function, Shaw (1911, p. 104) presents a contemporary insight into it,

> Messrs Clarke, Chapman & Co., Ltd., are a firm who have attained a world-wide celebrity, their productions being met with wherever examples of British engineering are found. This eminent firm originated in 1864, and has prospered in an almost unparalleled degree, being now one of the greatest establishments of its kind in the kingdom.
>
> The works cover 14 acres of land, and employ 2500 to 3000 men. They represent a striking example of elaborate and systematic organization and have been planned in a manner best conducive to convenience and expedition of manufacture. The works adjoin the South Shields branch of the North Eastern Railway, and are amply fed by sidings… All buildings are spacious and well lighted, and the large offices are an eloquent illustration of the firm's extensive commercial routine.
>
> Each department is replete with machinery exemplifying the latest developments of mechanical engineering science as applied to their specialities. The motive power throughout is electricity, and the buildings are illuminated by the same power. It is no exaggeration to say that a more complete and modern plant for the various processes of manufacture is not to be met within the kingdom.

Thus, it is apparent that Clarke Chapman grew to become a large, complex engineering firm at the forefront of technological and organisational development. Clarke Chapman undertook its most significant reorganisation of manufacturing during the downturn of 1904 when sales were 86% of 1903 levels and 81% of 1902 levels (Table 1). A General Works Manager was appointed at the head of a team of five managers in the General Department, four in the Electrical Department and one in the Metal Foundry (DS/CC1/145/1). Henry Chapman noted (DS/CC1/2/1) that

> in the earlier months (of 1904) work was very scarce, and throughout the prices ruling were very low. One advantage resulting from this depression is that we took the opportunity of looking carefully into the cost of production and we have been able to reduce this materially by the introduction of new machine tools, high speed steel and cheaper methods…and (the linking of) one department more effectively to another particularly in the utilization of machinery.

Thus Clarke Chapman's use of cost information lay at the heart of the fundamental re-organisation of its manufacturing system. It is apparent that the product costing system was judged to be fit for purpose and that there was no need to change or develop it to provide useful information for managers. However, the centrality of direct, personal management was also evidenced in this re-organisation. Henry Chapman commented (DS/CC1/2/1) that with one General Works Manager, there was 'one Manager to whom the Directors can go for all information about any part of the Works.'

A further aspect of the 1904 re-organisation was the introduction of an incentive scheme for foremen. Henry Chapman observed (DS/CC1/1/1) that

> The question of paying a bonus to the various foremen having engaged our attention for some time with a view to reducing the percentage of labour (cost) to output, and stimulating them to use their best endeavours to this end…It is hereby decided to introduce the system – subject to discontinuance at any time at our discretion if found not to produce the desired results – by a bonus of 20% of the savings in the reduction on the percentage of labour (cost) to total (sales value of) output, taking the labour cost generally over the first six months of this year and the (total output)…as may be found most convenient to establish a basis. Such percentage established being subject to fluctuations in the selling price of goods and general advances and reductions in wages – the bonus to be paid in February of each year and after results are ascertained.

Thus management accounting information was at the core of this incentive scheme. As this information was already produced for other purposes the incentive scheme could be introduced and operated at the minimal extra clerical cost of a 'weekly return of wages to output' (DS/CC1/201) instituted in 1904. There is no evidence that the foremen themselves used a management accounting system in the control and reduction of labour costs and it is probable that, in common with other British firms (Boyns & Edwards, 1997a, p. 43) they relied on direct, personal supervision. However, from 1884, Clarke Chapman's managers also had access to the 'weekly numbers of workmen analysed by department and trade' (DS/CC1/129/1 - 12), a simple but potentially useful control mechanism.

Similarly, Clarke Chapman's product costing information relating to materials and labour was employed in the context of careful scrutiny and direct controls. For example, the firm placed forward contracts 'at most favourable prices' for the purchase of materials and negotiated reductions in freight costs with the North Eastern Railway Company and reductions in business rates with Gateshead Council (DS/CC1/2/1). From 1884, Clarke Chapman developed its routine management accounting reporting for manufacturing by preparing comparative tables of output (DS/CC1/199). Furthermore, from 1901, this routine system was extended to include the preparation of 'weekly salaries analyses' (DS/CC1/140/1-2) and 'monthly salaries analyses' (DS/CC1/145/1), offering the potential to scrutinise and control this particular overhead cost. Ad hoc management accounting reports were prepared to examine the financial implications of particular issues such as strikes (DS/CC1/59). In a further extension to the management accounting system, from 1912 the firm prepared 'forecast statements of sales, output, costs and profit' (DS/CC1/204).

Thus, in developing managerial control of its manufacturing function, Clarke Chapman responded to economic downturn by undertaking significant reorganisations of its management structure, production system, and information management process. The current research finds that routine and ad hoc management accounting information for planning and control was developed in an evolutionary manner whilst the firm continued to exercise direct and personal business controls. Furthermore, the current research finds that there is no evidence that engineers or managers ever expressed any dissatisfaction with the management accounting system or fought for the control of it.

6. Conclusions

Clarke Chapman benefited from being enmeshed in various networks: links with the Quaker financial and banking community helped to provide financial stability for the firm; Robert Spence Watson, the firm's solicitor, enabled diversification into electricity; and networks built upon personal relationships and trust were fundamental to success in the shipbuilding and marine engineering industry.

The narrative and analysis of the current research indicates that Clarke Chapman operated on an engineering ethos and that engineers were at the heart of the business. However, it is clear that Joseph Gurney, Captain Abel Henry Chapman, Robert Scope and William Taylor provided continuity of accounting leadership and acted as a counter-balance to engineering. Clarke Chapman's strategic decision making was framed by its engineering values and the long-term view taken by its owners and managers. Diversification into new technologies was based on the firm's engineering ethos, market awareness and network inputs. In this context, management accounting information was not developed for explicit strategic decision making but information from the routine management accounting system was available for use in face-to-face strategic discussions which were tempered by financial caution. However, management accounting information was used explicitly in strategic continue/dis-continue decisions. Furthermore, although Clarke Chapman employed a direct, personal approach to management control, including the control of labour, it did so in conjunction with routine and ad hoc management accounting reports developed to aid this process.

In examining the impact of the fluctuations in demand from Clarke Chapman's markets on the development of the firm's management accounting system, the current research found that severe downturns in demand led the firm to undertake significant re-organisations of its sales and manufacturing functions, with the management and scrutiny of costs being important elements underlying these re-organisations. However, rapid upturns in the market did not lead to any discernible impact on any of the firm's management systems. Neither periods of rapidly rising or rapidly falling demand caused engineers or accountants to question and change Clarke Chapman's management accounting system to any significant extent. Based on the available archive evidence, the current research concludes that Clarke Chapman's management accounting system developed in a gradual, evolutionary manner in line with the overall growth trend of the firm rather than as a response to fluctuations in demand and organisational shock.

The Clarke Chapman archive contains no evidence of its engineers' use of engineering alternatives to accounting as noted in other firms of the period (McKinstry, 1999; McLean, 2013; McLean & Tyson, 2006). Furthermore, there is no evidence to support the finding of Hopper et al. (1986) that engineers and engineering culture undermined the operation and use of management accounting systems. The current research finds that the firm's management accounting system was designed and operated by accountants and provides support for the view (McLean, 2013) that, in some companies at least, there was no 'fighting for turf' (Boyns & Edwards, 2007, p. 994) between engineers and accountants over the development and ownership of management accounting systems. In Clarke Chapman, each of these professional groupings was content with the company's management accounting system and with their separate, distinct but complementary roles in the management of the firm's growth. It is apparent, then, that engineering and accounting are not necessarily uncongenial partners when each has strong leadership at a senior management level and the disciplines have clearly defined spheres of influence. Given that this finding contradicts much of the recent research literature, it is recommended that future research should investigate the roles of the engineering and accounting professions in the development of management accounting in particular organisational contexts. It is suggested that a key observation of the current research is that accounting was represented at the most senior levels of Clarke Chapman management. Although the firm had an engineering ethos and culture this did not exclude or dominate accounting and, thus, engineering and accounting were relatively equal partners in the management and growth of the firm. Future research should pay particular attention to this balance of organisational power and authority between engineering and accounting. Such research has the potential to contribute not only to our knowledge of the development of management accounting but also to contribute to the literature on the roles of management accounting in British economic growth and decline (McKinstry, 1999).

The current researchers also suggest that valuable contributions to our understanding of management accounting may be made by further studies which examine the impact of company growth and fluctuations in demand on management accounting systems. Furthermore, the impact of business networks on the development of management accounting offers much scope for further research.

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