Why did new strategies *not* come? The aging of an industrial enterprise A. F. Craig & Co. Ltd., c.1950-c.1970

Running title: Why did new strategies *not* come?

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Abstract

A. F. Craig & Co. Ltd. (1868-1982) in the British heavy engineering industry received world-wide recognition in manufacturing oil refinery equipment, textile machinery, and sugar machinery. The firm survived several economic recessions. Its financial performance peaked in the two World Wars. However, the period c.1950-c.1970 witnessed the firm's decline. I developed the theoretical lens of four forms of organizational inertia to understand why new strategies did not emerge to save the firm's destiny in its last decades. The four forms of inertia are strategic, economic, managerial, and social inertia, offering insights to the literature on organizational inertia and firm longevity. Studying the last decades of the once successful industrial enterprise, I realized that firm longevity could be a moving trade-off of various inertial forces of the firm.

Keywords

Organizational inertia, firm longevity, business history, A. F. Craig & Co. Ltd., industrial enterprise

INTRODUCTION

The aging of a firm affects its longevity. Firm longevity is a proxy for success in terms of survival (Napolitano, Marino, & Ojala, 2015; van Driel, Volberda, Eikelboom, & Kamerbeek, 2015). It relates to various types of firm performance, e.g., growth (Capasso, Gallucci, & Rossi, 2015; Davidsson, 1991), financial outcomes (Capasso et al., 2015; Hopenhayn, 1992), and innovation output (Balasubramanian & Lee, 2008; Sorensen & Stuart, 2000). Understanding the aging of a firm can improve firm longevity and performance. The process of aging in a firm is underexposed in the literature.

To achieve longevity, firms need strategic changes, which do not occur automatically. To answer 'Why did the new strategy, which called for a change in structure, come in the first place?' Chandler (1962) studied four American industrial enterprises in the late 19th and the early 20th centuries in his seminal research. Strategic changes result from an awareness of the opportunities and needs created by the changing environment, e.g., the prospect of a new market or the threatened loss of a current one, to employ resources more profitably (Chandler, 1962). One source of the awareness is the training and personality of top managers and their ability to keep their eyes on entrepreneurial problems. The studied firms were successful ones that had strategic changes. A large fraction of failed firms that did not introduce strategic changes were eliminated from observations in the literature because of a strong tendency to focus on successes (Denrell, 2003).

Why did new strategies *not* come during a firm's aging? Theories were developed to some extent to find answers. Path dependence affects the firm's procedures in searching and learning as it ages (Cucculelli, Mannarino, Pupo, & Ricotta, 2014; Ding, Kininmonth, & McKinstry, 2017). The resource-based view of the firm suggests that resources and

capabilities are specialized in old firms (Carr, Haggard, Hmieleski, & Zahra, 2010; Esteve-Perez & Manez-Castillejo, 2008). Specialization may inhibit organizational renewal (Barr, Stimpert, & Huff, 1992). Factors affecting firm longevity include the firm's conservative strategy, financial policy (van Driel et al., 2015)(van Driel et al., 2015)(van Driel et al., 2015)(Fernandez-Roca, 2012), management style, organizational structure (van Driel et al., 2015), and business culture (Sasaki & Sone, 2015), the industry's traditional nature, innovative activities (Audretsch, 1995), and institutional quality (LiPuma, Newbert, & Doh, 2013), and the broader environment of the firm (Ben-Menahem, Kwee, Volberda, & Van den Bosch, 2013). These perspectives do not explain specifically why strategic changes may not come in an aging firm.

Viewing longevity as the fit between a firm's internal and external contexts, organizational inertia may be used to describe strategic changes in the firm's aging. While the firm ages, it matures and stabilizes to fit its environment. Meanwhile, the price it pays for reliable reproduction is inertia (Hannan & Freeman, 1984). Inertial pressures increase in rapidly changing environments. This causes firm longevity to decrease because of a decline in firm-environment fit (Rosenbusch, Brinckmann, & Bausch, 2011; van Driel et al., 2015). A common view in the literature is that an organization exhibits inertia as a single unit. This view overlooks various possible forms of inertia in an organization. Organizational inertia is the net of various inertial forces that contribute to the aging of the firm.

This article aims to investigate how various forms of inertia and firm strategy were related in the aging of a once long-lived firm. I go beyond the existing literature by viewing organizational inertia as a latent element between firm strategy and four forms of inertia, i.e., strategic, economic, managerial, and social inertia. I conceptualize these forms along two dimensions, i.e., the organizational source of inertia and the cognitional source of inertia.

Although these forms of inertia are not exhaustive in their representations of the broader organizational inertia literature, they offer collectively a setting for explaining why strategic changes may not come in the aging of the firm. Firm longevity is thus a result of balancing and controlling these inertial forces over time.

This study makes two contributions to the literature. First, the paper enriches the emerging discussion around organizational inertia (Hannan & Freeman, 1984) by deepening the understanding of the sources and forms of inertia. The existing literature views the whole organization exhibiting one inertial force. I see inertia as a net result of several forms of inertia, each associated with several departments and functions of the organization. Second, this study reveals the aging of a firm by answering the question, Why did strategic changes *not* come? The process includes the evolution of and interaction between a firm's internal and external factors, reflected in the four forms of inertia. Aging is thus the outcome of a moving trade-off between these inertial forces.

I developed these ideas linking organizational inertia and aging by studying A. F. Craig & Co. Ltd., a manufacturer of oil refinery equipment, textile machinery, and sugar machinery in the heavy engineering industry in Paisley, UK from 1868 to 1982. I focused on the last decades (i.e., c.1950-c.1970) of the firm's trading history. Several characteristics of the firm make it of interest in the context of aging. First, the longevity of the firm survived economic recessions and two World Wars but not the free trade and the economic growth after the Second World War. Second, the fate of the firm changed from worldwide reputation to receivership. Third, the multiple businesses of the firm present an environment to study various inertial forces within an organization.

THEORETICAL FRAMEWORK

Structural inertia is relative and dynamic (Hannan & Freeman, 1984). An organization can have high inertia in one environment but not in another. This implies that a firm can have high inertia in one industry and low in another if it trades in multiple industries. Since different businesses of the firm are associated with the functions of its departments, e.g., technology, marketing, and finance, and the links between the departments, inertia in these businesses may be associated with these functions and links. A function or link can remain unchanged with or without adjustment by other functions or links. Inertia in functions and links may thus be termed functional inertia and architectural inertia[1]. The complexity of organizational arrangements increases the difficulty in listing all functional and architectural inertial forces. Furthermore, functions and links can emerge and disappear, causing changes to the importance of their inertia to the firm. Therefore, inertia defined by these forms proves inapplicable in explaining aging. However, the logic that various forms of inertia exist in a firm is worth developing.

I conceptualize four forms of inertia, i.e., strategic, economic, managerial, and social inertia, that differ along two dimensions, i.e., two sources of inertia, illustrated in Table 1. The organizational source of inertia describes whether the major source of inertia is internal or external to the firm. The cognitional source of inertia describes to what extent an inertial force depends on cognition, particularly managerial cognition.

[1] 'Architectural' refers to the ways in which the functions are linked together into a coherence whole. I borrowed this term from Henderson, R. M. & Clark, K. B. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. ***Administrative Science Quarterly***, 35(1): 9-30.

Table 1 Sources and forms of organizational inertia

		Cognitional source	
		Independent of managerial cognition	Dependent on managerial cognition
Organizational source	Internal to the organization	Strategic inertia	Managerial inertia
	External to the organization	Economic inertia	Social inertia

Strategic Inertia

Strategic inertia concerns the origin of the firm's business and how the firm integrates and uses its resources. For instance, firms in the pharmaceutical industry use traditionally the trial and error strategy discover and develop new drugs (DiMasi, Hansen, & Grabowski, 2003). Drug development is a research-intensive, time-consuming, and high-risk endeavor (FDA, 2015). It involves high fixed costs incurred over a period of ten to fifteen years before any returns from the drugs are realized. The cost of drug development increased from US$231 million in 1987 to US$802 million in 2000 and to over US$1 billion recently (Lesko & Woodcock, 2004). High failure rates in clinical trials is a fundamental issue in drug development (Colombo & Peretto, 2008). Less than 10% of compounds tested in clinical trials eventually become a marketable drug (CMR, 2006; Tornell & Snaith, 2002). Recently, new diagnostic and informatics approaches improved the understanding of the molecular basis of disease. Personalized medicine made treatments more specifically tailored to an

individual and began to change the traditional trial and error strategy of drug development. FDA integrated personalized medicine into their regulatory policies (FDA, 2013). Personalized medicine can reduce time and risk in drug development. A pharmaceutical firm shows strategic inertia if it tends to keep the trial and error strategy while other firms having an opportunity to follow the trend of personalized medicine in the industry.

Economic Inertia

Economic inertia concerns how the firm achieves financial returns. Profitability can be explained by strategic models of competitive advantage, e.g., cost leadership, differentiation (Porter, 1980), first-mover (Schumpeter, 1934), and second-mover (Boulding & Christen, 2001). Firms at different phases of an industry life cycle may need different models of competitive advantage to remain profitable. For instance, Xerox was a first mover in electronic paper copier and personal computer. The company did not pay enough attention to its competitors' activities in the 1960s. Xerox exhibited economic inertia when it tried to maintain some first-mover advantages while losing its first-mover position in the market.

Managerial Inertia

Top management affect firm conduct and its performance by determining the overall strategies of the firm (Adner & Helfat, 2003; Barnard, 1938; Hambrick & Mason, 1984; Holbrook, Cohen, Hounshell, & Klepper, 2000; Westphal & Fredrickson, 2001). Top management's experience predicts the likelihood and content of major strategic changes (Finkelstein & Hambrick, 1996). Managerial cognition can explain decisions that keep firms on certain paths or create new paths (Lamberg & Tikkanen, 2006), e.g., shaping established firms' responses to discontinuities (Kaplan, Murray, & Henderson, 2003). Managerial cognition can also explain why some top managers are more capable than others in directing

strategic changes and in responding to an evolving environment (Helfat & Peteraf, 2015). The mindset of top management contributes to the company's difficulty in adjusting to a changing marketplace (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece et al., 2007). For instance, the mental models of top management affect the actions of pharmaceutical firms in response to the emerging biotechnology sector (Kaplan et al., 2003).

Managerial cognition can explain organizational inertia (Garud & Rappa, 1994). Top management cognition influenced the evolution of capabilities and prevented an established firm, Polaroid, from successfully adapting the industrial shift to digital imaging technology (Tripsas & Gavetti, 2000). Top management that pay greater attention to emerging technologies can enter new product markets more quickly in the telecommunications industry (Eggers & Kaplan, 2009). Top management's misunderstanding of the value of firm resources contribute to the firm's demise (Danneels, 2011).

Managerial inertia concerns how managerial cognition contributes to organizational inertia in decision making. The idea of managerial inertia was reflected in Chandler's (1962) study on the structural reorganization of four American industrial enterprises. Chandler (1962) found that structure was slow or sometimes failed to follow strategy. The executives of Standard Oil Company (New Jersey) paid little attention to administrative matters and accepted traditional ways of management uncritically. Structural reorganization at Standard Oil came only after stress and strain. The president of du Pont de Nemours & Co. strongly resisted the recommendations for a new structure. A primary reason for delay was that the existing management was unable to change its ways (Chandler, 1962). The attitudes and activities of the different executives affected organizational innovation because 'men long accustomed to handling administrative matters in one way had difficulty in devising new administrative structures' (p. 323). Executives could become enmeshed in operational activities and had

little time, information, or inclination to make entrepreneurial and strategic decisions. Penrose (1959) also suggested that top management could be a fundamental constraint on the ability of firms to grow and diversify (Penrose, 1959).

Social Inertia

Social inertia concerns the ways the firm deals with social, political, legal, and ethical systems. A firm may find certain ways effective in dealing with these issues in the external environment. It thus exhibits social inertia if it maintains these ways in different circumstances while alternative measures were possible.

A BRIEF HISTORY OF A. F. CRAIG

A. F. Craig Co. & Ltd. was founded by Archibald Fulton Craig (1842-1931), a mechanical engineer in Paisley, UK in 1868. The firm developed three businesses in manufacturing oil refinery equipment, textile machinery, and sugar machinery over the years. It gained recognition for the erection of shale distillery and refining plant during the development of the oil trade in Scotland in the 1850s and 1860s. The firm improved the cropping machine and gained a prize at the Paris Exhibition in 1878. In 1894, A. F. Craig became a private limited firm (Slaven & Checkland, 1986). It merged with H. W. Aitken & Co., a sugar machinery manufacturer in Paisley in the 1930s and formed a new firm with David Crabtree & Sons Ltd., a textile machinery manufacturer in Sheffield in the 1950s. A. F. Craig went into receivership in 1982 and no longer traded in 2002.

A. F. Craig's production cycle started with negotiating a contract with a potential customer for the supply of machinery. After obtaining an order, it began to manufacture the machines.

It took several years for the firm to complete and dispatch the machinery. A. F. Craig sent technicians to the site after the dispatch to help with the assembly of the machines and the test run. The customer issued a Certificate of Completion if the machinery functioned as expected. A. F. Craig secured a Letter of Credit, although it allowed payment in installments over a period of one to several years. This production cycle could be interrupted and lengthened by inadequate supply of raw materials, e.g., coal and iron, delayed shipment of machinery to customers, or delayed payments by customers. The origin of the business required large asset base and faced long time lag between lodging a tender and recovering the cost of the contract.

A. F. Craig made significant contributions to the two World Wars through manufacturing heavy machines. For instance, the firm supplied super charger casings to the Merlin engines of Rolls-Royce, waste cordite cutting machines and acid storage tanks to Royal Ordnance Factory, and horizontal planning machines and lathes to the Soviet Union. During the Second World War, A. F. Craig acted ‘more as tax gatherer than as manufacturer’ (UGD173). The firm resumed its three businesses in pre-war times in 1946. It found markets worldwide in the mid-1950s (Slaven & Checkland, 1986).

A. F. Craig’s sales and profit over the years are displayed in Figures 1 and 2, respectively. Both sales and profit peaked in the two World Wars. Sales and profit did not agree, whose general trends moved towards opposite directions over the whole period. Sales increased, and profit dropped. In the last decades of the firm’s history, i.e., c.1950-c.1970, its sales reached the highest level in history while its profit could not be lower. The decline in profit was right before the receivership in 1982.

Figure 1 Sales of A. F. Craig, 1916-1968

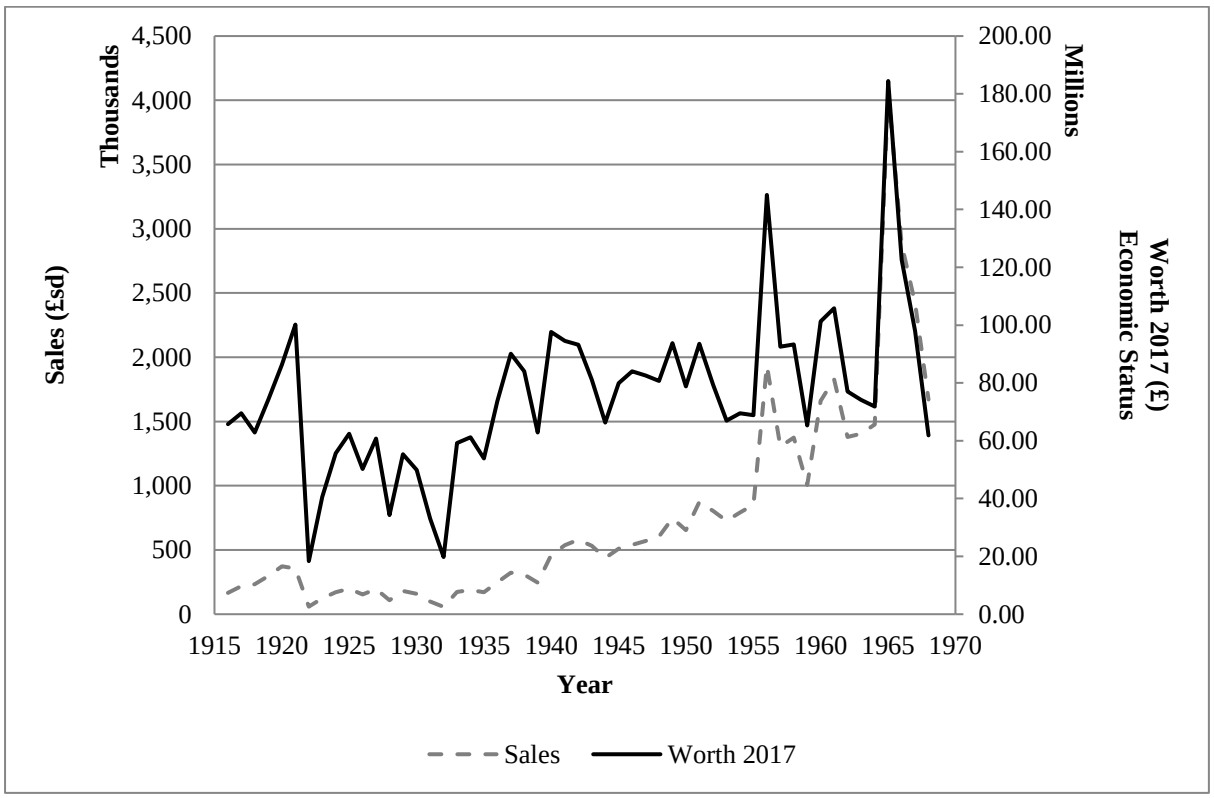
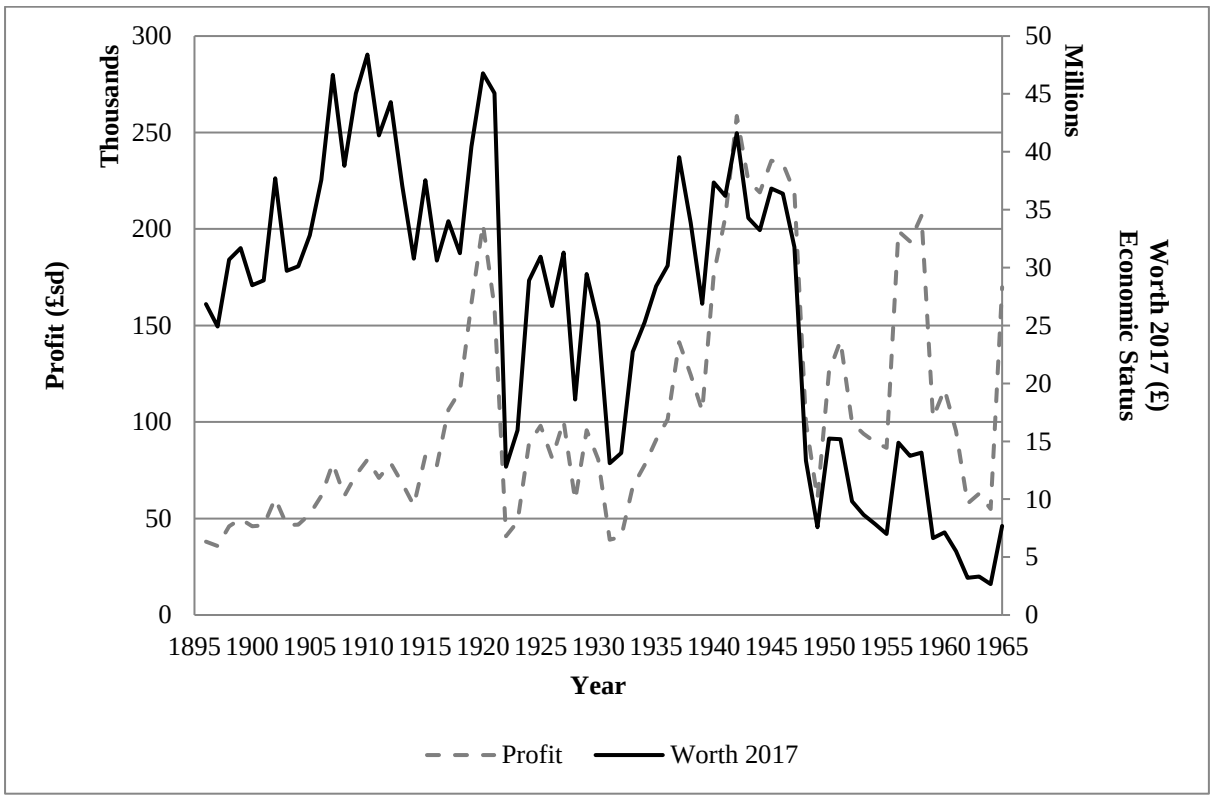


Figure 2 Profit of A. F. Craig, 1896-1965



A. F. Craig's board of directors changed over the years. Table 2 summarises these changes over the four decades before the termination of the firm. The changes were associated with death, retirement, replacement, and recruitment of members of the board.

Table 2 The board of directors of A. F. Craig, 1937-1974

Year	Directors (represented by the initials and a number distinguishing the same initials)													
1937	AR	RG	WM1	TH	RG1									
1938	AR	RG	WM1	TH	RG1	AC								
1942		RG	WM1	TH	RG1	AC								
1946		RG	WM1	TH	RG1	AC	HC							
1950		RG	WM1	TH	RG1	AC	HC	JS						
1951				TH	RG1	AC	HC	JS						
1956				TH	RG1	AC	HC							
1959				TH	RG1	AC	HC		WL					
1960					RG1	AC	HC		WL	JS1				
1965					RG1	AC	HC		WL	JS1	JM			
1972					RG1	AC	HC		WL		JM			
1973					RG1	AC	HC		WL		JM	JJ	WM	JW
1974					RG1	AC			WL		JM	JJ	WM	JW

A. F. Craig in c.1950-c.1970

A. F. Craig was entirely busy with government works of national importance in the Second World War. The government contracts included, e.g., TNT plant for Powfoot of Royal Ordnance Factory, Bliss horn presses, planning machines, bending rolls, Corvette engines, marine boilers for Admiralty Merchant Shipping, iron casting for Admiralty, and vessels works, etc. The firm also continued a limited amount of regular businesses, e.g., oil refinery equipment for Anglo-Persian Oil Company, comprising oil coolers, stabilising tower for Shell, exchanger and cooler for Trinidad Leaseholds, cooler cells for Assam, India, etc. The War damaged A. F. Craig's foreign plants, e.g., the oil refinery plants in Burma, Dutch East Indies, Romania, and France. The plants could not work at the full capacity, bringing A. F. Craig technical weakness in securing large volume of oil refinery contracts.

The firm had plenty of orders on hand in the years right after the War. A. F. Craig expanded their sugar machinery business to India, South Africa, and Mauritius. The market in India had a high demand for sugar machinery without sufficient suppliers. A. F. Craig decided to establish sales representation in India. A director of the firm visited South Africa to discuss the sugar trade there and completed an agency agreement. The firm had some difficulties in hiring skilled labour and gaining steel and other raw materials. Despite these difficulties, the firm maintained the expected outputs and dispatched the orders to the customers.

The 1950s saw growing competition in the manufacturing and engineering industries worldwide (Lorenz, 1979). The Scottish industry had difficulties in obtaining raw materials for the foundry productions (Payne, 1979). The industrial output in Scotland declined from 23.8 million tons to 23.6 million tons due to lack of sufficient raw materials during this time (Slaven, 1975). A. F. Craig's foundry sales dropped in early 1951.

A director of A. F. Craig visited America to study the production methods there. The firm also established co-operation with Koch Engineering Co., an American firm in the oil refinery equipment business. A. F. Craig sought oil refinery market in Yugoslavia, Turkey, and Mexico, sugar machinery market through tenders in Bolivia, Venezuela, and Iraq, and textile machinery market in Denmark. In the UK, the firm obtained orders in oil refinery equipment and textile machinery via sales agents.

The efforts of the firm in the international market gained the firm a high level of production in mid-1950s. However, its trading profit was a lower level than in early 1950s mainly due to the price competition at that time. In late 1950s, A. F. Craig found it difficult to obtain new orders while maintaining profitable. Competitors from Japan, Europe, and the USA dragged the price down. Japan became the lowest seller for tankers, ships, and cargos in the 1960s (Lorenz, 1991). Meanwhile, the rapid growth in the manufacturing industry increased the use of new technologies in the industry, making firms capable in lowering price further. The shortage of oil in the UK in 1956 also contributed to the recession in the heavy engineering industry (Johnman & Murphy, 2002). A. F. Craig's sales dropped 60% in 1959.

A. F. Craig had a better trend in sales throughout the 1960s. The manufacturing capacity of all departments of the firm was full. The firm developed sugar machinery business in Spain and Morocco. It obtained orders for oil refinery equipment, iron casting, and sugar machinery at a reasonable price, e.g., a sugar factory for the Sudanese government, a beet sugar factory in New Zealand, and iron casting of 105 liners for Poland. The trading profit remained low, however, due to the fall in prices of heavy engineering products. In some cases, the firm refused to take orders until the improvement of the price. This left rival firms in Europe and the USA the full advantage of the increased demand for manufacturing goods at a low price.

METHODS

The study adopts a tradition of in-depth historical case studies to explore a complex, non-linear process (Burgelman, 1991; Danneels, 2011; Rosenbloom, 2000; Vaccaro & Palazzo, 2015). Longitudinal case studies track the process in its natural context and reveal the dynamics in the firm (Eisenhardt, 1989; Miles & Huberman, 1984; Van de Ven & Huber, 1990; Yin, 2003). A. F. Craig Co. & Ltd. (1868-1982) is an attractive firm for an in-depth historical case study because the firm was once one of the largest engineering firms in Scotland, had a rich history, and had its archival data well preserved (e.g., the board of directors' minutes for 1895-1974).

Data and Analysis

In this study I investigated the last decades of the firm (i.e., c.1950-c.1970) and used the theoretical framework of inertia I developed earlier to understand how a once glorious firm faded. The firm's data used in this study included board minutes, ledgers, and invoices. The archival data of A. F. Craig are stored at the University of Glasgow Archive Services.

The data analysis follows several steps used in in-depth case studies (Danneels, 2011; Vaccaro & Palazzo, 2015). First, I studied the minutes of the board of directors to construct an event timeline. A. F. Craig's board of directors changed several times during the studied period c.1950-c.1970, shown in Table 2. The changes were associated with death, retirement, replacement, and recruitment of members of the board. I used the changes to the board of directors to divide the studied period to four sub-periods, i.e., c.1950-1955, 1956-1959, 1960-1964, and 1965-c.1970.

Second, I grouped the events in each sub-period to the categorical quadrants, i.e., strategic, economic, managerial, and social inertia, noted in Table 1. Some events demonstrated multiples forms of inertia. Third, I examined changes in each form of inertia over the sub-periods. Fourth, I used the extended case method to go through cycles of confrontation between data and theory (Burawoy, 1991). This method involves exchanges between theories and data analysis (Danneels, 2011). The theoretical framework guided data analysis, while data analysis pointed to theories in the literature. For instance, I developed the perspectives on cognitional inertia before analyzing the data. The data suggested that cognition could come from the internal or external context of the firm. Therefore, I furthered the framework by separating managerial cognition and social cognition.

FINDINGS

Strategic Inertia

A firm exhibits strong strategic if it maintains the ways it integrates and utilizes resources and capabilities without adapting them to the external environment. The nature of the firm's business would remain. A. F. Craig developed its strategic inertia in c.1950-1955 because of several successful contracts. The firm had some strategic inertia in 1956-1959 and strong strategic inertia in 1960-1964 when it began to lose contracts to other bidders in the severe competition. Strategic inertia of the firm weakened in 1965-c.1970 because the firm joined a new venture. Some cases below can illustrate the changes in A. F. Craig's strategic inertia.

c.1950-1955

A. F. Craig negotiated with Industre Chimiche Italiane del Petrolio (ICIP) on the supply and erection of an oil refining installation at Mantua, Italy. The value of the contract was £1,230,000. The two parties discussed the means of funds and the manufacture of some of the equipment commenced before reaching an agreement. A. F. Craig supplied an oil processing plant at Mantua before ICIP placed the full orders. A. F. Craig also approached the Export Credits Guarantee Department[2] (ECGD) for their underwriting the credit risk of £100,000 on the contract with ICIP. While the oil refinery being erected, two directors of A. F. Craig visited the site for supervision purposes monthly for ten months. The maximum capacity test was conducted successfully. The business with ICIP was a successful case. A. F. Craig also received other enquiries during this period, e.g., some for complete cane sugar factories in Thailand and Uruguay. It expanded its business to India, South Africa, and Mauritius. The firm's production was well maintained and had a satisfactory order position.

1956-1959

A. F. Craig started its negotiation on Haryana and Janta sugar factories in India. After receiving the desired amount of payment, A. F. Craig decided to send representatives to supervise the installation. However, the Letter of Credit was delayed. The customers did little in preparation for the factories. Despite these issues, A. F. Craig dispatched the first shipments of equipment to the customers and the rest within three years. Although the two parties had a dispute, A. F. Craig's procedure of doing business remained the same.

[2] Export Credits Guarantee Department (ECGD), known as UK Export Finance, is the UK's export credit agency and a ministerial department of the UK government. Established in 1919, ECGD's mission is 'to ensure no viable UK export fails for lack of finance or insurance, while operating at no net cost to the taxpayer' (GOV.UK; UK Export Finance; https://www.gov.uk/government/collections/uk-export-finance-products-and-services; September 1st, 2017.). It supports business in the aerospace, automotive, construction, healthcare, industrial processing, oil and gas, petrochemical, water treatment, and satellite sectors. ECGD's major activities include underwriting long-term loans to support the sale of capital goods, e.g., the export of aircraft, bridges, machinery, and services.

1960-1964

A. F. Craig prepared to lodge a tender to a cane sugar factory in the Sudanese town of Khashm el Girba to handle 4,000 tons of cane per day. The customer also requested extension to handle 6,000 tons of cane per day. A. F. Craig felt that the negotiation of a loan agreement proposed between British banks with insurance offices and the government of Sudan might be a protracted business. A. F. Craig later faced competition from German and Dutch manufacturers. The firm lost the contract to a German competitor.

1965-c.1970

Craig-Crabtree (Contracts) Ltd., a new company formed by A. F. Craig and David Crabtree & Son Ltd., lodged a tender to Tekig-Invest Import and Export Undertaking (TIIEU), Yugoslavia for the supply of looms. The company dispatched the looms and later quoted the same customer more looms for its Novost Factory, subject to arrangements for financing over five years. A director of the board of A. F. Craig visited Yugoslavia after delay in the post-shipment installments. A. F. Craig eventually received the initial installment and commenced he dispatches of the looms. The erection of looms was completed before Craig-Crabtree (Contracts) received the Letter of Credit.

Economic Inertia

Economic inertia tends to be strong if the firm focuses on, e.g., reducing cost, when it could pursue an alternative approach, e.g., differentiation. Technical progress and product diversification in early 20th century made effective marketing increasingly important. Meanwhile, keeping costs down pushed engineering closer to factory production rather than that of the workshop (Slaven & Checkland, 1986). A. F. Craig tried to reduce cost to maintain

reasonable prices for the orders. Its situation became gradually harder, although the firm invested in marketing often.

c.1950-1955

A. F. Craig found markets worldwide in the mid-1950s. The company had a satisfactory order position. It formed several collaborations with partners during this period. For instance, A. F. Craig and Koch Engineering Company, Inc., USA discussed closer cooperation in the development of oil refinery equipment, including sharing the engineering fees for the Mantua contract with ICIP, Italy.

Two directors of A. F. Craig visited Crompton Knowles International Ltd., New York on Axminster spool looms of Crompton Knowles' design and on the selling of A. F. Craig's Wilton looms in the USA. After surveying sales demand for Axminster spool looms, A. F. Craig discussed the acquisition of rights to manufacture Crompton Knowles' Axminster spool looms. After some efforts, the manufacturer of Axminster looms by A. F. Craig was possible. A. F. Craig also appointed Crompton Knowles to be a foreign sales agent for textile machinery.

1956-1959

A. F. Craig's trading profit dropped in this period. This reflected the recession in the heavy engineering industries. This period featured terminations of collaborations by A. F. Craig. The terminations reflected the firm's shrinking market and reaction to environmental changes. A. F. Craig terminated the agency agreement with Pierre Sourdis, the agency agreement with John Murray (Pty) Ltd. in South Africa, the cooperation and sales agreement with Indian Sugar and General Engineering Co. Ltd., etc.

1960-1964

A better trend in the heavy engineering industry progressed. The manufacturing capacity of all the departments of A. F. Craig was well employed in this period. The firm's order position was satisfactory. The trading profit of the firm, however, was low through a general fall in the prices for the medium to heavy engineering products. The better trend in the industry attracted severe competition, which tended to lower prices further. For instance, A. F. Craig lodged a tender to a cane sugar factory in Khashm el Girba, Sudan. The firm faced competition from German and Dutch manufacturers, who could offer competitive prices mainly due to better cost control. A. F. Craig lost the contract to a German company.

1965-c.1970

The firm Craig-Crabtree (Contracts) Ltd. formed between A. F. Craig and David Crabtree & Son Ltd. in this period lodged a tender to Romania for the supply of 14 looms at £340,000. The tender did not proceed further. The joint firm quoted looms to Poland and Italy. Nothing materialized from Poland. The joint firm later accepted an order from an Austrian company for two looms at £51,200. For this contract A. F. Craig executed a recourse agreement in favor of ECGD for the facility of the Austrian company to pay installments.

Textil Tabacow of Brazil ordered looms at £88,600 under a supplier agreement that A. F. Craig signed with ECGD. The financing of the looms was under negotiation with International Finance & Services Ltd. After Textil Tabacow finalized the financing arrangements, A. F. Craig received initial installments. Securing large contracts was a main goal of A. F. Craig during this period. The firm needed to deal with insurance policies and the trading relationships between several nations.

Managerial Inertia

A firm exhibits strong managerial inertia if the firm's top management team (TMT) pay little attention to matters that might require changes to administration, corporate strategy, business models, etc. In this case, the TMT tends to be path-dependent on traditional ways of management.

Over 50 civil, mechanical, and electrical engineering firms (excluding marine and locomotive engineering and shipbuilding firms) with over 250 employees emerged because of the expansion of the industry in Scotland in 1901. Engineers working for these firms had similar educational background and work experience. Their career route was through apprenticeship and part-time study, i.e., formal instruction in science and engineering at Glasgow University or the Royal Technical College. Most of them worked in the same range of metals and were bound together by their professional association. These features helped form their group identify and culture. Most of them had few interests outside the family (Slaven & Checkland, 1986).

Invention, design, and production were the main activities demanded of the engineers during the decades following the 1850s. Developing a product and implementing its manufacture as unique outputs or in small runs was the primary business. These engineers expected their creations to generate demand. Selling or marketing was their weakness. They were not businessmen or salesmen (Slaven & Checkland, 1986). In A. F. Craig, the engineers seldom realized the importance of understanding the market until the last period studied in this research.

1965-c.1970

A. F. Craig surveyed the European market and found that the design of shearing machine needed more spiral blades to increase its speed of throughput. Meanwhile, the firm invested in a Friden Electronic Calculator for use in the Design Department. The firm also investigated the benefits from the use of a computer on the rating and mechanical design of heat exchangers. A. F. Craig purchased its first heat transfer thermal program from Yarrows.

The Oil Department required a mechanical program for computer work. A. F. Craig sent staff to a course at Heat Transfer & Fluid Flow Service, Harwell for guidance on feeding into its computer the input to its thermal program and on its output. The computer service equipment was installed and in effective use afterwards.

Social Inertia

A firm has strong social inertia if it follows its traditional ways to deal with social, political, legal, and ethical systems. These aspects of the external environment of the firm are relatively stable compared to technological changes in the industry. However, situations the firm face could change, requiring different measures by the firm to reduce social inertia.

c.1950-1955

Due to delay in delivery, Thomson Shepherd & Co. Ltd. regarded the contract for 12 looms as unfulfilled unless the first loom was ready for tuning by a certain date. A. F. Craig consulted their solicitors. A mutual friend of the two parties suggested the case be settled by Thomson Shepherd & Co. Ltd. paying £5,000 and in return they receive the jacquards for eight looms. After prolonged discussion, Thomson Shepherd & Co. Ltd. agreed to take the delivery of the jacquards and to pay £2,500.

A. F. Craig prepared a scheme to settle the problem of British Diesel Oil & Petrol Co. Ltd. about oil circulation. A director of A. F. Craig visited the site and offered to supply two centrifugal pumps and two tube bundles. British Diesel Oil & Petrol Co. Ltd. signified the final acceptance of the solution and agreed to remit the outstanding final installment of £9,000.

1956-1959

A. F. Craig started their negotiation on Haryana and Janta sugar factories in India. The delays in structural and building work led the customers to submit their dispute with the firm. The claims were too great to settle. The dispute lasted two years. Eventually, the arbitrator dismissed all the claims of the sugar factories, who would bear their own costs of the arbitration. During the period of the dispute, directors of A. F. Craig visited India several times. The dispute made the company too fully engaged to enter into further arrangement in India.

1965-c.1970

A. F. Craig formed an agreement with His Imperial Majesty's Government of Iran Plan Organization for the supply of an extension to Abkouh Sugar Factory at £2,376,012. A. F. Craig experienced serious delays that affected the completion of the extension. During the visit of one of A. F. Craig's directors to Iran, Plan Organization agreed that they would not seek to claim any penalty for lateness, provided that the completion was effective in time for the commissioning of the plant. A. F. Craig eventually received the Certificate of Completion of the extension from Iranian Management and Engineering Group Ltd.

Various break-downs occurred while testing the extension at the Abkouh Sugar Factory, e.g., seizure of crystallizer bearings, defective tubes in heaters, and misalignment of pulp-press

and its gear box. Some of the process operators were returned to the UK and replaced by others of greater experience. At some point of time both boilers at the extension were closed. Replacements and repairs were in hand. A water softening plan was constructed to amplify the supply of treated water available for operations. The Abkouh Sugar Factory were insistent that A. F. Craig had a responsibility to keep Abkouh Sugar Factory going. Much care was required in making proper use of the water treatment plant. Two directors of A. F. Craig visited Abkouh Sugar Factory. At the end of the campaign, Abkouh Sugar Factory reached a maximum throughput of 1,549 tons of beet a day. The contract performance test was successful.

Directors of A. F. Craig later visited Teheran to claim for additional work and expenditure incurred on the Contract and to request the Iranian Management and Engineering Group Ltd. to issue a Maintenance Certificate. A. F. Craig suspended the sending out of specialists to induce Iranian Management and Engineering Group Ltd. to obtain implementation. In view of the lack of experience of the Iranian operators, the lack of cooperation by the factory management, the Iranian Management and Engineering Group Ltd.'s failure to implement their decision, A. F. Craig requested the Iranian Management and Engineering Group Ltd. to issue the Maintenance Certificate in unqualified terms in respect of the whole Contract, failing which a dispute would arise. The Iranian Management and Engineering Group Ltd. decided that A. F. Craig was not entitled to the Maintenance Certificate because remedial works were not completed. A. F. Craig tried to settle the dispute under the rules for Conciliation and Arbitration of the International Chamber of Commerce. Plan Organization complied with their settlement obligations and A. F. Craig received the final balance.

DISCUSSIONS

The Aging of A. F. Craig and Organizational Inertia

Organizational inertia is the net of four forms of inertia, i.e., strategic, economic, managerial, and social inertia. Two dimensions, i.e., whether the inertial force is internal or external to the firm and whether the inertia force is independent to managerial cognition, distinguish the four forms of inertia. This study tries to establish a connection between these forms of inertia and the aging of the firm. Studying the aging of a once long-lived industrial enterprise, A. F. Craig in the heavy engineering industry in the UK during c.1950-c.1970, I found the evolution of the four forms of inertia within the boundary of organizational inertia. The evolution is displayed in Table 3.

Table 3 The evolution of the four forms of inertia in A. F. Craig, c.1950-c.1970

Period	Strategic inertia	Economic inertia	Managerial inertia	Social inertia
c.1950-1955	Weak	Medium	Medium	Weak
1956-1959	Medium	Strong	Strong	Medium
1960-1964	Strong	Strong	Strong	Medium
1965-c.1970	Medium	Medium	Medium	Strong

The first stage of the studied period, c.1950-1955, saw weak to medium inertia in the four forms. Organizational inertia of the firm at this stage is the weakest among the four. A. F. Craig enjoyed a satisfactory order position and financial performance. Organizational inertia increased in the following two stages, 1956-1959 and 1960-1964, with every form of inertia increasing. The firm's profit dropped dramatically in these two stages. A. F. Craig tried to

reduce organizational inertia by reacting to environmental changes in the last stage. Although firm financial performance increased modestly, the overall trend was to decline. The firm became unfit for the changing industry and its severe competition.

New Strategies and Organizational Inertia

Organizational inertia describes an organization's tendency to keep its rate of changes independent from the rate of environmental changes (Hannan & Freeman, 1984). How does organizational inertia inhibit new strategies in the firm when the environment changes quickly? Each of the four forms of inertia may contribute the answer. Strategic inertia may keep the firm in its comfort zone of business. The firm relies on its existing resources and capabilities. A new strategy might change the firm's resource allowance or require new capabilities, leading the firm to exploration (March, 1991). Externally, the firm's position in the market and its functions in the value chain mean that how the firm gains financially is associated with other firms and partners. A cost leader in an industry may be an expert in refining existing procedures. It might enter a new business via refining procedures but not introducing new products. The cost leader may not favor new strategies to be a first mover because the lost leader does not have the necessary knowledge or skills. Managerial inertia largely depends on the perspectives of TMT. A firm's TMT affect its performance (Hambrick & Mason, 1984). A chief executive director with educational background in science might pay more attention to patents and less to the value of marketing. A non-academic dean of a school might emphasize administration and internationalization while devaluing research. Without changing the TMT, new strategies will hardly arrive.

CONCLUSION

Organizational inertia can exhibit different forms within the firm. The four forms discussed in this study may help explain the aging of the firm. It remains an open question whether inertia is a negative or positive issue in the context of organizational evolution. Inertia is an organization's character that always exists. It is path dependent. Inertia describes an organization's tendency to remain unchanged until the emergence of a force to change the organization.

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