

J. A. CRABTREE: A PIONEER OF BUSINESS MANAGEMENT

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John Ashworth Crabtree, who died in 1935 at the comparatively early age of 49, was a largely self-made industrialist who, starting from small beginnings, founded his independent manufacturing firm in 1919 with a capital of £7,000 and a handful of staff, building it up to an organisation of over a thousand people by the time of his death. Centred in Walsall, West Midlands, and from 1923 at the Lincoln Works where the firm still has its headquarters, Crabtree's company made switches and wiring accessories for the rapidly-expanding electrical-installation business. It made, and still retains, a high reputation for the quality of its products. After Crabtree's death the firm remained under nominal family control, although death duties had to be met by the raising of outside capital and 'going public'. In 1944 Mr. Jack Crabtree, eldest son of the founder, became a Director, and then Chairman a few years later. The firm's activities expanded, geographically in terms of new factories in the Midlands and in South Africa, and also in terms of new products such as circuit breakers. This expansion was financed from retained profits, but the outside capital which had had to be raised in 1936 represented a majority holding. When Ever-Ready bid for the firm in 1972, it was apparent that the family had inadequate control to prevent takeover. Mr. Crabtree remained Chairman, however, until his retirement a year or two later. The foundations laid by J. A. Crabtree in 1919 had enabled his family firm to prosper and expand for well over half-a-century.

In the few years immediately before his death, Crabtree had made the effort to set down his views on the building and management of a business with a view to publishing a book. The work reached the stage of a typescript, but he died before it could be printed. The typescript has very recently been brought to light by Mr. Jack Crabtree and made available for study.¹ We are grateful for the opportunity to read it, and in this paper we try to indicate something of Crabtree's pioneering work in analysing the principles of business management half-a-century ago.

This paper takes the somewhat unusual form of a 'running commentary' on an extended series of quotations from the unpublished book. The typescript had not been revised for publication and considerable editing would have been needed. In spite of tautology and incorrect syntax, we give all quotations literally. Naturally, our selection of topics for display and comment is personal; it represents some of what we feel to be the best among the numerous ideas and principles put forward on a vast array of business topics which range from people and morale to trade forecasting and technical research.²

The work itself is large (of the order of 120,000 words) and part of

its interest lies in the unconscious self-portrait which it provides of an entrepreneurial character, at one and the same time paternalistic and modernistic. Some of it is reminiscent, indeed, of Lorimer's John Graham in 'Letters of a Self-Made Merchant to his Son' with the added advantage that Crabtree was a real person setting down his views from his own immediate experience. Like Lorimer's merchant, Crabtree's comments are full of 'deceptively simple wisdom' and 'the clever if not subtle deployment of all those metaphors and similies in which he reinforces the form by giving substantive examples of the moral or economic purpose'.³ Insofar as human character shapes the formation of a business enterprise, Crabtree's manuscript abounds in insights, some instructive, some simplistic, some little more than the general reflections of an 'industrial worthy', others of penetrating interest for the study of business policy.

It is this latter context which it is the primary aim of this paper to display in particular, insofar as the book relates to four main aspects of the development of a manufacturing firm. These are: problems in the inception of a business; the phasing or ordering of the problems of growth; organisation as a response to increasing size and complexity; strategy and control in a small to medium-sized business. And the contribution to understanding of these matters stems essentially from the pioneering aspect of Crabtree's work over half-a-century ago, in that in a fairly small business he nevertheless emphasised at all points the fundamental importance of systematic analysis, systematic structure and organisational form, and the systematic principles of management in the conduct of enterprise, and that he expressed this in cohesive written form.

'I am supposed' writes Crabtree in his Preface, 'to have been "fortunate" in business. That, of course, is how men interpret any degree of success. The truth is that I have made many mistakes: some of them inevitable: the others through my ignorance of those basic principles which I now realise underlie and govern every business decision, so that I look back to see much of my best work wasted through this ignorance and the consequent misdirected efforts. We cannot think out these things in moments of action. They must have been studied beforehand so that they have soaked into our subconscious mind.' Yet, while there is this emphasis on principle, there is also at one and at the same time an insistence that 'pedantic adherence to theories, principles or formulae is almost invariably a mistake in business' and the assertion that 'whatever is worthwhile in this book has been hammered out on the anvil of experience.'

It would not be right to infer too much from what was clearly intended as a general declaration of principle, but it is of some interest to observe that some of Crabtree's remarks bear out the proposition that activity drives out thinking as routine drives out planning. They are also pertinent, if perhaps only marginally, to the phenomenon on which Ansoff and others have commented, that businesses often devote only

spasmodic attention to strategy and strategic decisions and that this is partly due to the pressure of operating decisions which present themselves for immediate consideration. The management of business and in particular what Crabtree conceives as the role of creative leadership involves systematic analysis in advance of action, the determination of strategy followed by the hurly-burly of active campaigning. The metaphor is by no means inappropriate: in a later Chapter the author says: 'Business is war'.

Inception and Growth

After his introductory generalisations, Crabtree goes on to consider the origins of his own business and its development in the period 1919-1930.

We started with £7,000 in cash Obviously, therefore, finance has repeatedly been a pressing problem during our development. Not that we are unique, for when I hear men speak of their business worries, I come to feel that finance *is ever* the pressing problem with every one. The capital necessary to develop any business always seems to be *as much as you can raise*. My own resources have run, yet permitted me to catch up with what I should like to do.

Later he remarks that:

In the majority of businesses, the amount of capital at the directors' disposal is the controlling factor in ultimate costs. The capital available serves as a rough indication to the general policy to adopt

Although Crabtree concentrates attention on finance, it is of especial interest to observe how, in the development of a small business, the problems of finance, employment and even organisation are inescapably intertwined. In the early stages of the business Crabtree was the classic 'Jack of all trades', keeping the books, doing the buying, designing, research and even working at a lathe at home. But this situation became untenable within a year and with employees numbering no more than thirty. A graph of growth of the firm is shown in Fig. 1 (see p. 210). He goes on to say that the next immediate problem was finance and bases his discussion of this on an interesting exposition of the situation of a small business founded on the basis of the restricted capital. Basically, what he points out is obvious: that survival requires that at all times the sum of capital plus income from sales must not fall below disbursements. He goes on, however, to utilise a graphical presentation in planning the scale of the business in relation to the capital, and in monitoring its performance. This is in essence, shown in Fig. 2 (see p. 210). Here the time-shift between the two graphs, as indicated, is determined by credit terms and stock held; e.g. one month's credit on sales moves S curve to right, similarly one month's stock held; one month's credit on disbursements is taken to move S curve to left (in

effect D curve to right). The historical context was the post-war slump which made it more difficult to widen the gap between the S and D curves and thus to amass further capital. Thus there were anxieties about liquidity, exacerbated by slump conditions which led to cancellation of some orders: but the strategic response is striking. Despite the emphasis on finance as the general constraint, Crabtree gives the phases of development in this way:

The early problems of our development were successively (1) Technical, (2) Finance, (3) Market, (4) Production, and again (5) Finance, in the order stated. The Market and Production research (3 & 4) led to the second reorganisation of the business to equip ourselves with the alterations in our sales policy. Our principal customers cancelled large forward contracts at a moment's notice in 1920, and we were faced with surplus production, a drastic reduction in our market, and limited financial resources. Our solution came through investigations of markets, production and finance, in the order stated.

. . . it was 'touch and go' whether the business would survive. This stage covered from 150 to 250 employees, and was the time when certain of our shareholders sold out This stage lasted well into 1923 before we had solved our problems. This stage over, we passed into a series of special production and research problems We equipped our first electrical laboratory and were very proud of it.

Crabtree goes on to a further comment of great intrinsic interest:

The period of development from 300 hands is of great significance, especially when we touch the level of approximately 600 people . . . the state of organisation which commenced at about 290 employees had a complicated stage of problems between 550 and 650 employees . . . what was wrong was that our reorganisation of the Higher Control at 290 employees was not sufficient in advance of the preceding organisation. I had not realised that very different problems had arisen out of the larger-sized business now involved, and that something more was necessary than the mere reorganisation of production and technical development.

This extended set of quotations exhibits the close inter-relationship already referred to, of cash flow and finance in general, markets, production and employment. Crabtree's response to a difficult financial situation is to attack the problem at the market end while planning longer-term product development. This implies an aggressive conviction about growth which is at the heart of success for a small new business in which the defensive option of cost-reduction can have only limited benefit. Crabtree was certainly alive to the importance of careful budgeting and cost-control; indeed, he contrasts the ability of the large firm to utilise large resources with the tactical situation of a small concern 'which possibly has to consider economy as of more importance

than the immediate result'. But in saying this he is simply stating that the scale of operations must be related to the volume of resources which can be deployed. Bold though he is, this principle is crucial to him. 'It would be absurd, for example, to adopt a policy dependent on dominating one's industry, without having the financial means for domination. Such an instance would be a firm adopting the policy of "lowest prices on the market" for their product' unless, as he puts it, they were in a condition to undersell their competitors indefinitely. A price war is a policy of 'bleeding to death' and for this you need to have 'more blood than your competitor'.

Crabtree is indicating that the separate phases of business operations in fact overlap: thus response to financial pressure in the early stages took the form of simultaneous attack on the market and production development.⁴ He is perhaps more moderate than Lorimer's merchant who says 'The way to think of a thing in business is to think of it first, and the way to get a share of the trade is to go for all of it.'⁵ But after all, Lorimer's man was a merchant: and the aggressive spirit is the same.

Organisation as a Response to Increasing Size and Complexity

Simultaneously with this response to financial pressures during growth Crabtree was faced with organisational problems which he relates to numbers employed and subsequently to what is, in effect, span of managerial control. Although some difficulties occurred very much earlier when it ceased to be practicable to work on the principle of 'Jack of all trades' it appears that major reorganisation became necessary after employment exceeded '300 hands'. The figures 200-400 crop up frequently in discussions with industrialists, usually in the context of the number of employees with whom more or less personal contact can be retained within a production unit: sometimes figures around 500 are cited and the ranges referred to by Crabtree are of the same order. The points being made by Crabtree are of wider significance than the question of personal contact, the essential argument being that organisation should be forward-looking and that the failure to be so at the 300 level gave rise to the difficulties encountered in the subsequent expansion. Thus by the time the 550 level had been reached, the anomalous situation had arisen that while production had greatly increased, too much of the product had gone into stock and too little was being actually sent out to customers; as a consequence, customer-complaints were becoming serious. Moreover, the situation was financially disastrous, as the growth of stock represented a drain on cash, and the potential income was not being realised. 'The organisation we had initiated around the 300 mark was not functioning satisfactorily. It was piling up stock, but it wasn't getting it out'.

To some extent Crabtree's problems were the result of external circumstances—the General Strike and Miners' Strike of 1926—but he was reluctant to attribute too great a role to these or to accept the fluctua-

tions in the numbers he employed—he expresses a keen belief in steadiness of employment as a responsibility of the business leader. The emergency reactions were to dispose of stock at attractive discounts or as scrap, to hold up works development and to suspend labour. They were the necessary survival responses to the financial pressures caused by the cash drain, but these merged into permanent measures, for:

what of course was wrong was the organisation, which installed at the time we employed 300 hands, was but little in advance of its predecessor. I did not know that the development of an organisation through growth alone, was not enough. Now I know that periodically one has at times to review the whole business in its fundamentals, and without prejudice by any existing organisation, decide what organisation is necessary to cope with the business for the immediate future.

The problems were attacked by giving second place to technical and production considerations and instead concentrating attention on 'the policy and records of Higher Control.' Specifically, Crabtree aimed via a system of 'Moving Annual Trends,' towards improved budgeting on the basis of more sophisticated forecasting.⁶

All this work of reorganisation, which excellent in its way only carried us a certain distance when our employees rose to the 850/900 mark, I found that something more was necessary. The figures for control did not carry the matter into sufficient detail. Decisions that were good enough for 300/700 people were not accurate enough now we had a larger number. The basic principles did not seem to have altered, but the analysis and control was too casual.

These quotations, while interesting, are perhaps simply straightforward comments on problems of size following the inception of a business, but they are given added force by Crabtree's remarks about complexity. The pure growth aspects arose in the progression from 'Jack of all trades' to 30, 300, 600, 900 employees, but:

Our difficulties in the control of manufacturing and selling— and particularly in manufacturing—arose from the fact that, while we are supposed to be mass producers, yet in a single week we have to supply to our public thousands of different varieties of product. The analysed list of sales for one week is 75 ft long. For a typical product we have to make 48 different parts out of brass, steel, china and other materials, and put them through 162 operations.

and later:

. . . I found that in a single week we delivered over 7,000 different articles, all of which have to be separately and distinctively labelled, having some separate catalogue number distinction. I further found that the 6,000 articles delivered in one week are not the same 6,000

as would be demanded in the following week, and that within a month nearly 20,000 varieties would be called for.

On making an exhaustive examination into comparative articles, I found to my surprise that in two articles sold to the market at identical prices, there was a difference in the cash received by us of over 10%. A difference far exceeding the difference in cost price and throwing a lurid light on our price and discount policy. It showed that the mass assembly of group figures suitable and indeed inevitable in a smaller business, were at our present stage extremely dangerous, and liable to lead us far astray into losses of which we could have no knowledge.

It is convenient at this point to draw together the combination of points made by Crabtree in the context of business growth, particularly because of the light which they cast on his pioneering spirit and thought in business management. Growth imposes a number of strains: the pursuit of business strategy leads to problems in organisation, a kind of, perhaps small-scale, description of the Chandler process.⁷ Moreover,

If a business has been in existence for any length of time, changes in organisation are necessary, which go beyond the normal expression of growth. Your organisation does not merely grow into something bigger, it has to be changed into something distinctly different.

And since, as Crabtree had come to realise, there was no such thing as the perfect organisation for any business and any time, there needed to be periodic re-organisation in response both to changes in economic and management thought and in the size of the business itself. He thought, unlike some writers but like Sargant Florence,⁸ that there seemed to be no limit to the growth of a business as a whole, but that there exist 'distinct limits to the growth of the specific type of organisation controlling that growth. In some way, which I cannot easily explain, it does not seem possible for the mechanism of an organisation to evolve, in the way that the business as a whole will evolve.' What he is arguing is that there is no 'evolutionary process in the organisation' capable of dealing with the problems of control as the business itself evolves. Thus, for him, 'The history of a large business is . . . the composite story of many successive organisations'.

This perception of the profile of business development, striking and original in its day, is still valid and illuminating. Crabtree had seized on an important principle which can certainly be seen at work, for example, in the changing patterns of departmentalisation and divisionalisation which are to be found in growth and diversification in large enterprises. He believed, in fact, that he had detected a precise rule which should govern the periodic re-organisation of a business—re-organisation whenever personnel treble in number, starting from the proposition that an organisation can cope with double the number of employees but not with five times the number. But it is his general principle which is of major

interest together, perhaps, with his view that organisational change must go through all the stages⁹ thus limiting the scale of the discrete jumps in size.

Strategy and Control in a Medium-sized Business

Of equal if not even greater interest are Crabtree's remarks about complexity which make clear that many of the problems associated with size are essentially problems of complexity—multi-product and multi-process. In a seminar at Birmingham University some years ago, the industrialist H. P. Barker expressed it, indeed, in the phrase 'size is a problem of complexity'. It would be wrong to attribute too much to Crabtree's analysis of this matter, since it is clear from the quotations that he was particularly exercised by the question of data for pricing policy. But the placing of the argument in the context of organisation suggests that he was at least on the edge of making the connection between complexity and the control and communications difficulties attributed to large-scale organisational systems. The concept of an enterprise as a composite succession of different organisations is, moreover, a striking comment on Crabtree's sense of system in management. Paternalistic and individualistic as he manifestly was, this attitude towards organisations has something of the thinking which is often thought to characterise professional management with its regard for the continuing life of the organisation as a whole. Strong as was Crabtree's sense of personal leadership, he realised the relevance of specialisation, of concentration on relative advantage, and of delegation of responsibility.

. . . one frequent cause of weakness lies in over-emphasis of our strong points. We have all met the cashier whose first objection to the comptometer was that it challenged his own personal dexterity—the Works Manager, who, being a clever mechanic, holds up production in order to develop some new idea, the Sales Manager who insists that his staff adopt his own methods of approach in salesmanship. There are far too many Managing Directors and Presidents of companies who fancy themselves as experts in some minor phase of the business and who drive their subordinates to desperation by riding their personal hobbies.

Crabtree asserts a number of guiding principles for delegation: 'Any duties which a subordinate can do as well as ourselves, even though it may take him much longer, should at once be delegated.' Continuing with his ideas for the head executives (which it is not unreasonable to translate into the central control of a business, however this control be constituted), Crabtree argues that:

If any of our duties can be considered as a distinct group and are capable of being controlled apart from our other duties by some one (imaginary or otherwise) below¹⁰ ourselves, then those duties as

a group should be devolved upon a subordinate, leaving us only to control that group through him The fact that some of our duties can be separated and controlled as a group apart from our other duties, implies that they are detail responsibilities and can be combined and delegated without surrendering the function of Higher Control. To show the process graphically, we will presume we have five duties lettered A, B, C, D, and E. Presume C, D and E are a group of responsibilities which could, in combination, form a department for control by some imaginary person junior¹¹ to ourselves. If we call him X then that group (C, D and E) should be delegated to some subordinate official and our job of Higher Control is A, B, X.

Certain fundamental reservations are attached to these views. The creative responsibility of the Higher Control cannot be delegated since this would imply that the Higher Control itself had been surrendered.¹² Moreover, 'Delegation is always carried too far'. Crabtree had no use for 'the senior executive who has so "organised" his work that his business will be run without his attention for long and indefinite periods.' Far from indicating efficiency, this suggests to Crabtree 'that the man does not know the rudiments of his job, and that the major cost of his salary is an unnecessary expense on the business.' Fundamental also is the proposition that:

In no case should the power of final decision on strategical issues be delegated.

All authority centres on the Higher Control. You thus have a focal point for all responsibilities. If you go lower in the scale of authority, you have many men of comparative equal rank. If any one of them can decide strategical issues, he has the power to involve the company in serious difficulties, although in making decisions he can only know that facet¹³ of the business for which he is responsible.

Strategy is defined 'to involve decisions on the business objective, your development and competition policy, your business means (financial and otherwise) to accomplish those aims, and the time, circumstances and direction of defence or attack.' The term 'business objective' appears here to be used in a specific sense and not to mean criterion of business behaviour. Thus Crabtree's idea of strategy corresponds in some measure to Ansoff's decision class of strategic decisions which concern selecting the firm's product-market mix; allocating total resources among product-market opportunities; deciding on objectives, expansion strategy, finance strategy, etc. etc., and which tend to be centralised.¹⁴ They tend to be reserved, in other words to Crabtree's 'Higher Control'.

On the conventional issue of span of control, Crabtree is explicit that 'Seven to eight is the maximum number of subordinate executives who should have access to a chief executive' and advances as a corollary that 'Our responsibilities for Higher Control should be limited to eight

(or less) groups.' He is not prepared to specify them in general though he indicates those which apply in his own case, and he distinguishes between those that work to scheduled dates and times, those which do not. And he adds that: 'Where possible, I do not like too definite a line of responsibility: there are always jobs which are no man's concern if you draw hard and fast limits to responsibility.' Nevertheless, Crabtree spoke out strongly against certain ambiguities in control. He was very much against Departmental Heads being on the Board of Directors, for this put them, although subordinate to the Managing Director, in the position of being able to influence, even determine, his orders. The Managing Director was to be the dominant personality representing Higher Control.

It can be seen, then, that in this manuscript written in 1930, Crabtree envisaged the inception of a business as something which required systematic planning and that he saw its development as a series of organisational changes. Those changes would be enforced by growth in size, complexity of product-range and processes, shifting economic circumstances, and advances in management thought. It is perhaps pertinent to comment at this stage that he saw this within a framework of market change.

In a notable chapter towards the end of his manuscript, Crabtree introduces the idea of 'product cycle' in which in fact he discusses and seeks to specify the determinants and precise shape of the product life cycle (to which so much attention has been devoted by writers on marketing and on strategic decisions, e.g. Ansoff). He refers to the work of Prescott¹⁵ and Wesley Mitchell¹⁶ and says:

I did not know at the time, but I now find that this view [rise, maturity, flattening of curve] has been argued with regard to industries which it has been suggested pass through four stages of development:

Stage 1 Experimentation

Stage 2 Period of rapid growth into the social fabric

Stage 3 Through the point at which the growth increases as a diminishing rate

Stage 4 Period of stability.

This phasing he disputes and goes on to argue as follows: suppose a curve of the shape shown in Fig. 3 (see p. 211), which he categorises as 'The earlier view of product demand'. Then he says:

- A The curves as at 'A' did not seem to be inevitable . . . it only occurred in cases where the product had been allowed to dribble on the market, leaving the selling pressure to be exerted at a later stage. Where the product was marketed with definite pressure from the commencement, this phase of the curve was absent, and the curve tended to follow the dotted line as at 'B'.
- B There did not seem to be any stage of stability when the curve

is seen with a long time view. It rises to a peak and then begins to fall, unless there is some definite increase in sales appeal (e.g. lower price). This tendency to decline could evidently only be counteracted by steps which tended to reduce the profitability of the article.

The precise shape of the curve about which Crabtree wrote is a separate topic and its relevance here lies in the emphasis on attempts to establish an improved basis for forecasting and control.

Crabtree's views on strategy were naturally bound up with his concepts of leadership, creativity and Higher Control, with his view of the twin motivating forces of money and power, his individualism and paternalism. His sense of business as war and campaigning emerges again in his Chapter on 'The Will To Do' and his conviction that a successful business will always be found to have within it a single, dominating personality. 'Progress in business' he says, 'is essentially a matter of *will* power' and weakness even among the most able is 'due largely to varying conditions of health'. Such statements are perhaps controversial though a good digestion and determination of purpose have much to commend themselves as aids in decision-making situations. But Crabtree goes on to quote with approval from von Moltke . . . 'Any General, who in a particular case, takes, if not the best possible decisions, at least rational decisions, has always a chance of reaching his goal'. The basis for this Crabtree asserts 'is to get one's facts as accurate as possible, within the limits laid on us by time or the importance of the decision.' Given the facts, 'Any decision is better than indecision.' To that sub-principle of 'the will to decide' Crabtree adds with some caution that:

Success only depends upon 55% of your decisions being correct.

This is only true in degree. It is obviously risk to apply to a small business. Experience alone can determine what proportion of correct decisions are essential. Certainly no progress is likely if only half our decisions are right. Yet on the other hand no man can possibly give 90% of his decisions correctly and wisely.

He advises his readers to check for themselves what percentage of their decisions are correct and to what percentage of accuracy they attain, and recommends that the results be reviewed after six months. Persistence in a decision is a virtue—never to change 'until new circumstances and new facts demand a change'.¹⁷

It is especially interesting to detect in the practical commonsense and experience, a number of wider generalisations. The industrialist in a real decision-making situation is not omniscient and does not make the optimal decisions. Perfect rationality does not belong to him but the quest for rational behaviour does: he does not have unlimited time, nor should he devote the same amount of time to the search for facts for all decisions. Time and the unequal importance of decisions prescribe the

extent of search. Uncertainty in a world of changing circumstances means that decision-making is always imperfect, but the decision-maker should nevertheless seek to be rational by close attention to the acquisition of information of as accurate a kind as possible. Bounded rationality does not mean that everything is merely a matter of guesswork and the response to the inherent problems of ignorance and uncertainty lies in facts, the attempt to establish good costing and budgeting information, and systematic analysis of forecasting and control methods.

On forecasting (beginning from a comment on the business cycle), Crabtree remarks that:

On these matters, the attitude of the pure economist is quite distinct from that of the practical businessman. The economist is anxious to explain the phenomena The businessman wants some idea which will give reasonable accuracy in its suggestions. The one should ask 'Is it true?' The other must demand 'Will it work?'

Ultimately the two angles will merge; for the present they involve an entirely different approach.

Some kind of business forecasting is fundamental to Control.

This applied not only in general but also to control in detail in respect to trends in trade and prices, in groups of products in the business, and in individual products. If you do not see to this says Crabtree, others will: and 'It is better to form any theory of forecasting than to have no theory at all'.¹⁸

In the last resort Crabtree was an industrialist to whom the organic unity of entrepreneurial creativity and organisational structure appears to have been the essence of effective business. The same man who emphasised the importance of principle and periodic reorganisations concludes 'that the greatest mistake that students of business are making today is in exaggerating the importance of organisations and system'. These are essential 'as are the bones, sinew and muscle of the human body:' but 'mind and will are primary essentials.' He believed in 'a growing need for a specially trained far-sighted type of man' and in the existence of 'a science in management'. Himself clearly an individualist who held that 'every industrial combine tends to crystallise round the catalyst of a single personality,' he felt that the individualist now held his own only where he aimed for stability. The rise of organisation over the individualist meant that there had now to be mastered 'the technique of control by an executive class.'

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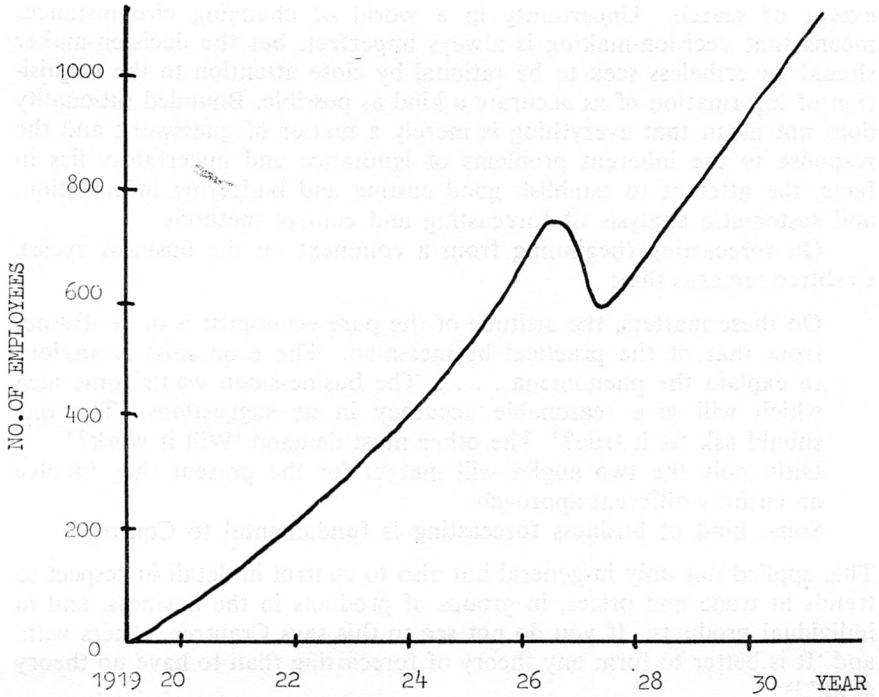
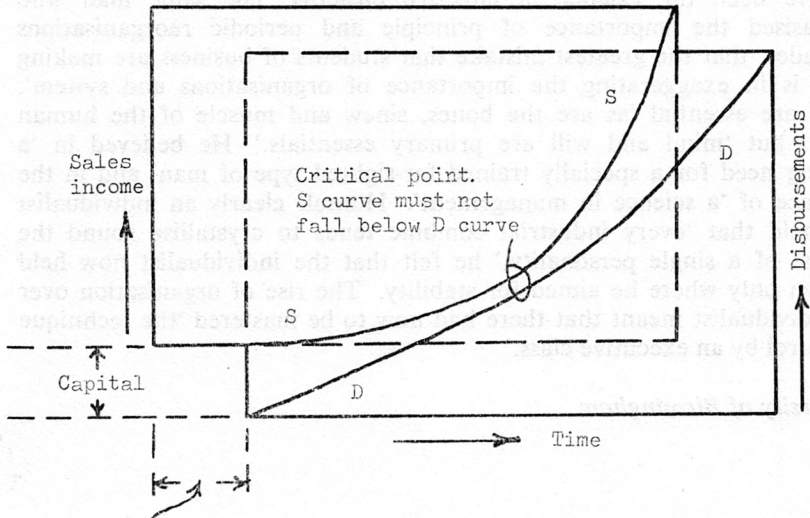


FIG. 1. Approximate graph of growth of firm, estimated by present authors from Crabtree's remarks



Time difference of curves due to credit terms of sales and disbursements, and to stock held.

FIG. 2. Survival analysis

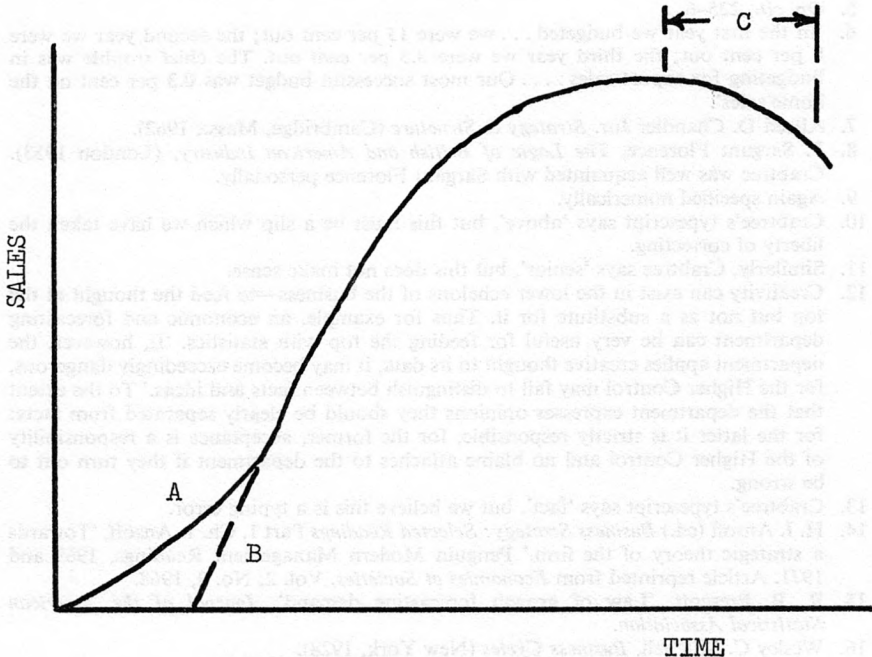


FIG. 3. Time-graph of product demand

NOTES

1. The typescript has been deposited in the National Archive for Electrical Science and Technology at the Institution of Electrical Engineers, Savoy Place, London WC2R. 0RL.
2. A rather surprising, but important, section of Crabtree's treatise deals with the role of research in manufacturing business—surprising because research was not (and indeed, still is not) normally associated with small firms, and important because, although at the time little attention was paid to the role of research, yet Crabtree's conclusions would probably still be agreed as valid. He saw research as an activity covering all aspects of the company's work—finance, marketing, administration and production as well as the technical and scientific bases of design. As to research on the product, he concluded that the manufacturing life of the product was nearly finished when the design had been perfected; it was then time to be researching its successor. Even in a firm with only a few hundred employees, he saw research as a basic necessity, and this must have been an important contributing factor in the continued success which his firm enjoyed.
3. G. H. Lorimer: *Letters from a Self-made Merchant to his Son*, (New York, 1902, 1970 edition) Introduction, xvii.
4. Unfortunately, though naturally enough, Crabtree does not really discuss the actual range of competitors with whom he was confronted. Nor does he expand on how the market was assaulted. We have, however, had the following note from his son Mr. Jack Crabtree:— 'Competitors: there were about eight or ten of them. The sharpest competition was with J. H. Tucker & Co., his previous employers and market leaders at that time. G.E.C. were then a growing force in wiring accessories, and one of my Father's most courageous decisions was to sue them for infringement of one of his main patents. The success of this action brought great prestige to his small company.'

5. *Op. cit.*, 225-6.
6. 'In the first year we budgeted . . . we were 15 per cent out; the second year we were 8 per cent out; the third year we were 3.5 per cent out. The chief trouble was in budgeting for export sales . . . Our most successful budget was 0.3 per cent on the home sales'.
7. Alfred D. Chandler Jnr. *Strategy & Structure* (Cambridge, Mass., 1962).
8. P. Sargant Florence, *The Logic of British and American Industry*, (London 1953). Crabtree was well acquainted with Sargant Florence personally.
9. Again specified numerically.
10. Crabtree's typescript says 'above', but this must be a slip which we have taken the liberty of correcting.
11. Similarly, Crabtree says 'senior', but this does not make sense.
12. Creativity can exist in the lower echelons of the business—to feed the thought at the top but not as a substitute for it. Thus for example, an economic and forecasting department can be very useful for feeding the top with statistics. 'If, however, the department applies creative thought to its data, it may become exceedingly dangerous, for the Higher Control may fail to distinguish between facts and ideas.' To the extent that the department expresses opinions they should be clearly separated from facts: for the latter it is strictly responsible, for the former, acceptance is a responsibility of the Higher Control and no blame attaches to the department if they turn out to be wrong.
13. Crabtree's typescript says 'fact', but we believe this is a typing error.
14. H. I. Ansoff (ed.) *Business Strategy: Selected Readings* Part 1, Ch. 1. Ansoff, 'Towards a strategic theory of the firm.' Penguin Modern Management Readings, 1969 and 1971. Article reprinted from *Economies et Societies*, Vol. 2, No. 3, 1968.
15. R. B. Prescott, 'Law of growth forecasting demand', *Journal of the American Statistical Association*.
16. Wesley C. Mitchell, *Business Cycles* (New York, 1928).
17. Crabtree recounts a rather curious story in this context. 'Many years ago we were manufacturing a certain electrical product which developed technical faults. We had copied the idea from current American practice. Experience soon showed that it was quite unsuitable for use in Gt. Britain. The position was very serious and necessitated very careful research. If we made a wrong decision we were faced with the gravest consequence. It was in fact the most critical time in our history. Certain changes in design were made and put into manufacture. Although we were then following the new methods, the complaints continued. One customer, taking a large proportion of our output, threatened to close his account unless we made further changes, in which we had no confidence. Even our salesmen weakened in their faith to us. The pressure brought to bear to make us give way was almost overwhelming. It was victory or death with a vengeance. We had done what we felt was the best we knew how and we decided to stand tight to our design even though the heavens fell upon us. Time has shown that the decision was right, and that the method was right. It was one of those experiences which fortunately do not often recur in a single lifetime.'
18. Mr. Jack Crabtree has pointed out to us, on reading our draft, that his father placed much more importance on the prediction of trade cycles than we had thought from our reading of his typescript. He had indeed had quite substantial booklets on the subject printed and circulated privately, and claimed that his prediction of the slump of c.1930 had enabled his firm to prepare for it and thus to survive it.