The first business computer: a case study in user-driven innovation

The First Business Computer: A Case Study in User-Driven Innovation

Frank Land
London School of Economics

Nearly half a century ago the world's first business computer application was rolled out. The host for the application was a British catering and food-manufacturing company, which had developed and built its own computer, designed for business data processing. The author traces the endeavor's history and presents an analysis of how and why the company—J. Lyons—was in a natural position to take on the challenge, the precursor of the information revolution we see today.

The final years of the 20th century mark the fifty-year history of the "invention" of electronic computing. Although the United States is now the greatest and most influential user of computer technology, and has and continues to produce great innovators, many advances had their source in Europe. Today Europeans continue to play an important role in the evolution of computing.

One of the most interesting innovations to come first from Europe was the application of computers to automating business and administrative procedures and solving business problems. Today, business data processing (or management information services as it's often called in the US) in all its forms, ranging from transaction processing and decision support to desktop publishing and e-mail, has become the largest single use for computing technology. The use of computers is pervasive in all kinds of businesses and administrations.

One of the first uses of computers in the business area came from a British food manufacturing and catering company, J. Lyons and Company, and dates back to 1949.[1] The case is of particular interest because this innovative use of computers was driven by an organization that had no prior experience in electronics, yet they built and applied to their business one of the earliest stored-program computers, the LEO I. Truly a case of user-driven innovation.

This article sets out, by means of a case study and an analysis of the case, to describe how J. Lyons came to design and build the world's first business computer.[1-5] The analysis is carried out in two stages. In the first, features of the case are selected that might provide a pragmatic explanation of how a food business company achieved precedence in a field where it might be expected that high-technology equipment manufacturers would be expected to lead. In the second stage, some theoretical frameworks derived from recent research into company culture and corporate success are examined to see if they throw further light on the case.

The case study

This study takes the case of J. Lyons to the point where the company decided to design and build their own computer in 1949. (Much of the material in this case study, including most of the quotations, are taken from Bird,[3] and Caminer et al.[4])

Company background

J. Lyons was founded in the late 19th century by the successful tobacconists Salmon and Gluckstein. The company name is derived from a relative of the founders because, at the time, Salmon and Gluckstein were not confident that they would make a success of the new enterprise and did not want their own names associated with a risky venture.

Salmon and Gluckstein formed the company in 1887 to fill a gap in the catering market. They had noted that catering facilities at exhibitions and trade shows were often of a very poor standard. They thought there would be a market for affordable, quality food combined with some entertainment at the many shows and exhibitions held in locations throughout the country. The provision of catering facilities for short duration exhibitions required meticulous planning both in the sense of controlling the operation with its highly-peaked activities

1058-6180/00/$10.00 © 2000 IEEE

so as to provide the quality demanded by the public and at the same time to maintain tight control of costs.

Thus J. Lyons management from their earliest days developed a culture of seeking the most effective ways of controlling their business. The company expanded rapidly from success at catering for special events, very much a niche market, to becoming one of the most important and respected food companies in the UK. In the 1940s and 1950s J. Lyons was one of the most successful businesses in the UK with its products, services, and establishments—Lyons Tea, Lyons Cakes, Lyons Ice Cream, the catering services provided at great national events such as the Buckingham Palace Royal Garden parties and the Wimbledon tennis championships, and the Teashops and Corner Houses (large, popular, but stylish London restaurants)—being household names.

From its beginnings the company embraced a culture of self-sufficiency. It built or acquired through purchase the capability to provide the goods and services needed for the core business of catering. It became a vertically integrated company, with its own engineering works designing and building machinery needed by the factories, body shops that built the company's transport fleet, laboratories engaged in food research, and laundries washing the company's dirty linen. Of course, where the company identified suppliers capable of meeting Lyons' exacting standards they were used, but the company ensured that such suppliers maintained laid down standards.

Nevertheless, the culture of self-sufficiency led to a belief by management that there was little the company could not do as well or better than any outsider. Wartime experience enhanced that confidence. Some of the Lyons factories had been converted to the making of munitions and company management prided itself on their efficient conversion that put the company on a wartime footing.

Lyons had built its success on quality products and services sold to a mass market. Selling to a competitive mass market required tight control over costs and margins and a sensitive response to customer preferences and market movements. Given the very large number of daily transactions—counted in tens of thousands—with an average very low value and a profit margin per transaction of a fraction of a penny, the company could progress only by a constant striving for value adding innovation.

Senior management—primarily members of the founding families, the Salmons and Glucksteins, plus a few trusted senior employees such as George Booth, the company secretary—recognized that progress could only be maintained if the company hired people of high academic standing. In 1923 they hired John Simmons direct from Cambridge university (where he had been a Wrangler, the term Cambridge used for the highest performers in the mathematics degree, and where he had earned a first class honors degree in mathematics) to join the company as a management trainee and statistician.

In an interview[1] with Chris Evans at the Science Museum about 1970 Simmons explained:

> In fact I was engaged to try to build up a system of information for the management of the company which would be superior, more sensible, than just depending upon the profit and loss account and such like. … in this respect the company was already ahead.

Simmons rose rapidly in the management hierarchy and was responsible for introducing a number of far reaching changes in practice and in organization. These changes were designed to cope with the growth of the business and to achieve the control necessary for the maintenance of profits. Simmons ensured that the company kept up a continuous striving for improving practice and, in doing this, introduced many innovations in particular to the management support services. This enabled management to keep their business under constant cost effective review.

In the early 1930s Simmons set up the Systems Research Office whose function was to review existing systems; trawl the world for better way of supporting management activities; and invent, test, and implement improvements. The Systems Research Office, working with line managers, produced a stream of business process innovations from the time of its establishment. Examples include the notion that sales representatives, each having a customer group of many small retailers, would not only be responsible for selling to their own customer group but would also be totally responsible for the accounting, credit, and payment functions. These functions were conventionally carried out at arms length by a separate accounting office. The introduction of "traveler covered credit" was a radical business process innovation, which increased efficiency and the effectiveness of the representative—the sales representative took responsibility for the accounting necessary to maintain a customer account.

Before World War II the Systems Research Office had for many years been investigating the possibility of coping with the mass of transaction data by some kind of mechanization or automation. They had started to investigate the possibility of devising a document reader for transaction data. They had researched the possible application of a unit record systems based on punched cards but rejected these as too localized, too constraining, and too costly. Lyons had only one punched card installation and that had a very limited application. Instead, the company had installed alternative types of office mechanization based on accounting machines and calculators.

By 1946 Simmons had been promoted to the post of chief comptroller responsible for all the management accounting and support functions in the business, and in 1950 he joined the family dominated Lyons' board as an employee director. In 1932 Lyons engaged another Cambridge Wrangler, T.R. Thompson, who had previously been employed as assistant secretary to a large Liverpool store. Under Simmons' tutelage Thompson also rose rapidly in the organization and by 1946 had reached the position of chief assistant comptroller.

John Kay[6] in his study of what makes businesses successful suggests that architecture, by which he means the structure and style of responsibilities and relationships, is one of the important enablers. Over the years Lyons had developed a distinct management style based on the way information was passed from operations—manufacturing, selling, distribution, as well as the concomitant operations concerned with invoicing and payments—to the decision making senior management. Each of the many businesses (tea, teashops, ice cream, bakeries, kitchens, outside catering, and so on) had their own groups of clerks and managers. The vast mass of transaction data stemming from these operations was summarized and compared with preset standards, forecasts, and budgets. The resulting information was analyzed by the junior manager in charge of each group, who would be responsible for explaining any important variances. (In the Lyons grading structure, junior managers were placed in the F or supervisor grade and not deemed managers. Many of them rose to manager rank in their subsequent careers and some reached the very top of the organization.) The junior manager had a direct line to the senior manager, often a Lyons director, responsible for that activity and to whom the functioning of that activity had to be explained. At the same time the senior manager could ask the junior liaison manager to undertake investigations of the "what if" type—suppose we wish to increase the production of Swiss rolls by 10 percent and reduce the production of cupcakes by 3 percent, what would be the effect on gross profit? The arrangement ensured direct access by senior management to information originating at the operating level and bypassed the more usual filtering through layers of middle management.

This management style provided the company, long before the advent of computers, with both an almost real-time management information system and a decision support system of considerable sophistication. In addition, the architecture and system provided senior management with a detailed picture of the week's trading on the Monday of the following week.

Yet in many other ways the company was deeply traditional and conservative. It operated on a strictly hierarchical basis. At the top were the owners, the founding families. They ran the company with the help of very few employee directors. Each grade of management had its own dining room. Separate toilets divided managers from the rest. As might be expected in a company with these types of relationships, interaction between employees was conducted in a formal way with formal modes of address, particularly to one's superiors in the hierarchy. Sports were encouraged and a great variety of team games took place with enthusiasm on the company's large sports grounds. Trade unions were discouraged, though the family took a paternalistic interest in its staff.

Nevertheless, top management encouraged innovation in working practices[7] whether in the factory with the design and introduction of continuous ovens for the manufacture of miles of Swiss rolls per day, or in the office with the adoption of microfilm to provide a single record of orders received that served as delivery note and invoice. Management insisted, however, that all new practices had to be tested and prototyped until most elements of risk had been eliminated.

Initiation

In May 1947 two senior company executives, Thompson and Oliver Standingford—another assistant comptroller who had joined Lyons in 1930 as a management trainee—visited the US to see what developments in office equipment had taken place since the start of World War II. They found little significant change in office equipment. But they did hear about experiments with electronic brains, such as the engineering numerical integrator and

computer, or ENIAC, used exclusively for military, scientific, and engineering calculations. They recognized quickly that the characteristics of the machines they saw could be modified to provide the necessary capabilities to solve some of the problems of business data processing. They visited a number of the pioneers and were particularly impressed by Howard Aiken at Harvard whose practical appreciation of bringing equipment into reliable operation mirrored their own ideas of the problems that they might face

Thompson and Standingford discovered that few of the pioneers had thought about the possibility of applying the machines to business operations, though American Prudential Insurance Company had already established plans to use a computer for premium billing and actuarial calculations. Both Aiken at Harvard and Goldstine at Princeton told them that England's Cambridge university under Professor Douglas Hartree—a mathematical physicist—had started work on the electronic delay storage automatic calculator (EDSAC). In May 1949 EDSAC would become the world's first stored program computer to do regular mathematical work.

On their return to England Thompson and Standingford visited Cambridge where they were introduced to Maurice Wilkes, director of the mathematical laboratory, who had started work on the EDSAC. They were most impressed with the advances in the technology, well beyond anything they had seen in the US. However they wrote:

> Progress on the machine is slow and they talk of 12-18 months before completion. They have all their plans drawn and the hold-up is purely due to lack of money. Dr Wilkes and one draughtsman assistant alone are handling the job, assisted at the moment by two vacation students. We told them that unless they could proceed more rapidly they may find the machines for sale in America before they complete their first model. We were told that given £2000 they could complete much more rapidly. Both Professor Hartree and Dr Wilkes were willing and keen to co-operate with us, in particular they are interested in applying their machine to any clerical job we may suggest.[8]

Having gathered all the information they thought they needed, Thompson and Standingford produced a report for the Lyons board, which they first showed to Simmons. With Simmons full backing they presented the report to the board, with a cover memorandum that included inter alia the following statement:

In May 1949 EDSAC would become the world's first stored program computer to do regular mathematical work.

> We believe that we have been able to get a glimpse of a development which will in a few years time, have a profound effect on the way in which clerical work (at least) is performed. Here, for the first time, there is a possibility of a machine which will be able to cope, at almost incredible speed, with any variation of clerical procedures, provided the conditions which govern the variations is predetermined. What effect such machines could have on the semi-repetitive work of the office needs only the slightest effort of imagination. The possible savings from such a machine should, be at least £50,000 a year. The capital cost would be of the order of £100,000.
>
> We feel, therefore, that the Company might well wish to take a lead in the development of the machine and indeed that, unless organisations such as ours, the potential users, are prepared to do so, the time at which they become commercially available will be unnecessarily postponed for many years.

The report describes details of Thompson and Standingford's visits and the ideas discussed with some of the computer pioneers. It describes how the computer works, suggests how the mathematical computers might need to be modified for business use, and goes on to indicate a number of possible applications and how they might be handled on the computer. These included ideas for a variety of transaction processing applications, but also hint at the possibility of using the computer for word processing.

Under the heading "Steps that might be taken by Lyons to advance the development of Electronic Machines" they wrote:

> Our first concern is, of course, the advantage which Lyons may gain from the commercial development of electronic machines, but there is a wider aspect which cannot be overlooked. This machine may well be a prime factor in

> relieving the present economic distress of the country. In this respect we cannot help but feel that Lyons occupies a key position; no-one else here, as far as we can learn, has realised the far-reaching possibilities of electronic machines.
>
> We assume that Lyons will want to take full advantage of these machines for their own offices. It is possible for us to play a passive role by merely keeping in touch with developments, and in due course buying machines as they become available, probably from American sources. But such a role would not enable us to have any influence on the kind of machine built, and without commercial influence they may be built in a form more suited to handling mathematical and census calculations owing to the influence of the large governmental concerns.

Finally, the report laid out five possible strategies for the Lyons board to consider that would enable the company to apply computer technology. These included the suggestion that Lyons should support the efforts of Wilkes at Cambridge with a financial grant and at the same time provide him with examples of clerical procedures to use in programming experiments. An alternative strategy suggested that:

> We could build a machine in our own workshops drawing on information and advice from Harvard University.

The board was persuaded to accept the basic recommendation that Lyons should itself take the initiative to acquire a computer for its office work. Once Booth, the company secretary, had thrown his support behind the recommendation there was no dissension among board members. They agreed to support the Cambridge venture but to work towards building their own machine with the help of Wilkes and his team. The board also agreed to help finance the work at Cambridge with a grant of £3000, the money to be made available as soon as Cambridge could demonstrate that the EDSAC could carry out serious mathematical work. In addition, Lyons offered to make one of their own people, Ernest Lenaerts, who had been a clerk in the Lyons offices prewar but had worked on radar during the war, available to Cambridge. Lenaerts, whose formal education has finished with high school examinations (matriculations), became an important contributor to the development of EDSAC and later a key person in the design and building of Lyons' computer.

In return for the Lyons help package, Cambridge agreed to help Lyons design and build their own computer and to help recruit a chief engineer, Dr. John Pinkerton, to head the technical side of the project. A project team was established and work commenced in 1949 to design and build the computer. Simmons suggested a name for the machine—Lyons Electronic Office, or LEO.

LEO differed from EDSAC in that it was designed specifically for large-scale data processing with multiple buffered input and output channels, capable of being linked to a variety of input and output devices. By 1951 the LEO team had built the basic computer and the first experimental, but regular, business application was being run for the Lyons bakeries. Further work in linking input and output devices, extending the store, and improving reliability continued until in December 1953, LEO I was formally declared completed and ready for full-scale operational work.

Discussion and analysis

To many observers the notion of a catering company in England shortly after World War II successfully pioneering what is now called the information revolution seems unlikely and incredible. Lyons not only recognized the potential role of electronic computers for business data processing but actually designed and built such a machine. Indeed, the US edition of the book *User-Driven Innovation: The World's First Business Computer*[4] is called *LEO—The Incredible Story of the World's First Business Computer*.[1]

The pragmatic explanation

Yet looking at J. Lyons in the period after World War II, their recognition of computers as a way ahead and the decision to build their own should not be regarded as surprising. There are a number of features in the way the company had developed and was organized in the immediate postwar period (1945-1955) that provided the basis for the pioneering move into business computing.

The nature of the business. The business was characterized by the very large range of food products and food providing services. This was supported by a range of company owned and managed services. The company sold its products directly to the retail trade or through its catering outlets directly to the public. This resulted in a mass of transactions with relatively low average values. Competitiveness depended on advantageous pricing of its products. Thus the company was constantly fighting to contain or reduce its costs of doing business—

its transaction costs in the parlance of economists. Hence, its constant search for improving its business processes in all aspects of the business including manufacture; distribution; supply; and most relevant to the decision to experiment with electronic computers, the support services provided by the office. The latter were responsible for the standard processes associated with bookkeeping and accounts, payment of suppliers, charging customers, and paying the staff but also with the management support activities of providing management information. By the middle 1930s the company had established a systems research office to put the search for improved methods onto a more formal footing.

Personnel and leadership. Senior management recognized that to sustain the growth and competitiveness of the company it had to have top-class management. Lyons was one of the earliest companies to establish a management trainee scheme and many of the people later involved with the LEO enterprise first joined Lyons as management trainees. These included Standingford and Thompson. David Caminer, probably the world's first business programming manager, joined Lyons as a management trainee in 1936, became head of the systems research office, and joined the LEO team as one of its first members.

By recruiting people with top-class academic qualifications, such as Simmons and Thompson, and permitting them to take leadership roles in the management of the company, the Lyons management ensured that it was never short of ideas on how to improve. This was reflected in the esteem in which the company was held in the first half of the 20th century. Their leading role in developing systems was widely acknowledged beyond the boundaries of their industry sector. Simmons played a leading role in the establishment of the Institute of Administrative Management and was elected as its first president. It is in keeping with this tradition that Thompson and Standingford could claim in their report that it was almost a duty for Lyons to get directly involved in the design of a computer for business applications to solve the critical problems of the nation (see preceding quotation from the report).

Self-sufficiency. The economist Oliver Williamson,[9,10] suggests that firms have two types of strategies for coping with transaction costs. The first, which he calls hierarchies, involves vertical integration. The firm attempts to minimize transaction costs and retain control by becoming as self-sufficient as possible. The second strategy, which he calls markets, involves going to the market (or outsourcing in today's parlance) for all but the core activities of the business. Companies minimize costs by using the mechanisms of the marketplace and retain control through contractual arrangements with suppliers.

By recruiting people with top academic qualifications and permitting them to take leadership roles, the Lyons management ensured that it was never short of ideas on how to improve.

Lyons, in general, preferred the first strategy because they had the confidence and experience to believe they could provide the relevant goods or services more effectively than any contractor. Of course, some goods and services had to be subcontracted or purchased when investigations showed that appropriate suppliers were available. But even then, Lyons, like Marks and Spencer (one of the UK's leading retailers), set up an organization that set standards and ensured that the suppliers themselves were efficient and were always seeking improvements. Thus it did not take Lyons long to realize that outside suppliers capable of meeting the requirements envisioned by Simmons and Thompson simply did not exist in the late 1940s. The company had confidence based on previous experience—including the very recent experiences of the war—that they were capable of effectively organizing businesses remote from their core food business.

The academic frameworks

Recent research throws some light on the conditions that have to be fulfilled if an enterprise is to be successful and capable of sustained innovation. Does the research and the frameworks developed help explain how the Lyons of the 1940s and 1950s came to be first in the development of computers working on business applications?

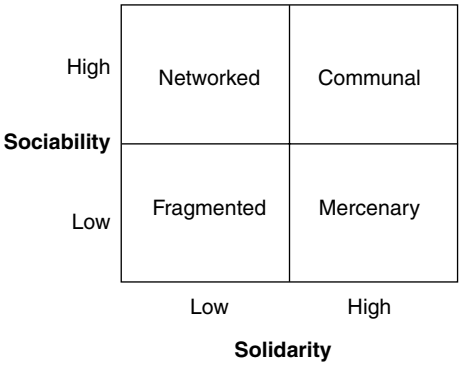

Figure 1. Two dimensions, four cultures.

Goffee and Jones. The most recent study is by Goffee and Jones[11] and reports on research that they are conducting on the relationship between company success and different styles of company culture. They distinguish between two dimensions of culture. The first dimension is concerned with the degree of sociability achieved by the employees of the organization. The second is concerned with the degree of solidarity present among the employees.

By sociability Goffee and Jones mean a culture that regards the organization as a community and encourages sincere friendship among its employees. Relationships are often more important than measures of performance. Hence it is rare to point the finger at a colleague who is under performing. Employees tend to share values and a high value is put on achieving consensus, even if that means engaging in compromise. Esprit de corps tends to be high; teamwork flourishes; and "a spirit of openness to new ideas, and freedom to accept out-of-the-box thinking" prevails. There is a wide range of sociability in organizations, from enterprises with few social contacts and few good relationships to enterprises that offer a well-balanced community or family.

Solidarity, in contrast, implies shared objectives rather than shared values. "Its relationships are based on common tasks, mutual interests, or shared goals that will benefit all involved parties." The organization will respond quickly to outside threats, and low-level performers are not tolerated. Members regard achieving consensus as having a low value and think it works against achieving high performance targets and could even help competitors. A good example is where in an effort to achieve consensus, difficult decisions are delayed, permitting a sharper competitor to take the lead. Employees are clear about job definitions and organizational roles. Again organizations vary enormously in the degree of solidarity achieved.

Goffee and Jones note that successful organizations can exist at all points in the two dimensions, including the extremes. They go on to suggest that we can classify organizational culture into four archetypes: networked, communal, fragmented, and mercenary. Each archetype is associated with a position on the sociability and solidarity dimensions. Again, each can be the basis of a successful enterprise, though they suggest that it is possible to devise a contingency framework that indicates the best fit between the cultural archetype and the enterprise. Goffee and Jones plot the two dimensions of culture, sociability, and solidarity against the four archetypes in a two by two table, as illustrated in Figure 1.

Does the Lyons of the 1940s and 1950s fit into this model? I used the assessment questionnaire provided by Goffee and Jones (see Figure 2) and rated Lyons in terms of sociability as moderately high. (Note: This questionnaire was not administered to a sample of Lyons' employees from the 1940s and 1950s, but was completed by the author and an ex-LEO colleague.) The rather formal, hierarchical structure of the firm was offset by the paternalistic attitude of the founding family, reflected by the social activities sponsored by the company. There were a large number of social events organized through a variety of cultural and sporting clubs. A relatively large number of employees took part in social events and often participated with their families. In these clubs, rank within the company, except at the most senior level, played little part. Ability at football, or chess, or bridge, or organizing concerts counted for more and led to esteem among the peer group. There was undoubtedly a Lyons esprit de corps. Sometimes newcomers found it difficult to enter established networks of friendship. This is in keeping with Goffee and Jones' findings that report the formation of cliques in some of the organizations that rated high on the scale of sociability.

In terms of the other dimension, solidarity, using the questionnaire Lyons scored a somewhat higher rating then on the sociability scale. The company introduced management by objectives as a way of ensuring that all employees had a definition of what was expected of them and, indeed, participated in the definition of the roles and the way performance was measured. Company solidarity was reflected in the arrogance with which members of the Lyons staff regarded competitors. There was a general feeling that Lyons the company and Lyons employees were an elite.

As Goffee and Jones point out many managers assume that the top right hand quadrant of Figure 1, scoring high on both the sociability and solidarity dimensions, the communal type of culture, is the most likely to indicate a successful company. But their research suggested that the communal type of culture tends to be unstable and is rarely sustained. Some of the characteristics of high sociability, for example, the reluctance to "shop" the low-level performer, are inherently in conflict with the high solidarity characteristics of putting a high value on business objectives. Nevertheless, they did find in existence organizations characterized as communal and for which that type of culture was appropriate and associated with success. Goffee and Jones suggest that strong, charismatic, leadership that believes in the values associated with sociability but, at the same time, is absolutely clear on the direction the company is driving and doesn't permit subpar performance is necessary to sustain the communal culture.

What is your Organization's Culture

To assess your organization's level of sociability, answer the following questions:

	Low	Medium	High
1. People here try to make friends and to keep their relationships strong	☐	☐	☐
2. People here get along well	☐	☐	☐
3. People in our group often socialise outside the office	☐	☐	☐
4. People here really like one another	☐	☐	☐
5. When people leave our group, we stay in touch	☐	☐	☐
6. People here do favours for others because they like one another	☐	☐	☐
7. People here often confide in one another about personal matters	☐	☐	☐

To assess your organization's level of solidarity, answer the following questions:

1. Our group understands and shares the same business objectives	☐	☐	☐
2. Work gets done effectively and productively	☐	☐	☐
3. Our group takes strong action to address poor performance	☐	☐	☐
4. Our collective will to win is high	☐	☐	☐
5. When opportunities for competitive advantage arise, we move quickly to capitalize on them	☐	☐	☐
6. We share the same strategic goals	☐	☐	☐
7. We know who he competition is	☐	☐	☐

Figure 2. Goffee and Jones' organization assessment questionnaire.

The Lyons of the 1940s and 1950s fits reasonably well into the communal culture quadrant, scoring quite well on sociability and somewhat higher on solidarity. Does this help to answer the question of how they came to make the decision to design and build a business computer to serve their management?

Goffee and Jones found three features common to enterprises that could be described as having communal cultures and were successful over a long period.

They found that successful communal cultures are associated with organizations in which extensive teamwork across functions makes innovation possible. They give as an example a pharmaceutical company (Glaxo Wellcome) in which competitive success is based on a continuous stream of patent-protected product innovation. But, although product innovation is important in the food business, there is little protection against copying, and more competitive advantages may be gained from process innovation both in manufacturing processes and support service processes. In Lyons, process innovation was encouraged through suggestion schemes and more formally via the activities of the systems research office. A stream of new ideas bubbled up through the organization and many were implemented over the years. Perhaps the same conditions that encourage product innovation in the pharmaceutical industry stimulated the kind of process innovation that led Lyons towards the recognition that computers would

help to make them more efficient and effective. In Lyons, the stream of ideas for improvement could only be effectively implemented if the necessary teamwork was deeply embedded in the culture.

Again the confidence to take on new types of work like designing a computer inside the organization rather than going outside to specialist contractors stems from the same communal characteristics.

Goffee and Jones' second feature of a successful communal culture is that there are real synergies among organizational subunits and real opportunities for learning. Again these appear to be important characteristics when it comes to disseminating and implementing the range of innovations discussed previously. Lyons encouraged the synergy and learning by widely broadcasting throughout the organization what the company was attempting in its LEO venture. Although the rapid growth of the LEO team necessitated recruiting, mainly of new graduates from the outside, many of the early LEO team members came from a variety of job functions inside Lyons. This, too, facilitated mutual learning and synergy.

The third finding of Goffee and Jones suggests that a communal culture is important in organizations that have to take a long view—where strategies are long-term rather than short-term. Clearly the Lyons decision to build and apply a computer looks like a long-term strategy, and thus supports the notion that a communal culture would enable long-term views to be taken. However, it is worth noting that the Lyons management was somewhat optimistic both on how long it would take to get the computer built and online and the time it would take to pay off the investment. Early estimates suggested that a time period of about two years for building the computer and a further two years to recover the costs would be needed. Perhaps a planning horizon of four years might be regarded as taking a long view in the food industry. There is no doubt that the Lyons management looked at the possibility of computers as one that influenced not only the long-term strategy of the company itself, but as something that might affect the whole direction of business practice in the UK.

Goffee and Jones note that organizations operating in a dynamic and complex business environment benefited from having a communal culture. In the immediate postwar period almost all businesses were faced with the transition from working on a wartime footing to that of peacetime. In the food industry the continuing problems of food rationing increased this complexity. Perhaps Lyons survived the complexities of the postwar period by having a communal culture. More importantly it is a culture that enabled the company to behave in a dynamic manner.

What Goffee and Jones' research point to is that culture provides the environment in which success or failure is played out. Certain types of culture facilitate or enable organizational behavior. The communal culture Lyons appeared to have in the 1940s and 1950s would lead us to expect a company that encouraged and welcomed innovation and was confident and capable of taking the long view and make long-term strategic judgments. It appears that it was a company capable of learning and therefore absorbing change and innovation. Goffee and Jones' research helps us place Lyons in its cultural context and to understand how the particular strengths of that culture could lead to the decisions they made.

John Kay. The second framework is derived from John Kay.[6] His research into what factors underlie corporate success found that four distinctive capabilities are associated with the successful enterprise. Kay notes that particular architectures, good reputation, a flow of innovation, and the presence of strategic assets are characteristics associated with successful enterprises. Any one of these can help to distinguish an enterprise and lead to its success. Although, usually more than one of the capabilities are present, and the presence of one can lead to others. Thus an appropriate architecture can help the business become a successful innovator, which in turn can ensure a sustained and a high reputation.

By architecture Kay means the set of formal and informal relations that exist in the enterprise. Kay describes architecture as "...a network of relational contracts within, or around, the firm." As noted previously, Lyons had developed a management style—really an architecture in Kay's sense—that provided clear information channels between operational and management levels unblocked by problems of hierarchy and its associated bureaucracy. This had three effects. It brought operational management and their supervisors into close contact with senior level management, resulting in mutual trust and esteem and hence, effective teamwork despite the existence of a notional hierarchy. Next, it made quick decision making possible at the senior level. Finally, it enabled new ideas bubbling up from the lower levels to be brought to the attention of senior management and acted upon speedily.

Reviewing the case study it is clear that Lyons in the period under discussion had been a company in which a flow of innovations (both process innovations concerned primarily with administrative procedures in the offices, and technical processes in the manufacturing units) and product innovations were facilitated by the distinct architecture developed by the company. Later all three consequences of the architecture helped to start the LEO project. The mutual trust engendered by the management style and architecture enabled the Lyons board to respond positively and quickly to the report produced by Thompson and Standingford without the delays (and obfuscation) generated by some other architectures.

The second distinctive capability identified by Kay is reputation. Kay illustrates the role of reputation in sustaining company success. A good illustration from today (not from Kay) of the role played by reputation is the Virgin organization and its charismatic founder Richard Branson. Branson made his reputation early by founding a successful record business. This reputation has carried over to the extent that the market appears willing to provide support for Branson whenever he branches into businesses that appear to be dominated by established corporations, such as Coca Cola, British Airways, or the major financial services companies.

The fact that Lyons had established a reputation of "can do" in catering and food manufacturing and in World War II in making munitions made it more believable that it could also make a success of computers. Management had the confidence that they could make computers suitable for business needs, where they also believed that more conventional electronic and business machine companies would be much slower off the mark. Lyons' management had a belief in their company reputation. But to succeed they needed others to share that belief. Would Cambridge university have been willing to collaborate with Lyons in building LEO as a successor to EDSAC if they did not share the confidence in the Lyons reputation? Subsequently, despite some skepticism, Lyons' reputation and in particular the reputation of certain individuals, such as John Simmons, played a major role in the successful launch of LEO Computers as a vendor of business computers.

The third distinctive capability in the Kay framework is innovation. He notes that it is often not enough for an enterprise to have the ability to make innovations. Too often the innovator does not reap the benefit of the innovation or cannot sustain the advantages which the innovations were expected to convey. He argues that it requires other distinct capabilities, notably architecture, to enable innovation to translate into business success. Kay's notion of architecture comes close to the concept of culture as defined by Goffee and Jones.

Lyons appears to have had the architecture to welcome and accept process innovations of a quite radical nature.

Lyons appears to have had the architecture characterized by their communal culture to welcome and accept process innovations of a quite radical nature. Whether they had the capability to reap the benefits of all the innovations and, in particular, their pioneering efforts in adapting information technology to the business, requires analysis of the later stages of the initiation, dissemination, and implementation of the technology.

The final distinct capability identified by Kay is the availability of strategic assets. Strategic assets to Kay comprise features such as the possibility of controlling the market via a monopoly position. Perhaps the LEO venture was made possible by the existence of a supply-side vacuum. Lyons' strategic asset was the lack of a viable supplier in the UK just at the time that Thompson and Standingford produced their report. Another strategic asset was the availability within the Lyons organization of employees of the caliber of Simmons, Thompson, Standingford, and Caminer. Without this very distinctive asset it is doubtful whether Lyons would have initiated the LEO project and built the world's first business computer.

A feature of Lyons at that time was that they had developed strength in all four of Kay's distinct capabilities, and that they reinforced each other. The right architecture led to innovation. Successful innovations improved reputation. Lyons had become an acknowledged leader in innovation for administrative efficiency. The strategic asset of the lack of supply-side competition was perhaps fortuitous, but having the right people on board was a consequence both of reputation —the best people wanted to work for Lyons—and of the architecture.

Conclusion

All three strands in the analysis—that based on a pragmatic analysis of the case history and those based on the academic frameworks—contribute to our retrospective understanding of how Lyons came to initiate such an unlikely venture as to invent the business computer. Retrospective analysis is always easier than prediction. Do the three bases of analysis used in the article, individually or in combination, enable us to predict which enterprises will lead (successfully) in innovation and which are more likely to be followers? These bases may help us identify enterprises that have in place the conditions for making successful and sustained innovation possible. They may also help identify the businesses that are unlikely to take up a leadership role via innovation. However, no single framework provides certain answers. Used in combination they may provide greater powers of analysis.

Innovation theory itself has produced a number of theoretical models and frameworks. Many of these emphasize the diffusion and adaption phases of the innovation phenomenon and are less relevant to the earlier invention and initiation phases. In the later stages of this study, analyzing the adoption by Lyons of the LEO computer and the diffusion of the technology first through Lyons and then many other companies, more use is made of theories of technology transfer[12-15] including those which are specifically tailored to the special case of information technology and information systems.[16-18]

References

1. D.T. Caminer et al., *LEO—The Incredible Story of the World's First* Business *Computer*, McGraw-Hill, New York, 1998. (Note that this book is the revised US edition of Caminer, *User-Driven Innovation*, see reference 4.)
2. J. Hendry, "The Teashop Computer Manufacturer: J. Lyons," *Business History*, Vol. XXIX, No. 1, Jan. 1987, pp. 73-102.
3. P.J. Bird, *LEO: The First Business Computer*, Hasler Publishing, Wokingham, UK, 1994.
4. D.T. Caminer et al., *User-Driven Innovation: The World's First Business Computer*, McGraw-Hill, Maidenhead, UK, 1996.
5. J.B.B. Aris, "Inventing Systems Engineering," *Proc. Kiev Symp. Computers in Europe: Past, Present, and Future*, Int'l Charity Foundation for History and Development of Computer Science and Technology, 1998, pp. 33-46.
6. J. Kay, *Foundations of Corporate Success: How Business Strategies Add Value*, Oxford University Press, Oxford, UK, 1993.
7. J.R.M. Simmons, *LEO and the Managers*, MacDonald, London,1962.
8. T.R. Thompson and O. Standingford, *Report on Visit to USA*, archives of J. Lyons and Co., May/June 1947.
9. O.E. Williamson, *Markets and Hierarchies: Analysis and Antitrust Implications*, The Free Press, New York, 1975.
10. O.E. Williamson, *Economic Organisation*, Wheatsheaf Books, 1986.
11. R. Goffee and G. Jones, "What Holds the Modern Company Together," *Harvard Business Review*, Vol. 74, No. 6, Nov./Dec., 1996, pp. 133-148.
12. R.L. Daft, "A Dual Core Model of Organizational Innovation," *Academy of Management J.*, Vol. 21, No. 2, pp. 193-210, 1978.
13. R.L. Daft, "Bureaucratic versus Nonbureaucratic Structure and the Process of Innovation and Change," *Research in the Sociology of Organizations 1*, S.B. Bacharach, ed., JAI Press, Greenwich, Conn., 1982, pp. 129-166.
14. E.M. Rogers, *Diffusion of Innovation*, 3rd Ed., Free Press, New York, 1983.
15. F. Damanpour and W.M. Evan, "Organizational Innovation and Performance: The Problem of Organizational Lag," *Administrative Science Quarterly*, Vol. 29, No. 3, 1984, pp. 392-409.
16. E.B. Swanson, "Information Systems Innovation Among Organizations," *Management Science*, Vol. 40, No. 9, 1994, pp. 1069-1092.
17. R.W. Zmud, "Diffusion of Modern Software Practices: Influence of Centralization and Formalization," *Management Science*, Vol. 28, No. 12, 1982, pp. 1421-1431.
18. R.W. Zmud, "An Examination of 'Push-Pull' Theory Applied to Process Innovation in Knowledge Work," *Management Science*, Vol. 30, No. 6, 1984, pp. 727-738.

Frank Land is currently a visiting professor of information management at the London School of Economics and at the University of Bath. He earned a BS in economics from the London School of Economics in 1950. Land was employed at J. Lyons and Co. and joined the LEO team in 1953 and worked with LEO until 1967. Recently, Land and colleagues who worked at LEO have published a book *LEO—The Incredible Story of the World's First Business Computer*. Land has spent most of his career working with computers and information systems.

Readers can contact the author at Strowford Barton, Harford, Ivybridge, Devon, PL21 OJD, United Kingdom; flandlse@aol.com.