THE FIRST BUSINESS COMPUTER
A CASE STUDY IN USER-DRIVEN INNOVATION

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Introduction

The theme of the conference is the contribution Europe and Europeans made to the evolution of computing in all its forms. Although the United States are now the greatest and most influential users of computer technology in the world, and have and continue to be great innovators, many advances, as this conference demonstrates had their source in Europe, and today Europe continues 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 MIS as it often called in the US), has become the largest single user of computing technology, and the use of computers is pervasive in all kinds of businesses and administrations.

The first use of computers in the business area came from a British food manufacturing and catering company, J. Lyons and Co, and dates back to 1949. The case is of particular interest because this innovative use of computers was driven by an organisation which had no prior experience in electronics - yet they built and applied to their business one of the earliest stored-programme computers, the LEO I. Truly a case of «User-driven Innovation».

This paper sets out by means of a case study and analysis of the case to describe how one company in the UK - J Lyons and Company - came to design, and build the world's first business computer (Hendry, 1986; Bird, 1994; Caminer *et al*, 1996; Caminer *et al*, 1998; Aris, 1998). The analysis is carried in two stages. In the first, features of the case are selected, which might provide a pragmatic explanation of how a company in the food business achieved precedence in a field where it might be expected that manufacturers operating in the high technology sector as equipment suppliers 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 study itself takes the case of J. Lyons and Company to the point where the decision to design and build their own computer was taken in 1949. The later building and first use of the computer by Lyons and the setting up of a subsidiary company to build and market computers, its successes and failures, and the final demise of LEO provides more material on the theme of innovation, diffusion and implementation of information technology and awaits a later paper.

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The case study[2]

1. Company Background

The case is that of J. Lyons and Co, founded by the successful tobacconists Salmon and Gluckstein.

The company had been formed in 1887 to fill a gap in the market. The company founders had noted that catering facilities at exhibitions and trade shows was often of a very poor standard. They thought there would be a market for affordable, but 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 so as to provide the quality demanded by the public, and at the same time to maintain a tight control of costs.

Thus J Lyons from their earliest days developed a culture of seeking for the most effective ways of controlling their business. The business 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. By 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 - 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 by 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 which built the companies transport fleet, laboratories engaging in food research, laundries washing the companies 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 the laid down standards.

Nevertheless, the culture of self sufficiency led to a belief 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 the management prided itself on their efficient conversion to putting 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 millions - with an on 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 Salmon's and Gluckstein's, plus a few trusted senior employees such as George Booth, the company secretary - recognised that progress could only be maintained if the company selected people of high academic standing to join the company. In 1923 they hired John Simmons direct from Cambridge University where he had been a wrangler with a first class honours degree in mathematics to join them as a management trainee and statistician.

Later, in an interview with Chris Evans at the Science Museum about 1970 (Simmons, 1980) Simmons explained «In fact I was engaged to try to build up a system of information for the

[2]Much of the material in this case study, including most of the quotations, are taken from Bird, 1994 and Caminer *et al*, 1996.

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 organisation 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 which enabled management to keep their business under constant cost effective review.

In the early 1930s Simmons set up an office, 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 each sales representative, each having a customer group of many small retailers, would be not only responsible for selling to his customer group, but be totally responsible for the accounting, credit and payment functions conventionally carried out at arms length by a separate accounting office. The introduction of "traveller covered credit" was a radical business process innovation which increased efficiency and the effectiveness of the representative.

Before the second world war the systems research office had began investigating the possibility of coping with the mass of transaction data by some kind of mechanisation or automation for many years. They had started to investigate the possibility of devising a document reader for transaction data before the second world war. They had researched the possible application of unit record systems based on punched cards, but rejected these as too localised, too constraining and too costly. Lyons had only one punched card installation and that had a very limited application. Instead they had installed alternative types of office mechanisation 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 by as assistant secretary to a large Liverpool store. Under Simmons' tutelage Thompson also rose rapidly in the organisation, and by 1946 had reached the position of Chief Assistant Comptroller.

John Kay (Kay, 1993) in his study of what makes businesses successful suggests that `architecture' is one of the important enablers. Over the years Lyon's 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, etc.) had its own groups of clerks and managers. The vast mass of transaction data stemming from these operations was summarised and compared with pre-set standards, forecasts and budgets. The resulting information was analysed by the junior manager in charge of each group, who would be responsible for explaining any important variances[3]. The junior manager had a direct line to the senior manager, often a Lyons Director, responsible for that activity and had to explain the functioning of that activity. At the same time the senior manager could ask the junior liaison manager to undertake investigation of the `what if' type - suppose we wish to increase the production of Swiss rolls by 10% and reduce the production of cup cakes by 3%: what would be the effect on gross profit? The arrangement ensured direct access by senior management

[3]In the Lyons grading structure, these people 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 organisation.

to information originating at the operating level and by passed 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 hierarchial basis. At the top were the owners, the founding family. They ran the company with the help of a 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 of this type relationships between employees were 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 companies 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 - 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 adaption of microfilm to provide a single record of orders received which served as delivery note, and invoice. They insisted, however, that all new practices had to be tested and prototyped until most elements of risk had been eliminated.

2. Initiation

In May 1947 two senior company executives, T.R. Thompson and Oliver Standingford, another Assistant Comptroller who had joined Lyons in 1930 as a management trainee, visited the United States to see what developments in office equipment had taken place since the start of the second world war. They found little significant change in office equipment. But they did hear about experiments with «electronic brains», such as ENIAC used exclusively for military, scientific and engineering calculations. They recognised 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 Aitken at Harvard whose practical appreciation of bringing equipment into reliable operation mirrored their own ideas of the problems which might be faced. They discovered that few of the pioneers had thought about the possibility of applying the machines on business operations, though the American Prudential Insurance Company had already established plans to use a computer for premium billing and actuarial calculations. Both Aitken at Harvard and Goldstine at Princeton told them that in England Cambridge University under Professor Douglas Hartree - a mathematical physicist had started work on the EDSAC, on what was to become the world’s first stored program computer to do real - mathematical - work (May, 1948).

On their return to England they visited Cambridge were 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 USA. However they wrote (Thompson, and Standingdford, 1947)

«*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»

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 his full backing they presenting the report to the Board, with a covering memorandum which included *inter alia* the following statement:

«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 their 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 include ideas for a variety of transaction processing applications, but also hint at the possibility of using the computer for word processing.

Then 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 they laid out five possible strategies for the Lyons' Board to consider to enable the Company to apply computer technology. These include the suggestion that Lyons should support the efforts of Hartree and Wilkes at Cambridge University with a financial grant and at the same time to provide them with «clerical procedures' to use in programming experiments. An alternative strategy suggests 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 weight behind the recommendation there was no dissension amongst 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. They agreed to help finance the work of Cambridge

University 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 the University. Lenaerts, whose formal education has finished with matriculation, 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 helped Lyons to design and build their own computer and to help in recruiting a chief engineer, Dr John Pinkerton, to head the technical side of the project.. A project team was established and work commences in 1949 to design and build the computer. Simmons suggested a name for the machine - LEO - Lyons Electronic Office. LEO differed from EDSAC in that it was designed specifically for large scale data processing with multiple buffered input/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 bakeries. Further work in linking input and output devices, extending the store, an improving reliability continued until in December 1953, LEO I was formally declared completed and ready for full scale operational work.

Discussion and analysis of initiation phase

To many observers the notion of a catering company in England, shortly after world war 2, pioneering successfully what is now called the information revolution, by not only recognising the potential role of electronic computers for business data processing, but actually designing and building such a machine, seems unlikely and incredible. Indeed, the American edition of the book **User-Driven innovation: The world's first business computer** is to be called **The incredible story of LEO the world's first business computer**.

A.The pragmatic explanation

Yet looking at J. Lyons and Co in the period after the second world war their recognition of computers as a way ahead, and the decision to build their own should not have been regarded as surprising. There are a number of features in the way the company had developed and was organised in the immediate post war period (1945-55) that provide the basis for the pioneering move into business computing. In summary these are:

1.The nature of the business

The business was characterised 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 direct to the retail trade or through its catering outlets direct to the public. This resulted in a mass of transactions with relatively low average values. Competitiveness depended on keen pricing of its products. Thus the company was constantly fighting to contain or reduce its transaction costs. Hence its constant search for improving its business processes in all aspects of the business - 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. Already by the middle 1930s the company had established a systems research office to put the search for improved methods onto a more formal footing.

2.Personnel and leadership

Senior management recognised 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 Oliver Standingford, who together with T.R Thompson, visited the USA in 1947, and whose joint report alerted the company to the possibility of electronic computers. David Caminer, probably the world's first 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.

The recruitment of people with top class academic qualifications, such as Simmons and Thompson, and permitting these to take leadership roles in the management of the company, ensured that the company was never short of ideas on how to improve itself. This was reflected in the esteem in which the company was held in the first half of the twentieth century. Their leading role in developing 'systems' was widely acknowledged beyond the boundaries of their industry sector. It 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 quotation from the report above).

3.Self-sufficiency

The economist Oliver Williamson (Williamson, 1975, Williamson, 1986) suggests that firms have two types of strategies for coping with transaction costs. The first which he call 'hierarchies' involves vertical integration. The firm attempts to minimise 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. Costs are minimised by using the mechanisms of the market place, and control is retained through contractual arrangements with suppliers.

Lyons, in general, preferred the first strategy because they had the confidence and experience to believe they could provide the relevant goods or service more effectively than any contractor. Of course, some goods and services had to be sub-contracted or purchased when investigations showed that appropriate suppliers were available. But even then, Lyons like Marks and Spencer set up an organisation which set standards and ensured that suppliers themselves were efficient and always sought improvements. Thus it did not take Lyons long to realise that outside suppliers capable of meeting the requirements as seen by Simmons and Thompson simply did not exist in the late 1940s. They had the confidence based on previous experience, including the very recent experiences of the war, that they were capable of effectively organising businesses remote from their core food business.

B.The academic frameworks

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

The first study to be examined is also the most recent. Goffee and Jones (Goffee and Jones, 1996) in their report on research they have been doing on the relationship between company success and different styles of company culture distinguish between two dimensions of culture. The first dimension is concerned with the degree of **sociability** achieved by the employees of the organisation. The second is concerned with the degree of **solidarity** present amongst the employees.

By sociability they mean a culture which regards the organisation as a community and encourages sincere friendship amongst 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 organisations ranging from enterprises with low social contacts and few 'good' relationships, to enterprises which feel like a well balanced community or family.

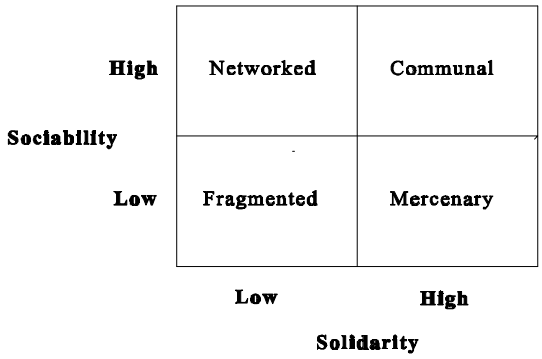
Solidarity, in contrast, implies shared objectives rather than shared values. «Its relationships are based on common tasks, mutual interests, or shared goals that will benefit all involved parties.» The organisation will respond quickly to outside threats, and low performers are not tolerated. Achieving consensus is regarded as having a low value as against achieving high performance targets or in bettering competitors. Employees are clear about job definitions and organisational roles. Again organisations vary enormously in the degree of solidarity achieved.

Goffee and Jones note that successful organisations can exist at all points in the two dimensions, including the extremes. They go on to suggest that we can classify organisational culture into four archetypes: Networked, Communal, Fragmented and Mercenary. Each of these 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 which indicates the best fit between the cultural archetype and the enterprise. They 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 1959s fit into this model at all. The author, using the assessment questionnaire provided by Goffee and Jones (Appendix 1)[4], rated Lyons in terms of sociability moderately high. 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 organised 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 organising concerts, counted for more and led to esteem amongst 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 which reports on the formation of cliques in some of the organisations which 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 had 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 to be measured. The 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.

Figure 1, Two Dimensions, Four Cultures



[4]Note the 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 only.

As Goffee and Jones point out many managers assume that the top right hand quadrant of figure 1, scoring high on both 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 performer - are inherently in conflict with the high solidarity characteristics of putting a high value on business objectives. Nevertheless, they found organisations which could be characterised as ‘communal’ and for which that type of culture was appropriate and associated with success. They suggest that strong, charismatic, leadership which believes in the values associated with sociability, but at the same time is absolutely clear in which direction the company is driving and will not permit sub-par performance, is necessary to sustain the communal culture.

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 that help to answer the questions of how they came to take the decisions to design and build a business computer to serve their management?

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

1. They found that successful communal cultures are associated with organisations in which extensive teamwork across functions makes possible innovation. 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 advantage may be gained through 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 throughout the organisation and many were implemented over the years. Perhaps the same conditions which encourage product innovation in the pharmaceutical industry stimulated the kind of process innovation which 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 organisation rather than going outside to specialist contractors stems from the same communal characteristics.

2. In communal cultures there are real synergies amongst organisational sub-units and real opportunities for learning. Again these appear to be important characteristics when it comes to disseminating and implementing the range of innovations discussed above. Lyons encouraged the synergy and learning by widely broadcasting throughout the organisation, what the company was up to in its LEO venture. Although the rapid growth of the LEO team necessitated recruiting, mainly new graduates, from the outside, many of the early LEO team members came from a variety of functions inside Lyons. This, too, facilitated mutual learning and synergy.

3. The third finding of Goffee and Jones suggests that a communal culture is important in organisations which 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, that the Lyons management was somewhat optimistic both on how long it would take to get the computer built and on-stream, and the time it would take to pay off the investment. Early estimates suggested that a time 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 which affected not only the long-term strategy of the company itself, but something which might affect the whole direction of business practice in the UK.

4. Finally they note that organizations operating in a dynamic and complex business environment benefitted from having a communal culture. In the immediate post-war period almost all businesses were faced with the transition from working on a war-time footing to that of peace-time. In the food industry the continuing problems of food rationing increased complexity. Perhaps Lyons survived the complexities of the post-war period by having a communal culture. More importantly it is a culture which 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 organisational behaviour. The communal culture Lyons appeared to have in the 1940s and 1950s, would lead us to expect a company which encouraged and welcomed innovation, which was confident and capable of taking the long-view and make long-term strategic judgements. A company capable of learning and therefore absorbing change and innovation. Their research helps us to place Lyons in its cultural context, and to see how the particular strengths of that culture could lead to the decisions they took.

The second framework is derived from John Kay, (Kay, 1993). 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. But more often 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 high reputation.

By architecture Kay means the set of formal and informal relations which exist in the enterprise. Kay describes architecture as *«...a network of relational contracts within, or around, the firm»*. As noted earlier Lyons had developed a management style - really an architecture in Kay's sense - which provided clear information channels between the operational and management levels, unblocked by problems of hierarchy and its associated bureaucracy. This had three effects: firstly it brought operational management and their supervisors into close contact with the senior levels of management, resulting in mutual trust and esteem and hence, effective team working, despite the existence of a notional hierarchy. Secondly it made quick decision-making possible at the senior level. Thirdly 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 - was facilitated by the distinct architecture developed by the company. Later all three consequences of the architecture helped to get the LEO project going. 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 architecture.

The second distinctive capability identifies by Kay is reputation. Kay illustrates the role of reputation in sustaining company success. A good illustration (not from Kay) of the role played by reputation is the Virgin organisation 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 which appear to be dominated by established corporations such as Coca Cola or 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 the second world war 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, when they believed that more conventional electronic and business machine companies would be much slower of the mark. They had a belief in their own 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 belief in the Lyons reputation? Subsequently, despite some scepticism, 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 a 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 be translated into business success. Kay’s notion of architecture comes close to the concept of culture as defined by Goffee and Jones.

Lyons appear to have had the architecture characterised by their communal culture to welcome and accept process innovations of quite a 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 in a following paper.

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. Their strategic asset was the lack of a viable competitor in the UK just at the time that Thompson and Standingford produced their report. Another strategic asset was the availability within the Lyons organisation of employees of the calibre of Simmons, Thompson, Standingford and Caminer (the head of the Systems Research Office). Without this very distinctive asset it is doubtful whether Lyons would have initiated the LEO project and built the world’s first business computer.

The feature of Lyons at that time was that they had developed strength in all four of Kay’s distinct capabilities, and that they had reenforced 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 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 paper, individually or in combination enable us to predict which enterprise will lead (successfully) in innovation, and which are more likely to be followers. They may help us to identify enterprises which have in place the conditions which make successful and sustained innovation possible. They may help to identify the businesses which 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 emphasise 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, analysing the adoption by Lyons of the LEO computer and the diffusion of the technology through first Lyons and then many other companies, more use will be made of theories of technology transfer (Daft, 1978, Daft, 1982, Rogers, 1983, Damanpour and Evan, 1984) including those which are specifically tailored to the special case of information technology and information systems (Swanson, 1994, Zmud, 1982, Zmud, 1984).

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Appendix 1

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:

	Low	**Medium**	**High**
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			