Universität Zürich[UZH]

Wirtschaftswissenschaftliche Fakultät

General Exam Information
For the Information Management Exam

June 18th 2020
8:00 to 20:00 o'clock

Please make sure you follow and read this information carefully!

A. General information about the examination

Total examination time: **12 hours**, from 08:00h until 20:00h

Maximum number of points achievable in the examination: **90 points**

The distribution of the points per question will be explained in detail during the exam introduction, on the 18th of June at 8 am via Microsoft Teams in the general Information Management channel where the lecture is held. It will also be described in detail in the exam.

We will start the exam period at 08:00 am together and go through all general information regarding the exam. Further you will have to confirm to the code of honor in MS Teams, just as we did with the voting for the exam. Afterwards, at 08:15 am all exam documents will be made accessible to you via OLAT. The Information Management lecture stream will be kept online for another 10 minutes to answer any general question or support with technical issues. We will not answer any content related question!

B. Honor code

You are subject to the *Honor Code of the Faculty of Business, Economics and Information* and must confirm knowledge of and compliance with the honor code at the beginning of the examination. For more information see: www.oec.uzh.ch/en/coronavirus/faq-students.html

According to the honor code, **collaborations of any kind** during the examination and the **use or attempted use of any means capable of serving this purpose** is not permitted. This includes, for example, chats, text messages, e-mails or any other means of jointly solving examination tasks or exchanging results online.

The **assistance or the engagement of other persons** when carrying out the examination is not permitted (identity fraud). Furthermore, even the **preparation of a fraudulent act** or the attempt to engage the assistance of other persons in the run-up to the examination is contrary to the honor code and will be sanctioned in the same way.

Any violation of the honor code will be sanctioned as **examination fraud**, modules being marked with a grade 1 and **disciplinary proceedings.**

Confirmation to the code of honor will be collected at the exam introduction period between 08:00 and 08:15. If you miss that time, or do not confirm to the code of honor, your exam will be counted as a failed attempt.

C. Resources

Due to the Open-Book examination setting, **all learning materials** can be used. Collaboration with fellow students or other persons in any form is prohibited.

D. Supervision

Except for the half hour introduction time between 08:00 – 08:30 am, there is **no supervision** during the examination.

E. Support during the examination

If you encounter any technical issues, report the problem **IMMEDIATELY** through the **MS Team to Ingrid Bauer** (ingrid.bauer@uzh.ch) **or Dario Stähelin** (dario.staehling@uzh.ch). In case you have no functioning internet connection you can contact Ingrid (+41 44 635 42 79) or Dario (+41 44 635 43 59) via phone. Describe the existing problem as **precisely** as possible. Explain step by step how the problem arose so that the error can be traced und understood. Add **important screenshots and examples**. Instructions and examples can be found under the following links: www.oec.uzh.ch/en/coronavirus/faq-students.html.

F. Accessing the examination and uploading your submissions:

To access and download the exam you will find the option "Examination" in the sidebar of the OLAT course “20FS MINF4200 Information Management (L+E)”. From here you are able to download all exam documents.

To upload and submit your exam, go to the Examination folder on OLAT and then select the file stored on your PC and upload it to OLAT (the same as you do with your homework). Your submission should be made in **a single Pdf Format**. Hence, if you have additionally used the PowerPoint Template that we provide via OLAT, you should insert it into the final exam document (e.g. via insert picture or file option). Once you have finished working on the Word Document that we provided, and inserted all additional templates, you should convert your exam document to a PDF format and upload it at the directed folder.

Further, be aware that,

- The files must be uploaded **within** the examination period.
- It is possible to hand in the examination early.
- Late hand-ins are not possible. The OLAT system will be closed at 08:00 pm sharp.
- We will also not accept any late hand-ins via Mail or any other format. Your participation and missed or failed hand-in on time will be noted as a failed exam.
- Please note that uploading may take several minutes. Therefore, plan time for uploading your solution.

To submit the files definitively, you must confirm your submission via Mail. In other words, if you have submitted your final version you will additionally have to send an email Ingrid Bauer (ingrid.bauer@uzh.ch) **and** Dario Stähelin (dario.staehling@uzh.ch). confirming that your submission is final and definitively. If we do not receive a confirmation mail from you by 08:00 pm your submission will not be counted but noted as a failed attempt.

Exam Information Management

18th of June 2020

This Word Document contains all exam questions as well as a room for your answers. You are supposed to hand in this document in a PDF converted version once you have finished the exam. Please make sure you read and understand the general exam information first and then proceed with the case and the exam documents.

You have 12 hours to work on this take-home exam. It is not expected that you work all 12 hours on the exam. You can achieve a maximum number of 90 points. In order to solve the questions below, you will need to read the case TAURUS & CREST, also provided via OLAT as PDF document.

For your exam you can select 5 out of the 8 questions that are described below. However, you are only allowed to solve either question 5 or 8, **but not both.** In case you solve both, question 5 and question 8 only the first (the one that comet first in the order of the document that you hand in) will be evaluated. In case you hand in a solution for more than 5 questions again only the solutions of the first 5 questions - following the ordering in which you present them in the handed-in exam - will be evaluated.

Please be specific to the case in your answer and apply appropriate concepts and tools from the lecture in your answer. Some question will also give you special hints to concepts which you should use.

The space for each question is limited. You have a maximum space of one-page text per task plus one figure in this Standard-Word-Document (Arial, Font: 11, single spacing). For question 6 and 7, you additionally receive a template in PPT-Format that you should inserted at the end of the response to the question in your word document. You can do this either by either the insert picture or file option. Please, make sure that it is readable. The figure does not count to the 1-page size limit. Do not reduce font sizes or adapt the page size. We will disregard all text that goes beyond the one page. In order to avoid misunderstandings, introduce a page break after each question. If you have to make assumptions, please make them explicit and make sure that they are consistent over all tasks.

Please write your name and your student ID on this cover page at the indicated place.

Your answers should be either in English or German, wither way you need to stick to the chosen language throughout the whole exam.

Good luck!

First Name:	Last Name:	Student ID Number:

Task	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Σ**	**grade**
Maximum	18	18	18	18	18	18	18	18	90	
Achieved										

Question 1 (TU01) (18 Points)

Please reconstruct the digital strategy of Crest applying TU01, Slide 25.

(Your Answer)

Question 2 (TU04) (18 points)

Did Crest have an appropriate outsourcing strategy? Why or Why not? Please include the Transactions cost theory in your argument.

(Your Answer)

Question 3 (TU05) (18 points)

a) What kind of a project was Crest in the application portfolio for the London Stock exchange? Why? Was it managed properly? Why/Why not? Include generic IT strategies and leadership styles in your argument.

b) What kind of a project was Taurus in the application portfolio for the London Stock exchange? Why? Was it managed properly? Why/Why not? Include generic IT strategies and leadership styles in your argument.

(Your Answer)

Question 4 (TU08) (18 points)

a) What kind of a project was Crest in the project portfolio (TU08, Slide 25)? Why? Was it managed properly? Why?

b) What kind of a project was Taurus in the project portfolio (TU08, Slide 25)? Why? Was it managed properly? Why?

(Your Answer)

Question 5 (TU10) (18 points)

a) Would an agile approach have helped at Crest? why?

b) Develop and explain a concept for managing application development at Crest using "Lean budgets". Please include an analysis on who is involved where?

(Your Answer)

Question 6 (TU09) (18 points)

Please construct a Benefits Dependency Matrix for Crest and apply it to explain, what went right and what went wrong.

A template for the Benefits Dependency Matrix is provided in the PowerPoint file.

(Your Answer)

Question 7 (TU09) (18 points)

Please conduct a Stakeholder Analysis for Crest and apply it to explain, what went right and what went wrong in Stakeholder Management. (Hint: Institutions may contain several stakeholders)

A template for the Stakeholder Analysis is provided in the PowerPoint file.

(Your Answer)

Question 8 (TU12) (18 points)

Please analyze Crest using the ITIL-Framework:

a) Would it have been better, if Crest had followed the idea of ITIL in their general approach? Why?

b) Did they follow the principles of ITIL v.4 (TU12slide 31-37)? Should they? Discuss each of the principles!

c) How would a value stream perspective change the development?

(Your Answer)

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(Your Answer)

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b) Develop and explain a concept for managing application development at Taurus using "Agile Release trains". Please include an analysis on who does what?

(Your Answer)

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c) How would a value stream perspective change the development?

(Your Answer)

101-003-1

ECCH Collection

TAURUS and CREST, Failure and Success in Technology Project Management

*This case was written by **Christopher H Head**, Henley Management College.* *It is intended to be used as the basis for class discussion rather than to illustrate either effective or ineffective handling of a management situation.*

The case was compiled from published sources and from an interview with Mr Brian Goode, Head of Requirements and Trialling at CRESTCo.

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CHIEF EXECUTIVES AT the London Stock Exchange (LSE) need excellent competence in technology management, judging by the history. It could not have happened on a worse day. On 5th April 2000 - the last day of the financial year - a computer crash closed the market for trading from 8 a.m. to 3.45 p.m. The main market makers (Merrill Lynch, Dresdner Kleinwort Benson, Credit Suisse First Boston and Winterflood Securities) sought out Chief Executive Gavin Casey. "If Casey does this again, then he is toast," said the director of one stockbroking firm, reported in the Times, pointing out that their business relationship was with the LSE, not their technology systems supplier, Andersen Consulting. Only Andersen's had been invited to bid for the LSE's outsourcing contract, and the LSE chairman at the time was a former Andersen partner.

Ironically, Casey was brought in as a "safe pair of hands" after a series of fiascos. His predecessor, Michael Lawrence had lasted just 18 months, leaving after a row about introducing order-driven trading which would have cut traders' margins. The *Sunday Times* reported the then Chairman, John Kemp-Welch as telling Lawrence "The first item on the agenda is your resignation. Either resign or we'll fire you." Lawrence had also initiated discussion with Werner Seifert of the Deutsche Börse about access to the LSE technology in return for a merger shifting much trading volume to London. Casey must also have reflected upon the downfall of another of his predecessors, Peter Rawlins, the rather dour Stock Exchange chief executive who initiated TAURUS, a huge computerisation project. TAURUS was scrapped very publicly in March 1993, at a cost of £75 million to the LSE, and an estimated further £400 million to the city. 350 exchange staff and contractors lost their jobs, and it proved the death knell for Rawlins who resigned amid the recriminations.

The LSE entered the '90s with its reputation for competence in management of technology broken. It took the head-hunters 5 months to find a replacement for Rawlins; Lawrence did not take office until a year later.

Rather more publicly than any institution other than the banks and government, the LSE has learnt the hard way how dependent it has become upon the technology it deploys. The LSE was far-sighted enough to realise the potential impact that technology would have upon international competition. It regarded itself as foremost amongst the world's bourses in international dealings, and first in Europe on any measure. Rawlins was brought in just after the inception of TAURUS, a system intended to maintain the LSE's position. He proceeded to reduce the total workforce at the LSE by one third from 2,850 when he joined to 1,800 in March 1993, greatly improving competitiveness.

The London Stock Exchange started with brokers meeting in coffee houses in 1760. In many ways it continued to run more like a gentleman's club than a business. Mutually owned by its members, the stock exchange adopted practices that restricted competition and resisted change. It had a monopoly on the supply of market information. There was only limited foreign ownership of the member market-making firms. The LSE has always been big business. By 1995 it listed the shares of 2078 UK companies worth some £1.3 Trillion ($1.95 Trillion), and a further 525 foreign companies. Trading volumes were £4.65 Billion ($7 Billion) per day.

In 1986 market de-regulation, known as "Big Bang", blew away many old practices and institutions. It was a compromise between Cecil Parkinson at the DTI who wanted sweeping changes or an Office of Fair Trading investigation, and Sir Nicholas Goodison, the Chairman on the LSE. At the time Margaret Thatcher's conservative

government was creating its vision of a shareholder economy. Public sector functions and nationalised utilities were sold to the public, increasing the interest in the market and producing exponential growth in trading volumes. The main impacts of "Big Bang" were:

- removal of many operating regulations;
- freedom for dealers to set their own commissions;
- the introduction of screen-based trading replacing the mayhem of face-to-face deals and "open cry" operations on the trading floor;
- replacement of "Jobbers" with 305 market-marking firms who set prices to buy or sell shares in order to encourage people into the market; and
- a rush by the banks to buy the old stockbroking firms.

Big Bang modernised the "front office" functions – the part of the operation most visible to customers and the public. The LSE needed a second shake-up to tackle the "back office" – the business conducted behind the scenes such as settlement. This process ensures that both the share certificates and the cash change hands between the interested parties after a trading transaction. TAURUS aimed to tackle this process.

Despite the restrictive practices, the LSE's thinking was in the vanguard of its international rivals. Its recognition that computerisation was the way to stay ahead came from the influential Group of 30 (or G30 – the top 30 industrialised countries) think tank, dating back to 1989. Prompted by the surge in stock market activity worldwide and by the crash in September of that year, it identified "risks and inefficiencies associated with post-trade clearance and settlement procedures; especially in equity markets". Other markets were already computerised. Singapore and Hong Kong had made the transition.

The London market had a fundamental difference, however. It used a quotation-based system – where brokers provided prices for buy and sell transactions. They received orders based upon these prices, and took a commission. Another market that used this principle was the North American high-tech stock market NASDAQ. An alternative approach is "order-driven", using computers to match 'buy' and 'sell' bids. Costs for this approach can be less than 50% of quotation-based trading. Lawrence at a subsequent Treasury select committee stated that the exchange's monopoly position protected member firms whose market share and profits might otherwise be "cherry-picked by high-tech upstarts". Despite pressure for change, the member firms were opposed. *Forbes* magazine in August 1996 reported Chris Rees, a Deloitte & Touche Consulting Group partner in London who worked on the Taurus project reflecting on the outcomes: "When it got right down to it, the members wanted the status quo".

So the 1989 proposal for TAURUS – Transfer and Automated Registration of Uncertified Stock – was to build upon the modernisation of the front office introduced through Big Bang, and incorporate the G30 conclusions from earlier that year. TAURUS would automate the settlement business transactions; i.e. to ensure that stock was exchanged for cash. Implicit in this process was the dematerialisation of stock certificates. Previously couriers carried bundles of certificates around in satchels, distributing them to their new owners in a time consuming bureaucratic process involving many human interventions. Once TAURUS was live, stock ownership would be reduced to an entry in a computer database, eliminating stock certificates as physical entities, masses of paper work and hundreds of jobs. Coopers,

Lybrand, Deloitte conservatively estimated the savings at £54 million per year, net of other savings from accommodation and overhead expenses. It could also reduce the delay between agreeing the trade and the transaction being completed. London operated on the basis of "settlement days" – fixed dates when transactions from the previous 2 or 3 week accounting period would be settled. This carried the business risk of the purchaser going bankrupt or refusing to complete between transaction and settlement, a risk that would reduce if the delay could be shortened. TAURUS promised to speed up the process.

TAURUS was a big project, and literally hundreds of contract staff were drafted in to tackle the design and build. John Watson came from Coopers & Lybrand with a strong reputation and took the helm. The project team envisaged 3 phases:

1 implementation of network links and testing facilities between October 1990 and March 1991

2 completion of a core system of book entries to replace share certificates (dematerialisation) by October 1991; and

3 introduction of rolling settlement and delivery versus payment by October 1992.

There were already order-matching systems running the front office systems for electronic bourses successfully. London chose a back office package design running on IBM mainframes. However, importing a standard system would impose standardised working on the member firms. The firms argued that their source of competitive advantage lay in the way in which they conducted their business, and a standard approach would strip away this key differentiator.

All the member firms would have to use TAURUS. This imposition dictated significant consultation with the firms over the design, and also much negotiation on the business approach. As the firms claimed their livelihood depended upon their method of doing business, they tended to get their own approach included in the design alongside the standard method. TAURUS had to be "all things to all men". An example of this was the so-called "Corporate Actions" or "Events". There were 21 of these, covering such occurrences as take-overs, rights issues, scrip issues and stock splits. The specification comprised 3 volumes each some 2" thick! Quite understandably, the designers were unable to fully get to grips with the complex business requirement.

It was not just the member firms who were stakeholders in the design. The Treasury took a major interest due partly to the legal constraints it wanted incorporated, but also because it had agreed to give up the £800 Million per year revenue stream it received from stamp duty on the transactions to encourage dematerialisation of stock certificates. The Bank of England was another stakeholder, concerned about the probity of the system. Another arm of Government, the Department of Trade and Industry took an interest because stock certificates were enshrined in company law. Government generally recognised that an efficient stock market was at the heart of "United Kingdom, plc", and was anxious to minimise risks to the economy. Government involvement resulted in a 150 page legal document defining the complex regulations with which the system would have to comply.

In addition to a large and complex project in terms of the sheer numbers and value of transactions, a bespoke approach, the variety and power of the principal users, and the constraints and interest of government, the project managers for TAURUS introduced

the further complications. The chosen package solution from Vista Concepts of New York required heavy modification to meet the demands of the member firms, the government requirements, and to speed up batch processes providing backward compatibility to other exchange systems. This involved the project team in time spent repeatedly crossing the Atlantic, and increased the risks from unproven software.

A large project requires a disciplined approach, and Watson adopted the Structured Systems Analysis and Design Methodology (SSADM) which was well proven in the industry. Later analysis questioned how rigorously this system was applied.

Soon the computer trade press began to report problems, but initially LSE management denied them. Delays were blamed upon technical difficulties related to effective management of share trading and necessary fund verification. By August 1991 implementation of the main system (Phase 2) had slipped to March 1992. Obviously delays also meant increased cost, but the LSE were less open about this. The estimated cost after the initial design work in February 1990 was between £40m and £50m. £47m had been spent by March 1992, and the bulk of the £25m per annum development budget was going to TAURUS. Deadlines were still slipping. The blame was placed upon the sheer size and complexity of the system. Observers expressed concern at the limited understanding LSE displayed of the legal framework for its own operation, and what would be required to change it.

By January 1992 doubts about the position of London in the international financial arena and progress with TAURUS were spreading. The *Director* opined that Frankfurt was ready to challenge London's position of pre-eminence, and noted that even the 'sleepy' Parisian exchange now had a computerised system far superior to London's. Rawlins seemed to concentrate his attention on the systems outsourced to Andersen and ensuring these delivered cost effectiveness as each was redesigned. The TAURUS system was the one area of LSE computer systems not within Andersen's control. Rod Margree, head of Settlement Services, and the Development Director Hugh Armstrong both left during 1992.

In September 1992, *The Economist* suggested complaints about TAURUS had become deafening. By the 4 March 1993 *Computer Weekly* published an in-depth exposé of the ills surrounding TAURUS. Although the systems at Frankfurt and Paris had also experienced difficulties, they were operational, and London was in danger of losing its position in Europe. On March 11 Peter Rawlins recommended termination of the TAURUS project to the LSE board.

The press were quick to report rationales for the failure. "The design of the aborted system had elements of compromise to cover the interest of all the various constituencies," complained John Lamb, a former NatWest Bank assistant general manager, to the *Daily Telegraph*, representing a common viewpoint. Others cited the inability to get to grips with the huge complexity. Some questioned whether immobilisation of certificates rather than dematerialisation would have been more successful. The New York stock exchange NYSE had adopted this approach, putting them all in a warehouse operated by the Depository Trust Company. Germany, Singapore, Canada, Italy, Japan, and Mexico also favoured immobilisation, but Paris and the UK Central Gilts office had successfully adopted dematerialisation.

Commentators thought that if TAURUS had worked, it would have secured a position for the LSE ahead of its European rivals and even NYSE. The main advantages would be the linkages between the settlements system and the other applications

which Andersens had rebuilt, coupled with London's existing standing, and superb geographical position mid-way (in trading time) between Tokyo and New York.

The collapse left a vacuum for the Bank of England to enter and take control. Howard Davies, Deputy Governor assigned Pen Kent, their Associate Director of Industry and Finance to head a 10 man task force and "knock heads together". It was imperative to press forward and recover the situation. The LSE lost its credibility, TAURUS, and its TOPIC system for supplying information to the industry.

The task force took evidence from all the interested parties, and just 3 months later delivered its blueprint for a new system called CREST. CREST is not an acronym! Industry watchers expected a revamp of the LSE's ageing TALISMAN settlement system along with an end to the 2 or 3 week settlement period, and a choice over dematerialisation. Certainly this was briefly considered as an option. Other options were to procure a package solution, or to start again from scratch.

The package option was discounted as a non-starter due to the different legal regime operating in the UK. The existing TALISMAN system worked well enough but was too old to consider modernisation. Only a couple of people knew its structure sufficiently well to maintain it. It was an old mainframe system, and did not even have a modular design. It contained "spaghetti code" – a change in one part could have unexpected knock-on consequences elsewhere.

The decision was to write a new system. The Bank of England had experience of building a similar system – it had already dematerialised gilts and tackled money market instruments. Members of these teams, including Brian Goode the IT Manager, were drafted into the design team at CREST. Their philosophy was to use tried and tested technology and "follow the recipe". There would be a minimalist approach.

The team spent little or no time agonising over the failure of TAURUS. According to Goode they "closed the door" on it. Not a single member of the TAURUS team joined CREST.

TAURUS had to be complex – it had to be "all things to all men". As the Stock Exchange was owned by the members, and it was the Stock Exchange that was building the TAURUS system, the design team tended to give in to demands to add in everything that was asked for. CREST usage was optional, but anyone could be a user. The designers could afford to exploit the Pareto effect, and cater only for the 10 – 15% of the business functions that made up 85 –90% of the volume of transactions. CREST published a specification for an exceedingly minimalist system. "The market went wild" reported Goode.

The Bank of England team brought in Oxbridge educated civil service career professionals who analysed the business processes down to their bare essentials. The 21 Corporate Events or Actions defined at length for TAURUS reduced to just 2 business processes: a stock movement or a cash movement (or a combination of the two).

The system's potential customers railed strongly at the minimalist design. It was not enough, for them, but they could not argue successfully against the intellect of the designers. Demands to deliver more business functions within the system, resulted in a "take it or leave it" response. The analysts asked all the necessary searching questions to identify what really needed to be done rather than what had always been done. Where a process had not been replicated in the new system, the business analysts suggested work-arounds instead. They were able to "think outside the box".

The design team representatives on the liaison meetings with the industry's predominant business groupings were instructed to give away nothing. Only if over 80% of the customer representatives in a business area demanded a missing function would it be included in the design. The market hated this approach, suggesting it would remove the basis of their competitive advantage – their way of doing business.

The proposed system relied heavily on the Bank of England's design team's experience with Tandem "non-stop" systems involving central resilient servers and distributed "client" computers in the customer firms. They would stick to what they knew as far as possible.

CREST did not formally adopt a systems development methodology. Some 50/60 staff were "body shopped" from Admiral software, and brought with them the disciplines of that firm's approach. So CREST implicitly took a structured systems analysis approach with periodic reviews and written change request procedures. In addition to the 20 strong design team there was a programming team. To maintain co-ordination and control over the design, a core, high-level design team of 4 or 5 kept an overview of the whole project. It was their responsibility to determine the impacts of any proposed change on the various component modules of the system. All changes were processed strictly through the documented design before being translated into code.

This rigorous approach paid dividends, but it didn't stop the biggest change request. The team thought that the government agreement to waive stamp duty on TAURUS share transactions once the system went live would apply to CREST too. However, CREST was an optional system, and the Treasury wasn't prepared to give up what had grown to almost £3bn of revenue (1994 value) which they collected "without lifting a finger". This major change had consequences throughout the system design.

The team were always in the spotlight. After the high profile collapse of TAURUS, industry observers predicted another failure. The press watched eagerly for signs of collapse, and lack of evidence didn't stop them writing articles. Early on, Project Controller Iain Saville bravely specified a "go live" date, and the press received it sceptically. The team learnt to take time out to establish relations with the press, and to brief them fully on progress. Despite the pressure, the design and development team's morale remained high. Generally they knew nothing about securities – this knowledge was in the business analysis team from the Bank of England.

System testing was conducted by a team completely independent of the Admiral contractors. Customer training was handled by the Securities Institute – CREST staff trained them in a "train the trainers" approach.

The system went live on schedule and within budget on 19 July 1996. However there were no settlements in the first month – this was spent acquiring the static data about bank accounts and lines of credit. From that point groups of stocks were taken on at 2 weekly intervals. The team always said it would take a year to get the system fully operational. They managed it in 9 months. The Bank of England handed CREST to a not-for-profit company called CRESTCo as the system went live.

The transition from a development organisation into an operational unit demanded different management techniques and was painful. There were 2 major crises at 4 and 9 months from "go-live". The 4 month problem arose after a relatively quiet post cut-over honeymoon period. It had not been possible to do real volume testing – there was only a simulation with computers generating mock transactions. The problem

was locking within the database – the software was in contention for access to locked portions or "pages" of the data involved in another process. The design team had designed a sound system, but had no advance knowledge of how the customer firms would use it. Some enquiry transactions which the designers thought would be little used were recording hits some 300% higher than design load. A major redesign of some central processes to obviate the problem would take time. Breathing space was bought by changing the tariffs to make usage of the offending transactions more expensive. By 9 months after go-live, the total volume of trading through CREST was running at 130% of design maximum loading of 100,000 transactions per day. The overnight batch system could not cope. It was still running when the real time system was needed the next morning. CRESTCo could not increase the power in their TANDEM computers: another system change was needed to strip out and streamline offline processes. Again they stuck to the rigour of changing the design, and rolling this out through to the code.

Customer firms needed new systems or to rebuild their existing systems to coincide with go-live. Alternative approaches were a complete rebuild of their back office system, or an update by adding a new graphical front-end. Some recklessly gambled upon a repeat of the TAURUS fiasco, failed to keep a tight schedule, and were left with a problem when CREST went live on schedule.

CREST looks an attractive package that must have sales potential abroad. 5 or 6 foreign bourses have approached CRESTCo, but the system is not for sale. The CRESTCo board reckon that they have insufficient resources to support the multiple copies of the system that would necessarily be required to suit local requirements.

CREST has not stood still. It now handles 330,000 transactions per day, with a settlement value of £200bn. There is £1.5 trillion of dematerialised stock in the system. The Gilts system has just 10,000 transactions per day, but these alone are worth £150bn of the daily total.

With the Bank of England taking over the settlement operation, and the loss of TOPIC, commentators asked what the Stock Exchange was for. The LSE responded that it saw it operation as:

- converting savings into investment capital for industry and commerce;
- providing services for its member firms at cost;
- balancing the interests of investors, large and small, and issuers, large and small, and
- conducting its business in a cost-effective, commercial and efficient way.

The Stock Exchange is clearly less than interested in transactions that generate small margins. However, the big firms are beginning to wonder what value the stock exchange provides to them in an increasingly automated age. The threat from Europe was still there, and growing.

During the summer of 2000, discussions between the LSE and the Deutsche Börse resulted in an announcement that the two would merge to form a joint market called ***iX***. This situation reflected the loss of status following TAURUS, and the lack of drive to rethink the role of the exchange and move it forward in the previous three years. The press responded with much critical comment. By late July, Per Larson the Chief Executive and Olof Stenhammar the Chairman of OM the technology company behind the Swedish stock exchange entered the fray with a hostile bid. On 12

September the Don Cruickshank, Chairman of the LSE was forced by massive opposition to announce the end of negotiations to introduce ***iX*** as the true European exchange. At the shareholders meeting on 14 September, Gavin Casey was ousted as Chief Executive on a show of hands, only to win a secret ballot by just 56.3% to 43.7%. When Cruikshank asked Casey to comment he replied weakly "no thank you". He resigned the next morning.

Things looked bad for the LSE. Brian Williamson, chairman of Liffe, the London Futures Market, offered co-operation and a fresh modernisation of the LSE. Introducing their new European share dealing operation on BBC's Radio 4 Today programme on 23 October, Hugh Simpson emphasised CRESTCo's independence from the LSE. They could standalone as an autonomous operation. The *Financial Times* on 19 September reported that the French-led European stock exchange Euronext planned to offer itself as a "white knight" to the LSE.

Per Larson's comment was "It is time for the London Stock Exchange to start talking to us. It has no management, no strategy, and is weak on technology.