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Your Ref:
BC-0063-11

Our Ref:
HYP B4/01

Date:
05.12.11

Ms Bernie Conlon
Secretary to the Inquiry
Arthur House
41 Arthur Street
Belfast
BT1 4GB

Dear Madam

RE: INQUIRY INTO HYPONATRAEMIA RELATED DEATHS

I refer to above and your letter which we received on 2nd November 2011. I now enclose the following for your attention a copy of the April 1995 Final Report of the System Options Review of the Trusts' Laboratories Rationalisation Project in response to request 2 (a) (g) thereof.

Yours faithfully

JR Bolton

Joanna Bolton
Solicitor Consultant

ROYAL GROUP OF HOSPITALS TRUST AND
BELFAST CITY HOSPITAL TRUST

LABORATORIES RATIONALISATION PROJECT
SYSTEM OPTIONS REVIEW

FINAL REPORT

April 1995

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MC/BCH/dmp0wtdb

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1. INTRODUCTION

1.1. Purpose of this Report

The aim of this project is to advise the Royal Group of Hospitals (RGHT) and the Belfast City Hospital (BCHT) on the options for computer systems to support the merged Pathology Directorate.

The Terms of Reference for the project were as follows:

- *to identify and anticipate key information requirements, acknowledging that the laboratory system must be able to satisfy the strategic operational, management and research requirements of what will be one of the largest NHS laboratory complexes in the UK;*
- *compare and contrast the DIS system with the ACT and Telepath commercial products:*
  - *highlighting key differences between the products;*
  - *in comparison to the anticipated key information requirements of the unified laboratory service;*
- *prepare and present two complementary reports:*
  - *a technical report, including the explicit addressing of the key requirements and including informed comment on the ability to proceed with two separate systems on the two sites in the short to medium term, with common decision support as necessary;*
  - *a costed option appraisal (based on the technical report), only to the level of detail necessary to compare the business advantages of adopting any of the three identified options.*

An interim report documenting the results of our technical evaluation was produced in early January for consideration by the Project Board. The Board meeting, held on 5 January 1995, clarified the options for consideration. This is the final report, and includes the costed option appraisal and associated recommendations for the Directorate.

1.2. Methodology

The stages in our approach were as follows:

- agreement between the sites of a statement of user requirements.

  This statement was designed to highlight those key factors which would be of particular importance to the merged Directorate. The agreed list is included as Appendix B to this report. This list is not intended to be exhaustive, but it is an attempt to identify those requirements which are seen:

  – either as particularly important given the specific needs of this project,

  – or as areas of differentiation between products;

- discussions with staff at the hospital sites.

  These discussions provided valuable insights into local requirements, the experiences with those systems currently in use and the implementation and maintenance support provided by the respective suppliers;

- structured interviews with suppliers and selected reference sites.

  All three suppliers were interviewed (DIS, ACT and Telepath) and reference sites visited. In addition to BCHT, the reference sites interviewed included Antrim Hospital, Craigavon Hospitals, the United Leeds Healthcare Trust and Hastings Hospital. Pro-forma questionnaires were used for the interviews. These have been included as Appendices C and D. Questions such as the approach to on-going support and development of the products and the strategic product development plans of the suppliers were investigated in the discussions;

- option appraisal.

  The options agreed with the Project Board were appraised. Indicative costings were obtained from suppliers and compared with data from other sites. The appraisal considered the implications of implementing each option. On the basis of the appraisal, the recommendations were developed.

1.3. Structure of this Report

The background to the laboratory services and associated information systems at the RGHT and the BCHT is outlined in Chapter 2. Chapter 3 summarises our view of the future requirements of the Directorate. The main findings of the evaluation are summarised in Chapter 4. The options identified by the Project Board are introduced in Chapter 5. This describes the wider set of options considered, and the revised set agreed with the Project Board.. These are appraised in Chapter 6 in the light of our findings. Our recommendations are set out in Chapter 7.

2. BACKGROUND TO INFORMATION SYSTEMS

2.1. Business Background

The Laboratory Directorates at BCHT and RGHT are in the process of merging to form one new Directorate. The service and business profile of the merged Directorate are detailed in Appendix A to this report.

The merged Directorate is a substantial organisation with a high workload and a total annual budget of around £15million per annum. The statistics contained within the Appendix (particularly the workload figures) were used in the analysis in Chapter 6.

2.2. Belfast City Hospital

The origins of the laboratory information system currently operating at the City Hospital go back to the early seventies. Software developed on site in a Mumps environment and implemented on a PDP 11/34 machine was initially applied in the Clinical Chemistry Department. It was a bespoke system and as far as possible mimicked the manual systems then in use. The system has subsequently been extended to the other laboratory disciplines.

Histopathology and Cytopathology originally ran on the same laboratory system as the other disciplines. It was decided that these services would be operated on a pan-regional basis, and hence a separate system to support these two disciplines was set up on a separate machine using software from South West Region, modified locally. Both of the systems run under Mumps and operate under the same communications protocols.

With the close co-operation and input from the Directorate of Information Systems (DIS), the non-Histo/Cyto system has been upgraded to include new modules and new functions. It is currently the standard regional system and is implemented in all hospital laboratories with the exception of the RGHT.

The system is a processing and reporting system for all departments except Medical Genetics. There is a two-way communication with PAS and results are transmitted to all nursing stations and secretarial offices within the BCHT complex and to the Lagan Valley and Downe hospitals. A number of GP Fundholding practices are also connected. In addition, a link exists to the Renal Unit where results are transmitted to a stand-alone foreign host, operating under a commercial package. A link with the Ulster Independent Clinic is also planned.

2.3. Royal Group of Hospitals

The Royal Group of Hospitals laboratories currently use a range of systems designed in the 1970s and 1980s, with virtually all aspects of the work being recorded and processed by IT systems. The large departments use two ITL minicomputers running Phoenix, Microlab and in-house software for Haematology and the blood bank. The small departments use a PC version of the Haematology system. The Haematology and blood bank systems are linked to the PAS. The Royal has its own in-house Histopathology system, by the Department of Cytology uses the Regional system, running on hardware located at the BCHT.

There are approximately 80 terminals attached to the systems, with about 10 linked analysers providing direct transfer of test result data. There are a few specific ward links, and the Altnagelvin Hospital Laboratory inputs specialised blood issue data directly into the system through the communications network.

To address the business needs of the laboratories, an ORACLE based system has been set up which takes data from all the systems operating within the laboratories and generates the Directorate's activity analysis statistics, cost per case invoices, specialty costing data and other reports for monitoring workload and activity.

The laboratories also make extensive use of IBM compatible PCs with about 120 installed. Approximately 30 are attached to the Hospital fibre optic network. In addition, two Novell servers provide printing, software and file-sharing facilities.

As systems are running on old hardware, and also because of the multiplicity of systems, it is difficult to provide direct access to ward and GP users of the service. The laboratories have therefore actively worked towards a replacement system by producing a detailed requirement specification, participating in a regional procurement project, undertaking and completing a full business case to CCTA guidelines.

The business case for the RGHT Laboratories system was approved in May 1993, following which the advertisement for the current procurement was placed. This is now at the stage of agreeing contracts with two suppliers: ACT and Telepath.

2.4. Regional Approach

An initial procurement exercise, started in 1989, was undertaken with support from DIS. The intention at that time was that the chosen system would become the new regional standard. Over recent years, the DIS systems have been implemented in most laboratory sites in NI, with the main exception being the RGHT. For various reasons, this procurement did not lead to the award of a contract. The current laboratory system procurement exercise which encompasses the RGHT and two units within the Northern Board, commenced in 1993.

The strategic stance towards Pathology systems in Northern Ireland therefore, remains unclear.

2.5. Strategic IM&T Issues

Each site has its own information systems strategy, each of which includes plans for the introduction of a person-based environment of integrated systems. The position with Cytopathology and Histopathology is slightly different, given the tests carried out by both sites on behalf of the Regional Screening Service.

The provision of a service to the merged Directorate is not straightforward, and will require consideration of:

- physical computer communication between the two sites, with (for instance) the installation of an optical fibre link;
- the ability to provide `cross-site' reporting (e.g. if a patient at one hospital has tests performed at a laboratory at the other hospital, then the requester must receive the result, preferably electronically, in the same way as if the test were carried out locally). Without this, it would be difficult to provide the transparent service;
- the ability for the pathology system(s) to link to each site's current Patient Administration System. This is not a purely technical issue; it relates also to the discrete patient numbering systems in use at the RGHT and BCHT sites. There are alternative approaches to resolving this issue. One of the products evaluated in this study has provision for multiple patient numbers. This would enable linkage of records under a unique identifier, but with pointers to the respective hospital numbers for the BCHT and RGHT PAS master files.

Each of these issues is discussed as part of the option appraisal (Chapter 6).

3. FUTURE REQUIREMENTS

3.1. Introduction

This chapter aims to assess the future development and hence requirements of the merged Directorate. As the merger is recent, it has been necessary to make a number of assumptions about how the service is likely to develop. These assumptions are documented here in order to set the context for the option appraisal (Chapter 6).

3.2. Commercial Issues

In view of the increasing pressures on efficiency, most laboratories are already experiencing the following:

- higher customer expectations;
- the need for clarified relationships with users of the service;
- reductions in total expenditure;
- increasing workload with fewer staff.

In response to these pressures, many Trusts are considering ways of establishing pathology services on a more commercial footing. Examples include:

- cross-charging. This may fundamentally change the method of funding for pathology services, with even internal customers charged on a per test basis. Craigavon laboratory services operate on this basis, with contracts agreed with most providers (and some GPs) in Southern Board;
- market-testing. It is possible that the merged Pathology Directorate may be subject to a market-testing exercise at some point in the next few years.

The response to the pressures faced by pathology will require investment in technology and revised processes to achieve improvements in efficiency.

3.3. Service Issues

The Directorate will need to address a number of more general service issues:

- role of Pathology. Increasingly, there is a need to consider whether the primary role for Pathology is to provide a diagnostic service or to act as a centre for clinical practice;
- controlling demand for Pathology services. It has been contended that a significant proportion of tests make no contribution to clinical care. Set against a background of steadily increasing workload, there needs to be a mechanism by which the flow of requests may be controlled;

- the impact of changes in junior doctors' hours. Some sites are finding that this affects the continuity of care, although it has been argued that the emphasis on consultant-led care will lead to improvements;

- the impact of developments in clinical practice: Pathology needs to assess, and address, the implications of developments in clinical practice such as the increase in day surgery.

3.4. Technical Developments

More generally, and in common with all other areas of healthcare, Pathology is facing a period of change and adaptation in the face of technological advance. In particular, issues which are likely to have an impact on the new Pathology Directorate will include:

- peripheral laboratories.

  Laboratories at other sites will be seeking to establish their identities and build their own user communities. The growing sophistication of laboratory analysers will provide such sites with opportunities to carry out work previously undertaken only by specialist laboratories.

- near-patient testing.

  This may change the way in which specimens are collected and tests carried out, although it is unclear how quickly this will develop.

- more efficient analysers.

  The Belfast hospital laboratories contain a large number of labour-intensive, out-of-date machines. One example is the Prisma machine at the City Hospital; there is a Hitachi machine which (at a cost of £800,000 over five years) is capable of processing many times the workload of the Prisma with fewer staff. There are trends to automation in disciplines other than Chemistry and Haematology. Microbiology will benefit from these technical advances, with Cytopathology following.

- merger of disciplines.

  Analysers will continue to become more sophisticated and in time will break down barriers between disciplines. This is already starting to happen between Clinical Chemistry and Haematology.

3.5. Configuration of Services

The Heads of Service in the merged Directorate have just been appointed, and will shortly start on the development of the business plan. At this stage, therefore, it is too early to consider in detail future requirements or objectives. It is our view, however, the physical configuration of the services is likely to change substantially. This is partly driven by the considerable scope for increased automation across the Directorate. Similarly, there is a trend in other laboratories to move towards one reception area per site.

One of the main requirements identified within the Directorate is the need to provide a 'transparent' service to users (i.e. one in which requesters need not know where test are being carried out). This implies a fast, responsive service. The following table, taken from a recent study of pathology services at a large teaching hospital, summarises the required response times for pathology results. These were derived from investigations and interviews with consultants at the site.

Table 1
Required Response Times for Inpatients

	Within 2 Hours	2-24 hours	24 hours - 1 week
Chemical Pathology	21%	49%	30%
Haematology	27%	48%	25%
Histopathology	5%	13%	81%
Microbiology	5%	27%	68%

Table 2
Required Response Times for Outpatients

	Within 2 Hours	2-24 hours	24 hours - 1 week
Chemical Pathology	7%	15%	78%
Haematology	10%	14%	76%
Histopathology	0%	9%	91%
Microbiology	0%	14%	86%

Given these users' requirements, it might be more appropriate for each site to retain core services in Chemistry and Haematology to provide a fast turn around. Services provided off-site would then be non-urgent. This might obviate the need for a vacuum tube link between the two sites.

The reprofiling of services could take place within a framework in which the clinical support is separated from processing of tests. Hence, if Microbiology and Histopathology were each located at one site, the microbiologists and histopathologists could continue to provide separate clinical support at each site. This could be under-pinned by video-conferencing, and the transfer of data and images across the sites.

From a management perspective, we do not consider the proposed arrangements for the Directorate (reporting to both Trust Chief Executives) to be a long-term solution. We believe it is more likely that the Directorate will either become a separate entity within one Trust or will obtain agency status. The latter option has major implications in relation to strategy and systems requirements.

3.6. Future Direction of Pathology Systems

On considering user requirements (Appendix B), we have attempted to identify some of the future requirements of the new Directorate; these include:

- controlling costs;
- planning workload;
- links to billing and budgetary control systems;
- improved monitoring tools.

The last two issues will assume greater importance if the Directorate moved to agency status.

Developments in pathology and pathology systems are likely to lead to:

- increased 'intelligence' within analysers, i.e. the test equipment itself will perform a much larger proportion of the standard reporting functions;
- further development of rules-based facilities;
- development of management reporting functions and features.

A current issue is that of set-based versus test-based systems. The prime differences between set-based and test-based systems are in terms of support for workload analysis and decision support. The architecture of test-based systems allows greater flexibility in profiling tests within sets. This makes it much easier to accumulate costs, pricing details and contract minimum datasets. Some of the same results can be achieved within set-based systems, but managing the cost base is not easy.

A system with a high degree of flexibility will be required to allow the new organisation to adapt to both internal and external changes brought on by the merger and the business need for rationalisation.

4. ANALYSIS OF PRODUCTS

This Chapter provides an overview of the three pathology products (ACT's APEX system, the Telepath system and the DIS Regional Standard System) considered by the study. The summary is presented against the following headings:

- system profile;
- system design;
- functionality;
- support and maintenance;
- user acceptability;
- development activity.

Our analysis was carried out through a programme of meetings with suppliers and reference sites. The baseline for discussions was the statement of key user requirements (Appendix B). The agendas for the meetings were the reference site and supplier scripts included as Appendices C and D respectively. The detailed analysis of the products against the criteria identified in the list of key user requirements has been included as Appendix E.

4.1. System Profile

4.1.1. Background to Current Systems

Most operational laboratory systems currently in use are written using Mumps. Latterly, a number of suppliers have been working on the development of replacement systems using modern tools and technologies. To date, however, the 4GL developments have struggled to achieve a satisfactory level of systems performance. Shortcomings arise from the trade-offs between flexibility, functionality, speed of response and management reporting. Mumps has consistently proven its ability to support operational use, whereas the developments of pathology systems in environments such as Oracle have, as yet, failed to do so. More typically, suppliers use Mumps for the front-end processing, and tools such as Oracle or Focus for management reporting. This creates the problem of maintaining consistency between the two modules.

In the context of DIS, for example, developments so far have been carried out in Mumps, with Oracle being used for Decision Support. The introduction and / or rewriting into M/SQL would allow facilities such as screen and form design to be given to user sites, but it appears unlikely that the M/SQL toolset will be given to end-users; its impact might hence be limited.

4.1.2. ACT

The ACT product, APEX, is the most recent of the three products. Development started in 1989 as a complete replacement for the earlier CILMS product. The differentiating features of the new product are that it is test-(rather than set) based and that it incorporates a significant rules-based capability.

APEX is implemented in 13 sites, with 60 disciplines in use. The older CILMS product has over 250 disciplines in use across sites in the UK.

ACT have 24 staff dedicated to their pathology system, with 14 consultant and technical staff, three support staff and six dedicated to systems development.

4.1.3. DIS Regional Standard System

Some of the background to the DIS Regional Standard System (RSS) has been described in Chapter 2. Development of this system started in the early 1980s, and modules have been added and the system upgraded since then. The system is used in 15 hospitals in Northern Ireland. In addition, the DIS Histopathology and Cytopathology system, which is run as in central database, used by all NI Laboratories (except RGH Histopathology). Though the DIS pathology team belongs to a mature organisation, they are still in the process of developing the management processes required to support a complex product running on multiple sites. There are nine staff designated as part of the Pathology Team, but most of their time recently has been spent on systems implementation. The small size of the team hinders many of their aspirations for product development and support procedures.

4.1.4. Telepath

The Telepath system grew out of the Phoenix project at the Queen Elizabeth Medical Centre, Birmingham, during the 1970s. The system became a commercial product during the 1980s, and is the current market leader in terms of the number of installed sites.

The Telepath system is currently implemented in 127 sites, with 462 disciplines in use across the UK. The staffing levels for Telepath are of similar order to those for ACT. Both Telepath and ACT have developed large and mature organisations to provide support for their products. In each case, this user support is staffed independently of the suppliers' development teams.

4.2. System Design

The ACT APEX system is the most recent of the products, and has an inherently more sophisticated database and at present has great potential for development and enhancement. It would appear that the system design leads to much greater requirement for disk storage (not least because of the audit trail data that are saved). No site has yet been running any module for enough time to be able to assess whether or not this has any long-term effects on performance.

The Telepath system is based on an older design and has been enhanced by retro-engineering to overcome some of the deficiencies inherent in its architecture. There has been some concern amongst users about the long-term future of the current product. Whilst further enhancements are being made to the system, we understand that Telepath is planning its redevelopment.

The DIS system was originally designed as an hierarchical database. This was modified and streamlined about 8 years ago, with extended data fields and enhanced recall facilities. The re-mapping of the database onto a relational database using M/SQL is in progress. The software is still built around the original manual worksheet methodology.

All three applications are written in Mumps. ACT and Telepath use Micronetics Mumps which at present is available only for single processor systems. DIS is written using InterSystems MUMPS which is already available in multi-processor format, and has a broader set of application tools. All three systems operate under Unix on a range of possible hosts.

4.3. Functionality

It appears that the ACT and Telepath products offer significantly greater functionality than the DIS product. Given their longer history in the field and wider distribution, they incorporate many more development cycles of experience and this is evident on inspection of the systems.

In both the Telepath and ACT systems, sophisticated rules can be applied within the system to control the flow of work. These can select results for validation queues on complex criteria including the ability to differentiate between request sources as well as age, diagnosis, ethnic group, medical specialty, etc. Furthermore, several different validation queues can be managed allowing work to be assigned logically between different users on the basis of specialisms or seniority. In addition, the rules can be used to control cascade testing and automatically to add appropriate comments to reports. In Microbiology, if used correctly, they can be used to automate much of the diagnostic decision making process. These features are essential for modern pathology systems as they greatly improve the efficiency of scientific and clinical staff and add great value to the final reports. They allow for the use of less qualified staff in many routine areas.

Though providing a level of basic functionality for the main laboratory disciplines, the DIS RSS lacks many of the 'added-value' features of the Telepath and ACT systems. This is evident from the relative paucity of the commands available to the user within each of the operational programmes. Furthermore, it appears that different sites have different facilities available to them. DIS is already aware of some of the development required to the system before it could be used by the laboratories on the Royal site.

The DIS 'DSS' management reporting and decision support software is not used by all sites. Craigavon has developed its own reporting system to consolidate the details from its three sites.

4.4. Support and Maintenance

All suppliers offer maintenance support for their products in addition to product upgrades. ACT and Telepath charge commercial rates for their services. The DIS Team provides support to user sites as part of the overall DIS service (which is part of the Management Executive), although it is understood that a move to agency status by DIS is under discussion.

Both the ACT and Telepath systems allow extensive user control of the system configuration. To exploit these systems fully, expert system managers are required, particularly during implementation, to ensure that package configurations are optimised. Once running, less system support is needed, but nonetheless the staffing commitments can remain high as systems are adapted to cope with changes in business needs and clinical practices.

It is necessary, with the RSS, for DIS to carry out directly many of the functions which are available to system managers on the ACT and Telepath systems. These include the creation of codes, test sets, worksheets, etc which are features under user control in the packages. It is expected that a re-write of DIS using M/SQL would enable many of these features to be provided. At present, the need to request operational changes from DIS inhibits the flexibility which laboratories need to respond to customer demands.

4.5. User Acceptability

Users of the Telepath system professed themselves satisfied with the system and with the company. It was more difficult to identify users of the ACT APEX system (apart from isolated modules). Those questioned were satisfied with the company and the product, but the reliability of APEX has yet to be fully confirmed. Both suppliers have active user groups who meet regularly to discuss product enhancements.

Users of the DIS RSS at the City Hospital, Belfast, were satisfied with both the system and the support provided by DIS. The nature of the system is such that it requires significant assistance from DIS. The City Hospital considers that DIS provides a very responsive service. The other regional sites interviewed presented a less positive picture, with claims of delays in fixing problems or dealing with requests. There is a perception among other users that the City Hospital receives priority. The recent institution of a Regional User Group may help to address this situation, although there is the related danger that the City may, as a result, begin to experience a loss in ownership of the system.

4.6. Development Activity

ACT have invested substantial resources in the development of the APEX product. The process of development took a number of years, during which time the supplier appeared to be `standing still'. The main system facilities are now in place, and the more recent developments have continued to add to the sophistication of the product. Much of the current development work is based around:

- support for workload control, and costing and management systems;
- extended rules-based processing support;
- introduction of expert system support.

Telepath is, as noted, understood to be planning for the redevelopment of their system. Many of the current developments are in the same areas as ACT, with work on costing and management and rules-based processing. Telepath has strategic alliances with other system suppliers, notably with SMS, the provider of the Patient Administration System used throughout Northern Ireland.

The DIS approach has been to upgrade and port the RSS software but not to engage in substantial enhancements or a rewrite of the system. The creation of the User Group, which met for the first time in December 1994, has provided a focus for these upgrades. Their identified priority is for a rewrite of the Microbiology module. It has been difficult for DIS to commit to timescales for developments to the RSS, however, given the requirements for supporting system implementations across NI.

The current RSS is characterised by hard coded routines and rigid file structures. The redevelopment using M/SQL is designed to replace these features incrementally with table structures, an underlying data dictionary and the use of an OpenDataBaseCommunication server. This will lead to a replacement of all rigid files, and a move to a client/server architecture. The use of the table structure, for instance, would enable new fields to be added easily for patient data. Most user interfaces are hard-coded. Some existing and new user interfaces are being routed to the data dictionary. One module (referrals) has been re-written already. This applies to tests being referred by other laboratories into the City or the Royal, and hence would not be used by those two sites. DIS anticipates that within three months, the framework product for Microbiology would be ready, and that a further three months would see the development of the rest of the framework.

We have some major concerns about the DIS plans for the M/SQL rewrite. There are two specific issues:

- approval for the development. We have seen no evidence that the development activity currently being undertaken has been formally agreed or approved by the users. The work that we are given to understand that is in progress on the system is being carried out by existing staff, as and when time permits. There do not appear to be specifications or project plans for the work, and no costed option appraisal has been produced to our knowledge;

- complexity. Whilst the intentions of the laboratory team at DIS are laudable, and their commitment undeniable, the experience of other suppliers redeveloping pathology systems has not been easy. We have, in Chapter 6, referred to an example of a NHS provider of systems. This supplier has recently completed a rewrite of pathology. In total, the project took four years to complete at an estimated cost of £1.5million.

4.7. Summary of Findings

There is no `perfect' solution with a 100% degree of fit. The ACT system looks the best, with the most sophisticated facilities, but is as yet unproven in more than a few sites. Telepath is the market leader in the UK and is known as a functionally-rich and reliable system. The RSS is some way behind the two commercial packages in terms of functionality, but is considered by the users at the City Hospital to meet more than 80% of their current operational requirements.

In terms of the requirements for the merged Directorate, it has been agreed that as far as possible a strategic approach should be adopted. Whilst each of the systems would be capable of supporting the operational work of a laboratory today, we have a number of concerns about the longer-term. We believe that the Directorate needs to plan for a system that will support its requirements over the next few years. In that context, we feel that:

- both the commercial systems would provide an appropriate platform for current and future needs;

- whilst the DIS RSS could meet most short-term needs, the growth path for the product appears to us to be associated with a significant risk.

5. IDENTIFICATION OF OPTIONS

5.1. Original Options

The Terms of Reference for this project assumed that the requirements for the merged Directorate would be met by one of the three following options:

- *Option 1: the roll-out of the DIS RSS to the RGHT and the continued use of the DIS RSS by BCHT;*
- *Option 2: the continued use of the DIS RSS by the BCHT and the implementation of a commercial system at the RGHT with the integration of information at a higher management level to facilitate decision support;*
- *Option 3: the roll-out of a commercial system to the RGHT immediately and to the BCHT in the medium term (i.e. 2 to 3 years).*

5.2. Alternative Options

It was clear from our discussions that, at present, users at RGHT do not favour the current DIS system and, equally, users at BCHT are unconvinced about the need for a commercial system. These views would prejudice the successful outcome of any overall solution. The options defined in the original terms of reference were also, in our view, non-equivalent, in that two were configured mainly to meet a short-term need whilst one had longer-term strategic implications for the merged Directorate. For these reasons, some alternative options were identified, in order to provide the basis for discussion on possible differing approaches (it should be understood, however, that these option were not discussed or agreed with any of the suppliers concerned). These are:

- Option 4: the merged Laboratories Directorate takes control of the DIS team.

  One of the features of the DIS product is the lack of user control over the development and support of the system; although the creation of the User Group should assist this process. There are constraints upon the users' desire to dedicate more effort to the development process.

  This option would allow development to take place by the Directorate taking over the current DIS team; however, there would be a responsibility to continue providing a service to the other sites in the Region currently using the system.

  RGHT would implement the current system once initial developments have been undertaken, and both sites would upgrade as new facilities become available.

  There are some variations on this option, including:

  – agreeing to take the DIS team on secondment for a period of time (say two years);

- forming a 'break-away' team that develops and maintains the system locally.

- Option 5: RGHT agree a three-year contract for a new system

  RGHT needs a replacement system. Under this arrangement, the current procurement would be completed with agreement (with the successful supplier) for a three-year contract, with an option to renew.

  This would provide the Directorate with the opportunity to review its requirements and consider the most appropriate longer-term solution once the revised management structure had settled down.

  There are certain legal implications (regarding the current procurement) which would need to be explored should this option be considered further.

- Option 6: Commercial supplier takes over the DIS Pathology team.

  This option would require a tendering exercise to be carried out. This could lead to the 'buy-out' or possibly a facilities management arrangement for the DIS team provided by a commercial supplier. The DIS team is dispersed to support the installed systems and to provide local enhancements / development, e.g. in Decision Support etc.

  The interest for the suppliers would lie in the nucleus of an Irish office, together with 15 user sites for the pathology system. In the longer term, the supplier may replace the current system with its products, at a time and pace agreed with users.

  The DIS team would aid the implementation of the commercial system throughout the Region.

5.3. Discussion of Options

The desire of the laboratory staff is to identify a suitable long-term, strategic solution to the needs of the merged Directorate. The original options appeared to be more focused on the short-medium term requirements. This was explored at a Project Board meeting held on 5 January. The clear consensus of the meeting was that the prime need was for a strategic option, but with an acknowledgement that RGHT had an urgent need for a replacement system.

5.4. Revised Options

The agreement on the strategic thrust of the project provided the basis for the discussion of each of the options identified in the draft report. The outcome was as follows:

- Option 1: this would be retained, but with consideration of how the DIS RSS product would be upgraded to meet the agreed requirements for the Directorate. This consideration would include issues of development and support for the product, together with its position as a strategic solution to meet the longer-term needs of the merged Directorate;
- Option 2: this would be retained with an additional feature, the provision of a central results database which would enable consolidation of data from the two sites. This option may be ruled out on the grounds of feasibility; in any case, separate systems on each site would not form an acceptable long-term solution;
- Option 3: this would be retained as a joint laboratory option (i.e. for both sites together rather than in series). The consideration would include options such as roll-out of the chosen system discipline by discipline;
- Option 4: this would be dropped, with the future development for the DIS product considered in the re-defined Option 1;
- Option 5: this would be dropped;
- Option 6: this would be dropped as it required agreement between two third parties. DIS may, or may not, wish to pursue this course independently. Consideration of this will be taken into account as part of Option 1.

5.5. Constraints

The prime constraints are those of time and resource. The initial problem is that the merger of the directorates is still in its early stages. The implications of the rationalisation report are that the next two to three years will see substantial reconfiguration of services, with consequent changes in the organisation's structure, management, style and staffing levels. Over this time, the information requirements for the merged Directorate will become better defined, as the new organisation's business objectives and relationships with major customers evolve. At present, however, it is too early to be confident what those requirements will be.

In the meantime, as noted in Chapter 2, RGHT is in urgent need of a replacement laboratory system. The procurement of a replacement system has been underway for some months, and the position with the current system has become increasingly difficult.

At the same time, there has been substantial pressure on resources, and the merged Pathology Directorate will be faced with difficult choices about the allocation of available funds.

5.6. Northern Ireland Perspective

In view of its size, any decision made for the RGHT/BCHT laboratories will have an impact on the other sites. For instance:

- a decision to replace the DIS system would probably mean that the DIS product would become non-viable overall and the other sites would also have to replace their systems. It is assumed, however, that DIS would continue to support, but not to develop, its system as long as there are still users of it;
- a decision by the merged Directorate to procure the commercial package solution will, according to the current regional policy, make this the de-facto Regional Standard System for the future;
- a decision to invest in the major development of the DIS system would need buy-in from the other sites.

5.7. Assumptions

It was acknowledged by the Project Board that a number of issues (such as the business strategy for the Directorate) would not be clarified during the timescale of this project, but that as a speedy response was necessary, we would be required to take a view on this and other issues. Some of the general assumptions about the future of laboratories were documented in Chapter 3. The more specific assumptions are detailed below.

5.7.1. Hardware Siting and Sizing

For the purposes of this option appraisal, we have assumed that the physical hardware configurations required to support the options will be broadly similar. We have appraised the options on the basis that the requirements and hence costs for peripherals, networking and communications will be the same in each case.

There is a DG Aviion system configuration at the Belfast City Hospital supporting the pathology application on that site. The hardware at the Royal, used to support the ITL system, is out of date and needs to be replaced. For the purposes of this option appraisal, we have assumed that the hardware required to support the system(s) for the merged Directorate would best be provided by upgrade of the equipment at the City Hospital. Links to the RGHT site would be provided by a Megastream line, with a router at each end.

All options assume systems running on Data General Aviion equipment under the DG/UX operating system. The options imply the use of different versions of Mumps and appropriate license costs have been included in each case.

The estimated disk sizing figures are summarised in the table below. The disk capacity required depends entirely on the application software. Indicative figures were supplied by each of the suppliers. However, the commercial systems varied widely in their figures. We have therefore taken a view based on illustrative figures from another supplier as quoted to an English NHS site. In view of the falling prices of disk capacity, we consider this the relative cost of this element to be sufficiently small so as not to affect the figures significantly. Our assessment of the sizing for Option 2 has been based on an adjusted average of the other two options.

Table 3
System Options: Disk Sizing

	Option 1: RSS	**Option 2: RSS / Commercial**	**Option 3 Commercial**
Year 1	Megabytes	Megabytes	Megabytes
Patient Files	100	150	150
Haematology	290	590	880
Chemistry	500	610	720
Microbiology	150	470	800
Histopathology	100	210	320
Cytology	50	100	150
Total	1,300	2130	3,020
Year 5			
Patient	200	250	300
Haematology	1,450	1870	2,290
Chemistry	1,500	1650	1,800
Microbiology	750	3100	5,600
Histopathology	500	1390	2,240
Cytology	250	750	1,200
Total	4,650	9010	13,430

5.7.2. Costs

We have assessed the indicative costs of the DIS RSS and the two commercial packages, and have accordingly made the following assumptions:

- hardware: for Option 1, upgrade the existing DG kit at BCHT with a DG 8500 and additional disk capacity. The cost would be £50,000 capital and £4,000 revenue. We have assumed that the additional storage capacity for Option 3, and hence possibly additional processor capacity, would double this cost;

- we have assumed, in each case, a sum of £50,000 for peripherals as we understand that some replacement equipment will be required at RGHT;

- system software: Unix for the new processor would be £5,000 capital, M/SQL would be £15,000 capital, and support costs for the two together would be £4,000 per annum. For Option 3, separate costings have been given for Micronetics Mumps; the DG/UX costing as provided by DIS has been doubled for this Option;

- communications: a Megastream between the two sites, with a brouter at each end would cost £15,000 capital, plus £3,000 revenue. There are alternative ways of providing communications, and ensuring resilience between the sites, but for the purposes of this study the Megastream link is the option which has been costed.

In addition, we have made the following assumptions:

- it is expected that upgraded hardware can be installed at BCHT within the existing computer room, and hence no additional accommodation costs would be incurred;

- we have assumed that there will be no additional on-going staffing costs. We have allowed a non-recurring figure of £30,000 for the effort required from laboratory staff to support the implementation.

Within the costings there are a range of other non-recurring costs. We have calculated these on the basis of indicative figures provided by each supplier. However, in some cases, these figures have been provided not as a total but as a per diem rate or as a cost per item (e.g. interface cost per analyser). For comparison purposes, we have used figures from the example used above of an English NHS site. This allowed 200 days support for implementation and a further 80 days for data conversion.

5.7.3. Benefits

The benefits of the various options have been difficult to assess, given that they will be dependent, in large measure, on organisational changes introduced by the Directorate.

The benefits to be gained from the implementation of any system, however, are directly proportional to the functionality provided by the system. We have therefore assumed that the overall functionality of each of the systems options under consideration will be broadly equivalent, i.e. each system will be upgraded / enhanced as appropriate to meet the overall requirements of the merged Directorate. We have therefore further assumed, for the purposes of this exercise, that benefits of each option would be the same.

It is worth noting, however, that we believe that one of the major potential areas of benefit would be in relation to the reduction in clerical input, and the effect of single point entry of data if the move to a single reception area were achieved.

6. OPTION APPRAISAL

The appraisal in this Chapter includes, for each of the three options:

- description;
- assessment of cost over seven years;
- operational implications for the sites;
- risk factors;
- overall assessment.

6.1. Option 1: Implement DIS RSS

6.1.1. Description

The DIS RSS is implemented across both sites. Development effort would be required in order to meet:

- specific functional requirements for RGHT;
- general functional requirements for the directorate;
- the rewrite of the system using the M/SQL toolset.

6.1.2. Costs

In addition to the costings identified previously, specific details for DIS would include:

- implementation and training at £350 per day, assuming external contractors. On the basis of the estimated days required (see previous Chapter), this gives a total of £70,000 for implementation and £28,000 for data take-on;
- interfacing at £500 per analyser (assuming 2 days per item). Interfaces would be required at one site only (RGHT). In addition, there are the costs of establishing the links with the two PAS's. We have estimated this to total £24,000;
- on the basis of discussions with DIS and comparisons with similar exercises elsewhere within the NHS, we have assumed the cost of specific developments for RGHT to be £100,000. This includes a figure of £30,000 for the modules required by departments at RGHT for which no software currently exists, but does not include costs for the M/SQL development;

- support and maintenance from DIS have been estimated at £60,000 per annum from Year 2. The reasons for this are given in the section below on implications.

We have made no allowance for full access to the DIS Management Reporting module, although this might require additional software licenses.

Table 4
Option 1: RSS

Costs £'000	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
Capital / Non-recurring								
Application Software								0
Systems Software	20							20
Hardware (CPU)	50							50
Hardware (Peripherals)	50							50
Procurement	0							0
Interfaces	24							24
Communications	15							15
Implementation	100							100
Data Take-on	28							28
Developments	100							100
Sub-Total	387	0	0	0	0	0	0	387
Revenue								
Hardware	8	8	8	8	8	8	8	56
Software (systems)	4	4	4	4	4	4	4	28
Software (applications)	0	60	60	60	60	60	60	360
Hospital Support Staff	0	0	0	0	0	0	0	0
Communications	3	3	3	3	3	3	3	21
Sub-Total	15	75	75	75	75	75	75	465
Total	402	75	75	75	75	75	75	852
Net Present Value	402	71	66	62	59	55	52	767
Cumulative NPV	402	473	539	601	660	715	767	

6.1.3. Implications

Implementation of the DIS system at RGHT would consume significant resource both for the development and implementation activities. This would adversely affect the development effort on behalf of other (existing) DIS sites. Potentially this could be addressed by the use of consultancy support, although the availability of such staff is not known. There is already a lot of knowledge and experience with the product at BCHT which would be used to assist (for instance) in training activities.

System support would be provided by DIS. At present such support is provided as a 'free good'. It is expected, however, that from April 1996, DIS may operate on an agency basis. In the lifetime of this project, we expect arrangements to be in place requiring sites to pay the full cost of services provided to them. The pathology team currently has seven staff. Our estimate of total cost for the team is around £200,000 per annum (including on-costs). The merged Directorate will account for around 30% of the user base for pathology, and on this basis we assume a support cost of £60,000 per annum. This has been charged with effect from Year 2.

The major question relates to the future development of the DIS system. This development falls into three categories: specific enhancements for RGHT, general enhancements and system rewrite.

- specific enhancements.

  It has already been acknowledged that certain aspects of the Royal laboratories operation are not addressed by the current RSS software. New modules would be required (e.g. for PKU).

  The requirement for a single system which supports a transparent service requires seamless integration with both PAS installations. Support for this will require specific development activity;

- general enhancements.

  Developments would be required for:

  - rules-based support;
  - test cascade methods;
  - audit trail;
  - clinical validation;
  - auto-commenting;
  - Microbiology;
  - management reporting;
  - cross-linkage between modules;

- system rewrite.

The analysis in Chapter 4 described aspects of the proposed rewrite of the RSS by DIS. We have, however, already indicated our major concerns about the feasibility of these plans. We have made reference to another NHS site where such a development took place. This was carried out over a period of four years at an estimated cost of £1.4million.

It was in this context that we previously identified an option whereby the merged Directorate investigates the options for taking over the development team. If it were decided to proceed with Option 1, we still believe this to be a route worth exploring.

6.1.4. Risks

There are a number of risks relating to this option:

- requirements issues,
  - rationalisation plans might be at variance with optimal IT configuration e.g. split of core automated functions within / across sites;
  - rewrite may not proceed;
  - functionality may not be sufficient;
  - may be unable to support requirements for management information;
- implementation issues,
  - one site may disapprove of systems choice and frustrates implementation;
  - requests for system enhancements and changes may require significant additional resource;
  - DIS team may not be large enough for job in hand;
- support issues,
  - DIS team may break up. High demand for 'M" programmers / IT specialists in healthcare in NI;
  - DIS team may not be capable of restructuring to provide adequate system development;
  - DIS team may be constrained in terms of staffing and budget by civil service rules on recruitment;

- insufficient resources may be provided to support DIS team and allow for full development;
- final number of sites may not be not large enough to provide market support for DIS team.

6.1.5. Assessment of the Option

We believe that in the short term, the DIS RSS could meet most of the needs of the Directorate. However, we have identified some gaps for which developments would be required and are convinced that unless most of these are addressed, the system will remain unacceptable to users at RGHT.

In view of the strategic requirements of the Directorate and our concerns regarding the redevelopment of the RSS, we consider this option to be high risk in the longer term.

6.2. Option 2: Implement New System at RGHT, BCHT Continue with RSS

6.2.1. Description

In this option, BCHT continues to use the RSS, while RGHT implements a commercial system. In order to meet the operational and management needs of the Directorate, this will require a third system, a 'results database' which is able to consolidate test results.

6.2.2. Implications

The provision of a central repository of results would require two parallel systems to be retained. In this case, data entry must be duplicated, so it is difficult to see how a transparent service may be provided to users. In addition, there are particular problems associated with results databases, in terms of changes to reference ranges and accumulation of results for each patient.

The implementation of the systems, whilst apparently more straightforward, will not address the issues of consolidating laboratory activities under the one management structure. This would require, for instance, consistent system set-ups, with shared codes, and the need to keep separate applications in step.

In addition, there would be two (or maybe three) sets of support costs to be paid, two sets of system software (for the different versions of Mumps) and separate system managers for each application.

6.2.3. Risks

The risks associated with this option are fundamental:

- requirements issues,
  - rationalisation plans might be at variance with optimal IT configuration e.g. split of core automated functions within / across sites;
  - use of separate systems may provide poor fit for overall & long-term strategic objectives;
  - there may be poor growth potential;
  - it may be unable to support merged Directorate;
  - commercial systems may be a poor buy because they contain functionality which is not required;
- implementation issues,
  - there may be difficulty of ensuring consistency across sites;
  - the directorate may be unable to implement results database;
- support issues,
  - there will be a need to support two separate systems;
  - provision of support from the mainland may add excessively to support costs.

6.2.4. Assessment

We believe that this option is not feasible, and contrary to the underlying desire to create a single, merged Directorate. The option assumes separate installations, although to meet business needs considerable work would be required to reconcile the systems.

We have not provided detailed costs for this option. We believe, however, that the costs would be substantial, since there would be no economies of scale in terms of support, and possibly additional costs in order to support the results database.

6.3. Option 3: Implement Commercial System

6.3.1. Description

This option is for the implementation of a commercial system for the whole Directorate, with the new system being implemented in both sites in parallel.

6.3.2. Costs

Indicative costs have been provided by both of the suppliers currently shortlisted for the Royal procurement. There are some common elements to these costings:

- in both cases, suppliers have stated that the application software and support costs would be charged as for one site (examples have been given of other hospitals where this is the case) at a cost of £80,000;
- the implementation costs would be broadly similar for two sites as for one depending on the approach to implementation. If, for instance, one discipline were rolled out across both sites at one time, then joint training could be provided. Otherwise it would be necessary to provide separate training, and additional costs would be incurred.

Other cost elements would include:

- DG/UX and MSM upgrade. We have costed the former at £10,000 (double the figure DIS provided for Option 1), and the latter at £30,000 (this would support 128 users). In addition, there would be costs for other management reporting software. These have been estimated at £17,000;
- implementation costs have been estimated at £105,000. Data transfer costs have been estimated as £30,000;
- separate PAS interfaces will be required at £13,000 per site. A general messaging product could be considered, but this would be a strategic issue for the hospitals. The analyser interface costs are assumed to be £52,000, giving an interface total of £78,000;
- we have allowed a sum of £10,000 for the administration of the procurement project;
- we have assumed a development cost of £10,000 to allow for minor enhancements to meet requirements.

6.3.3. Implications

This option does not assume any one supplier at this stage. Both those on the RGHT shortlist have installed their applications in multi-site laboratories, and each has some experience of supporting multiple PAS's.

The current procurement started in June 1993, and it is some time since the shortlist was announced. However, we believe that there is no sound reason why the procurement cannot proceed to award of contract, provided that this is done without any further delay. The advertisement for the procurement in the European Journal allowed for the software to support 'up to two other units of management' in addition to the Royal Hospital laboratories.

There would be a number of options in terms of the approach to implementation of the system. We believe, however, that for a number of reasons, it would be appropriate to proceed on a discipline by discipline basis. This would encourage much closer working between the sites, with a consistent approach being required without any one site taking an independent lead. We consider that it is important for the Directorate to view the implementation as the replacement of old systems on both sites by a single new system.

Table 5
Option 3: Commercial System at Both Sites

Costs £'000	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
Capital								
Application Software	80							80
Systems Software	57							57
Hardware (CPU)	100							100
Hardware (Peripherals)	50							50
Procurement	10							10
Interfaces	78							78
Communications	15							15
Implementation	135							135
Data Take-on	30							30
Developments	10							10
Sub-Total	565	0	0	0	0	0	0	565
Revenue								
Hardware	12	12	12	12	12	12	12	84
Software (systems)	6	6	6	6	6	6	6	42
Software (applications)	30	30	30	30	30	30	30	210
Hospital Support Staff	0	0	0	0	0	0	0	0
Communications	3	3	3	3	3	3	3	21
Sub-Total	51	51	51	51	51	51	51	357
Total	616	51	51	51	51	51	51	922
Net Present Value	616	48	45	42	40	37	35	863
Cumulative NPV	616	664	709	751	791	828	863	

6.3.4. Risks

The potential risks of this option include:

- requirements issues,
  - rationalisation plans may be at variance with optimal IT configuration e.g. split of core automated functions within / across sites;

- use of commercial systems may provide a worse fit for overall and long-term strategic objectives - e.g. the establishment of province-wide pathology services with a common system by providing a point solution for the RGH/BCH laboratories' current perceived needs;

- commercial systems may seem to be poor value for money because of functionality which is not required;

- implementation issues,

  - one site may disapprove of systems choice and frustrate implementation;

- support issues,

  - provision of support from the mainland may add excessively to support costs;

  - implications on disk capacity of test-based systems are not yet known;

  - the supplier could face financial difficulties or change of ownership. (During the course of the study there has been speculation regarding the ownership of the ACT Group).

6.3.5. Assessment

In our view, this option represents the most appropriate way forward for the directorate. We believe that the potential risks identified above may be managed and contained.

There are some difficulties in terms of acceptability with BCHT, which is broadly satisfied with the DIS system. However, we consider that, providing a suitably co-operative approach to implementation is encouraged, this need not hinder a successful project.

Similarly, we believe that through the current procurement project a number of the risks regarding fit to requirements and support issues can be controlled as the suppliers are required to commit to formal specifications.

We believe the long-term requirements of the Directorate would be met by a commercial system, where planned enhancements are introduced on a regular basis.

6.4. Histopathology and Cytopathology

The Regional Cervical Cytology Screening Service uses the call-recall module within the BCHT based Histopathology and Cytopathology system, which supports the work of these two laboratory disciplines across the whole of Northern Ireland (except RGHT Histopathology). This situation is unlikely to change in the near future, and hence recommendations for the merged Directorate need to address requirements for these two disciplines in order to maintain the integrity of the call-recall function.

In our view, the need for data integration at an operational level is not so important except in specialist areas (e.g. bone marrow). The drawbacks would be for end-user reporting and for Casemix aggregation. On balance, whilst it would be preferable for a single solution to the needs of the Directorate, we believe that for the time being, it would be more pragmatic if each site continued to use the systems for these disciplines as operated currently, in the short term. For the purposes of introducing a new system, these two disciplines would be left until the end of the implementation programme.

7. RECOMMENDATIONS

The analysis presented in Chapter 6 rules out Option 2, leaving a comparison of Option 1 with Option 3. It may be seen from the costings that the overall difference in indicative costs is marginal over the seven years.

In our view, the comparison of these remaining options depends on a number of key criteria. These include:

- the ability to support the functional requirements of the Directorate;
- the ability to support the management reporting requirements of the Directorate;
- the ability to provide a growth path for the future, and to support strategic developments.

We believe, from our analysis, that the commercial option offers a better strategic platform for the Directorate, and present a lower risk in terms of future development. In view of what we consider to be a relatively small extra cost over the seven year period, we therefore recommend that the Directorate proceeds with Option 3.

We are conscious, however, of the need for ownership from the whole Directorate. We believe full commitment from all staff is a pre-requisite for any implementation to be successful. For this reason, we would strongly urge that implementation of the system at RGHT first is resisted. We recommend that any implementation should proceed, module by module, across both sites simultaneously, as we consider it important that the implementation of the new option is seen, as the replacement of old systems at both sites, rather than the imposition of one sites solution upon the other. The Directorate must not, however, underestimate the task involved in implementing any system, and the effort (and co-operation) which will be required.

We recommend that, for the time being, the scope of this implementation be limited to Clinical Chemistry, Haematology, Microbiology and the blood bank. We believe the existing Histopathology and Cytopathology systems in use on each site should remain in place at least until the implementation of the other modules is complete, and the position with regard to these two systems and the maintenance of the Regional Screening Service reviewed at this point.