NHS Connecting for Health
Process Capability Appraisal
prepared for the National Audit Office by QinetiQ

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Summary

‘Connecting for Health’ is the agency created in April 2005 to bring together the former *National Programme for IT in the NHS (NPfIT)* and the *NHS Information Authority*.

Connecting for Health is providing a major new nationwide Information System for the NHS.

The new Information System will potentially maintain and share health information on patients throughout England, and provide services to stakeholders throughout the NHS.

- Logically, the System has been designed around a national repository of health information with principal system elements[1] providing secure data access and messaging throughout the UK (known as the Spine), plus other system elements which provide key services.

- Physically, the System rests upon a new nationwide broadband communications system, the *New National Network,* which will connect national data centres to users within clusters of Strategic Health Authorities.

We understand that the agency has adopted a service-oriented contracting strategy, whereby suppliers receive payment only after the systems they have developed are taken up by users, and the services they provide yield measurable benefits within the NHS.

As well as acting as acquisition agency and programme manager, the agency is acting as de facto overall systems engineer, establishing foundational specifications at the outset of the development lifecycle, with ultimate responsibility for the performance of the delivered system at the end.

This report presents the results of a systems engineering Process Capability Appraisal of the new agency, carried out in Leeds between 18 – 21 April 2005. The appraisal was based upon two recently published international standards, and utilised the QinetiQ Process Capability Appraisal method.

As described in Section 1 of this report:

- BS ISO/IEC 15288:2002 presents a unanimous international consensus on the systems engineering lifecycle processes critical to developing large and complex man-made systems – exactly the sort of system being specified, designed and acquired by Connecting for Health. This standard places considerable emphasis upon Requirements Engineering and Human Factors within systems, speaking in its introduction of the ‘..hardware, software *and human elements* from which systems are constructed….

- BS ISO/IEC 15504-2:2003 provides a means of determining process-related risk[2] and assessing the likelihood of a new system capability being introduced on-time, on-cost, and meeting user needs. Key themes involve the disciplined coordination of staff activities, and the active identification and consistent deployment of proven best practice and corporate learning

[1] ISO 15288 uses the term *system element* to describe a subordinate system, sub-system or application.
[2] ISO/IEC 15504:2003-4 contains a comprehensive explanation of process-related risk.

During the appraisal, a 5-strong team visited agency staff at their offices in Leeds for a 4-day site visit beginning 18 April 2005. The team carried out some 30 confidential, structured, 20-minute interviews with a sample cross-section of staff on a number of projects. The team also reviewed organisational and project documents.

The ISO 15288 processes appraised were:

- Project Planning Process,
- Project Control Process,
- Decision-making,
- Risk Management Process,
- Configuration Management Process,
- Stakeholder Requirements Definition,
- Architectural Design Process,
- Integration Process.

All of the information collected during the appraisal was carefully weighed and analysed by the team, who generated findings covering both process strengths and improvement opportunities through a formal, unanimous consensus process, with no minority opinions opposed to the consensus. All findings were based on multiple sources of evidence, both verbal and documentary.

Emerging findings were briefed to the agency before the team left Leeds. The agency then had the opportunity to comment upon the findings and bring forward further information. This was intended to provide early feedback, help avoid misunderstanding, and validate the team's findings. The appraisal concluded with a 4-day analysis period and the production of this report.

Detailed findings are set out in Section 2 of this report, highlighting some 24 significant strengths and 9 potential improvement opportunities.

A set of process ratings, generated using the measurement framework defined within ISO 15504, is included at Section 3, along with a brief analysis of the benefits of taking action in the areas where improvement opportunities have been identified. An overall assessment of process capability is also included, plus a summary of employee views concerning their work within the agency, and an overview of the process innovations introduced within the agency - as identified by interviewees.

It was observed that the agency has:

- Grown rapidly,
- Been subject to aggressive timescales,
- Been tasked to implement a system of major political significance under intense scrutiny,
- Employed extremely high-calibre staff and consultants,
- Adopted strong and forceful leadership,
- Attracted unequivocal political sponsorship and funding,
- Instigated strict contracting arrangements on payment for suppliers.

This naturally leads to agency staff experiencing a strong team dynamic, feeling a strong sense of ultimate success, and perhaps placing less emphasis on process and staff coordination. Nonetheless, actions taken to address the improvement opportunities identified would give increased assurance of the agency's ability to ensure timely, on-cost delivery of the required capability.

This report recommends that the improvement opportunities identified in this report and tabulated at Section 3.2 be addressed with the aim of reducing the overall risk to the programme.

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1 Introduction

1.1 Connecting for Health

Connecting for Health will provide a major new nationwide information system for the NHS.

The new system will potentially maintain and share health information on patients throughout England, and provide services to stakeholders throughout the NHS.

In April 2005, a new agency - Connecting for Health - brought together the *National Programme for IT in the NHS* (NP*f* IT), established in 2002, and the former *NHS Information Authority*.

We understand the term NP*f* IT has been used to describe both the new Information System and also the Department of Health organisation charged with its specification, design and acquisition. Throughout this report, we have use the term *agency* when referring to the organisation, and *System* when referring to the new information system.

System Architecture

Logically, the System has been designed around a national repository of health information with principal system elements[3] providing secure data access and messaging throughout the England (known as *The Spine*), plus other system elements which provide key services.

The national information repository will provide a central electronic store of over 50 million healthcare records that will be made accessible to health professionals through secure access arrangements. Patients will be able to view their own health records using secure Internet access[4].

Spine system elements which surround the information repository include[5]:

- The transaction and messaging system,
- The access control framework,
- The personal spine information service,
- The personal demographics service,
- Spine directory services,
- Workflow/rules services,
- Terminology service,
- Clinical spine applications.
- Secondary user services.

These Spine system elements provide secure message handling and information access, and in turn enable key services including:

[3] ISO 15288 uses the term *system element* to describe a subordinate system, sub-system or application.
[4] http://www.npfit.nhs.uk
[5] ICRS Output Based Specification – OBS1 Part 1 Final.doc

- Electronic booking of appointments (eBooking) for referral from primary to secondary care,
- Electronic transmission of prescriptions (ETP) which will enable GPs to transmit electronic prescriptions to pharmacies,
- Picture archiving and communications (PACS) which will enable medical images to be stored and shared electronically by clinicians and health professionals.

> Physically, the System rests upon a new nationwide broadband communications system, the *New National Network,* which will connect national data centres to users within *clusters* of Strategic Health Authorities.

The System will be implemented through both national and local service providers. England has been divided into five regional clusters[6]: North East; North West and West Midlands; Eastern; Southern; and London. Within each cluster a local service provider has been contracted. At national level, several service providers have been contracted to supply system elements.

We understand that the core information repository is to be partitioned, with summary care records being held nationally whilst more detailed care records are held at cluster or local level.

> Because information and services are to be distributed and accessed utilising networked assets, then the System can be considered to provide a *Network Enabled Capability*.

Network Enabled Capability systems are recognised as cutting edge technology with many challenges involving interaction, integration and performance not yet fully understood or overcome.

The agency is also responsible for delivering a new NHS email and directory system known as *Contact* which we understand does not depend upon the New National Network.

Procurement Strategy

We understand that the programme has adopted a service-oriented contracting strategy.

> Suppliers will receive payment only after the systems they have developed are taken up by users and the services they provide yield measurable benefits within the NHS.

We understand that payments to suppliers will also reflect the take-up of services within the NHS.

Acquisition and Systems Engineering

We understand that the agency has responsibility for the specification, design and procurement of the System.

[6] http://www.connectingforhealth.nhs.uk/regions/

- Staff within the agency have developed the logical and physical information architecture, determined how best to partition the System into high-level system elements, specified message passing amongst system elements, and developed a detailed specification for each message and for each system element.
- Suppliers have then been contracted to develop the systems elements,
- We understand that suppliers are responsible for integrating their subcontracted system elements, but that the agency retains ultimate responsibility for the operation and performance of the overall system.

As well as acting as acquisition agency and programme manager, the agency is acting as de facto overall systems engineer - establishing foundational specifications at the outset of the development lifecycle, with ultimate responsibility for the performance of the delivered system at the end.

1.2 Systems Engineering and ISO 15288

> ISO 15288 presents a unanimous international consensus on the systems engineering lifecycle processes critical to developing large and complex man-made systems – exactly the sort of system being specified, designed and acquired by Connecting for Health.

According to ISO 15288 [Reference 1]:

'…The complexity of man-made systems has increased to an unprecedented level, which has led to … increased challenges for the organisations that create and utilise them.

These challenges arise from several sources:

- *Inherent differences among the hardware, software, and human elements from which systems are developed,*
- *Most new systems rely heavily on computer based technology,*
- *Lack of harmonisation and integration of the involved disciplines (science, engineering, management, finance etc)…'*

ISO 15288 provides a common framework for defining, controlling, assessing and improving systems engineering life cycle processes associated both with acquiring and supplying complex systems.

The content of ISO 15288 is generic in nature, and not prescriptive in terms of measures, procedures or content. The International Standard is not intended to conflict with any organisation's existing process, but rather to assist in embedding key systems engineering activities, and assessment against agreed world best practice.

> Processes should be deployed within an organisation in a manner appropriate to the difficulty and importance of the work, and to a degree proportionate to the business and technical risk involved.

ISO 15288 presents an agreed set of processes, outcomes and activities deemed key to the successful introduction of large and complex systems. Inappropriate omission of system engineering processes or process activities - anywhere within the supply chain - can significantly increase the risk to the overall system.

1.2.1 Requirements Engineering

ISO 15288 places considerable emphasis on Requirements Engineering, setting out distinct processes for:

- eliciting stakeholder requirements,
- analysing stakeholder requirements to establish the system requirements,
- generating an architectural design expressed in terms of functional and performance requirements for subordinate system elements.

> One of the major purposes of Requirements Engineering is to ensure that products or services supplied are founded firmly upon analysed and agreed stakeholder needs and requirements.

Stakeholder Requirements Definition

The System will have a fundamental influence on the way health care is delivered in the UK; potentially every NHS worker and UK citizen is a legitimate stakeholder of the system.

Clearly it is impractical to collect every individual's requirements for the proposed system. However, if acceptance and ultimate success of the System is to be assured, it is arguably essential that the representative views of key classes of stakeholders are collected in a defined and systematic manner to establish an agreed baseline of *Stakeholder Requirements*.

The Stakeholder Requirements can then be analysed, categorised and de-conflicted – and explicitly traded off if necessary between relevant stakeholder groups. In a project of significant size and complexity, the Stakeholder Requirements should be captured in a tool that facilitates this process and enables a number of attributes to be associated with each requirement - such as ownership and priority. The ownership attribute is particularly pertinent to the agency, as ultimately this will be used to show that the delivered system meets the needs of particular groups of stakeholders, and hence achieve stakeholder buy-in to, and acceptance of, the system.

According to ISO 15288, the Stakeholder Requirements baseline provides:

- The basis for defining the overall system functional requirement,
- The basis for contracting to supply the service or product,
- The basis for validating the conformance of delivered product or services.

Requirements Analysis

ISO 15288 describes how the Stakeholder Requirements baseline can be analysed to transform the stakeholder-driven view of desired services into a technical view of a System that could deliver these services – the *System Requirements*.

This transformation may involve re-visiting the stakeholder requirements – potentially requiring further interaction with representatives of identified stakeholder groups.

Architectural Design

The System Requirements are then synthesised into a solution - the *Architectural Design* **-** after having considered systematically alternative architectures - referenced back, as required, to the stakeholder requirements (and by implication, the stakeholder). The architectural design then forms the basis for early definition of the integration and verification strategy, and for the verification of the delivered systems.

1.2.2 The Human Element

> ISO 15288 places considerable emphasis on human factors within systems, speaking in its introduction of '..the hardware, software *and human elements* from which systems are constructed….'

Users are seen as a key and central part of a system. The way new hardware and software is taken up and used within a user community is seen to be of great concern to systems specification and development.

This emphasis is clearly relevant to the System being specified, designed and acquired by the agency, who have placed considerable emphasis on Benefits Management. Acceptance by a wide range of stakeholder classes within the prevailing culture of the NHS is certainly a challenge but ultimately critical to success.

1.2.3 Process Sampling

Following the method used for the appraisal, the appraisal team selected the following processes from ISO 15288 processes as being both deployed within the agency and key to ultimate success:

- Project Planning Process,
- Project Control Process,
- Decision-making,
- Risk Management Process,
- Configuration Management Process,
- Stakeholder Requirements Definition,
- Architectural Design Process,
- Integration Process.

1.3 Process Capability and ISO 15504

Process capability appraisal provides a defensible means of determining process-related risk[7] and assessing the likelihood of a new system capability being introduced on-time, on-cost and to specification.

Background

The origins of process capability appraisal date back to the first two decades of the twentieth century and the scientific management movement of Taylor, Gilbreth and Gantt - Reference [2]. These principles were further developed by Shewart at Reference [3] in the 1930s and by Deming and Juran - Reference [4] - in the post war years to introduce Statistical *Quality* Control (SQC) and Statistical *Process* Control (SPC). These principles are credited with making a significant contribution to the successful application of SPC by Japanese industry in the years after the Second World War.

In 1979, Philip Crosby introduced a Quality Management Maturity Grid in his book 'Quality Is Free' - Reference [5]. In just thirteen pages he introduced the concept, describing five increasing levels of process capability and measurement attributes for each level.

The Software Capability Maturity Model (CMM) was developed as a common sense application of concepts in quality improvement and process management, based on a consensus view of sound engineering and management practices – see Reference [6]. The Software Engineering Institute (SEI) argued compellingly that the quality of a product or service is highly dependent upon the quality of the processes used to acquire, develop and deliver it - Reference [7]:

The Process Capability Levels introduced within the CMM have now been standardised within ISO/IEC 15504-2:2003 - Reference [8].

Process Capability Levels

The first four Process Capability Levels standardised in ISO 15504 are summarised below and elaborated in Appendix A.

Level 0	Process activities are incomplete - important priorities may be overlooked or key outputs not produced.
Level 1	The process is complete, achieves its stated purpose, and generates required work products, although implementation may be informal, incompletely planned and overly dependent upon key individuals.
Level 2	The process is planned and managed using sound project management techniques, although possibly differently within individual projects as determined by the assigned project manager.
Level 3	The process is now defined - typically on an intranet system - at organisation level, and incorporates identified best practice and corporate learning; projects consistently deploy approved, tailored versions of the organisation's standard processes.

The key theme of Level 2 is *disciplined coordination* of activity,

The key themes of Level 3 are *proven best practice* and *corporate learning*.

Capability levels are used to express the process capability of individual processes, and are measured using the Process Attributes defined in ISO 15504 and included at Appendix A.

[7] ISO/IEC 15504:2003-4 contains a comprehensive explanation of process-related risk.

The systems engineering processes selected from ISO 15288 have been assessed against Process Capability Levels 1, 2 and 3 as is appropriate for an undertaking of this size and scale.

- At Level 1, the process outcomes from ISO 15288 are used to gauge process completeness,
- At Levels 2 and 3, the Process Attributes from ISO 15504 are used to gauge process capability.

Process-related Risk

Provided both acquisition and development processes are defined and adhered to, staff are trained and motivated, and necessary tools are available and used, then there is a high probability of the required capability becoming operational to time and cost.

ISO/IEC 15504-4:2004 - Reference [9] - clause 5.5.1 tabulates the process-related risk associated with outstanding improvement opportunities within Capability Levels as follows:

Capability level	Potential consequence
Level 1	• missing or incomplete work products; process outcomes not achieved
Level 2	• cost or time overruns; inefficient use of resources • uncoordinated activity, unclear responsibilities, uncontrolled decisions, and uncertainty over whether time and cost objectives will be met • unpredictable product quality and integrity, uncontrolled versions, increased support costs, integration problems and increased re-work costs
Level 3	• identified best practice and lessons learned from previous projects not defined, published and available within organization • no foundation for organization-wide process improvement • implemented process not incorporating identified best practice and lessons learned from previous projects; inconsistent process performance across organization • lost opportunities to understand process and identify improvements.

1.4 Process Capability Appraisal

ISO 15288 and ISO 15504 together provide an authoritative model for assessing process-related risk within large systems engineering developments.

The QinetiQ Process Capability Appraisal method provides a rapid and cost-effective means of identifying the process-related risk associated with a specific sample of processes within a particular organisational unit.

The QinetiQ method is derived from the SEI SCE method, which is fully defined in public domain documents at Reference[10]. The QinetiQ method utilises the SEI approach, principles and techniques, but has been tailored and aligned to ISO 15504.

During the appraisal, a 5-strong team visited agency staff at their offices in Leeds for a 4-day site visit beginning 18 April 2005. The team carried out some 30 confidential, structured, 20-minute interviews with a sample cross-section of staff on a number of projects.

Throughout the appraisal, at the outset of each interview, the team explained the purpose of the appraisal, emphasised the non-attributable nature of the interview, and asked interviewees both to assume no prior knowledge on the part of the team and to avoid or explain acronyms and local jargon.

The team also reviewed organisational and project documents.

All of the information collected during the appraisal was carefully weighed and analysed by the team, who generated findings covering both process strengths and improvement opportunities through a formal, unanimous consensus process, with no minority opinions opposed to the consensus. All findings were based on multiple sources of evidence, both verbal and documentary.

Emerging findings were briefed to the agency before the team left Leeds. The agency then had the opportunity to comment upon the findings and bring forward further information. This was intended to provide early feedback, help avoid misunderstanding, and validate the team's findings. The appraisal concluded with a 4-day analysis period and the production of this report.

The appraisal findings are thus based entirely upon what the team were told within confidential interviews by the sample of staff selected, and on what they observed within the sample of documents reviewed.

2 Findings

The appraisal findings are set out within this section.

Each of the 8 processes assessed is presented on a single page showing:

- The process purpose statement from ISO 15288,
- The statement of process outcomes from ISO 15288,
- The appraisal findings presented as:
  - Strengths,
  - Improvement Opportunities,
  - Recent Improvement Initiatives.

A finding is a conclusion of an appraisal that identifies the most important issues, problems and opportunities within the process.

- A Strength reflects some characteristic of process implementation that tends to mitigate the risk inherent in the process.
- An Improvement Opportunity reflects some characteristic of the process implementation that does not mitigate the risk inherent in the process.
- A Recent Improvement Initiative reflects a potential strength which cannot yet be said to be fully institutionalised within an organisation

2.1 Project Planning

Purpose

The purpose of the Project Planning Process is to produce and communicate effective and workable project plans.

ISO 15288 states that if this process is fully performed, then :

- Project plans are available,
- Roles, responsibilities and authorities are defined,
- Resources and services necessary to achieve the project objectives are formally requested,
- Project performance measures are defined,
- Project staff are directed in accordance with the project plans.

Strengths

Observed that:

- Milestone completion was the primary method used for setting targets and measuring progress,
- Schedules were controlled, reviewed and adjusted when necessary,
- The Primavera tool, with standard work breakdown structures and contract milestones, underpinned planning activities across the programme.

Improvement Opportunities

Observed that:

- The effort and resource needed to undertake agency tasks and activities was not proactively estimated and recorded.

Recent Improvement Initiatives

- The EWIP Project Planning Procedure & Guidelines for P^3E Primavera use, identifying WBS and lifecycle stages had recently been issued, and the tool was being populated.

2.2 Project Control

Purpose

The purpose of the Project Control Process is to direct project plan execution and ensure that the project performs according to plans and schedules, within projected budgets and it satisfies technical objectives.

ISO 15288 states that if this process is fully performed, then :

- Corrective action is defined and directed, when project achievement is not meeting planned targets,
- Project re-planning is initiated when project objectives or constraints have changed, or when planning assumptions are shown to be invalid,
- Project action to progress (or not) from one scheduled milestone or event to the next is authorized,
- Project objectives are achieved.

Strengths

Observed that:

- The structure of Project Control Managers, PSOs and Planners was consistently deployed, and ensured that programme and supplier performance was monitored,
- When project achievement did not meet planned targets, corrective action was initiated through discussions with suppliers,
- Projects were re-planned as required by changes in constraints[8] or achievements.

Improvement Opportunities

- None observed.

Recent Improvement Initiatives

- None observed.

[8] E.g. dependency on other suppliers delivering on time

2.3 Decision Making

Purpose

The purpose of the Decision-making Process is to select the most beneficial course of project action where alternatives exist.

ISO 15288 states that if this process is fully performed, then :

- A decision-making strategy is defined,
- Alternative courses of action are defined,
- A preferred course of action is selected,
- The resolution, rationale and assumptions are captured and reported.

Strengths

Observed that:

- A Governance Framework for NPfIT - consistent with the government model for mission critical projects - supported decision making, enabled escalation to high levels of accountability, and was being applied,
- The agency Delivery Board tracked decision outcomes and monitored trends occurring as a result of decisions made,
- Records of decisions were maintained under File-CM.

Improvement Opportunities

Observed that:

- For decisions which did not need to be included within the governance framework, we found no documented process[9] setting out a systematic approach for selecting the most beneficial course of action where alternatives existed.

Recent Improvement Initiatives

- None observed.

[9] e.g. written guidance to staff on the issues to be considered and the approach to be followed, both consistently applied.

2.4 Risk Management

Purpose

The purpose of the Risk Management Process is to reduce the effects of uncertain events that may result in changes to quality, cost, schedule or technical characteristics.

ISO 15288 states that if this process is fully performed, then :

- Risks are identified and categorized,
- The probabilities and consequences of risks are quantified,
- A strategy to treat each risk is specified,
- Risk status is available and communicated,
- Risks that have become unacceptable are acted upon.

Strengths

Observed that:

- *Issue and Risk Management* was carried out within all projects,
- Risks were recorded in *Risk and Issue* registers,
- Mitigation actions were routinely defined for identified risks,
- Senior management were kept informed of issue and risk status on a weekly basis.

Improvement Opportunities

Observed that:

- Notwithstanding the fact that PCMs, as focal points for Risk Management, were recruited with generic risk management expertise, staff were not trained specifically in the agency Risk Management process,
- The Issue and Risk Management Guide for Project and agency Managers did not emphasise probability as a means of prioritising risk.

Recent Improvement Initiatives

- None observed.

2.5 Configuration Management

Purpose

The purpose of the Configuration Management Process is to establish and maintain the integrity of all identified outputs of a project or process and make them available to concerned parties.

ISO 15288 states that if this process is fully performed, then :

- A configuration management strategy is defined,
- Items requiring configuration management are defined,
- Configuration baselines are established,
- Changes to items under configuration management are controlled,
- The configuration of released items is controlled,
- The status of items under configuration management is made available throughout the life cycle.

Strengths

Observed that:

- Planned version control and change management of internal work product documents was evident within all of the projects appraised,
- The File-CM tool was universally deployed as a configuration management repository for internal work product documents,
- A comprehensive process description addressed configuration management of software plus other assets and configurations within all organisations delivering agency services.

Improvement Opportunities

- None observed.

Recent Improvement Initiatives

- None observed.

2.6 Stakeholder Requirements Definition

The purpose of the Stakeholder Requirements Definition Process is to define the requirements for a system that can provide the services needed by users and other stakeholders in a defined environment.

ISO 15288 states that if this process is fully performed, then :

- The required characteristics and context of use of services are specified,
- The constraints on a system solution are defined,
- Traceability of stakeholder requirements to stakeholders and their needs is achieved,
- The basis for defining the system requirements is described,
- The basis for validating the conformance of the services is defined,
- A basis for negotiating and agreeing to supply a service or product is provided.

Strengths

Observed that:

- Clinical boards, public consultation and existing business modelling of NHS systems had all been employed to analyse user and stakeholder needs,
- Historical requirements sources, original stakeholder consultation records and stakeholder requirements were retained in File-CM ,
- Benefits management is being deployed to measure and validate the extent to which stakeholder needs are actually met within the NHS.

Improvement Opportunities

Observed that:

- Arrangements for stakeholder requirements definition were not defined within a documented process,
- Individual stakeholder requirements cannot be explicitly traced back to specific stakeholders or stakeholder classes[10],
- Stakeholder requirements definition had proceeded directly to production of the OBS without the production of an analysed[11] statement of stakeholder requirements.

Recent Improvement Initiatives

- None observed.

[10] Some parts of the OBS grouped individual requirements under the functional headings of Ambulance, Mental Health etc, thus indicating in general the associated stakeholder groupings.

[11] i.e. categorise, prioritised, de-conflicted and explicitly traded off if necessary between relevant stakeholder groups

2.7 Architectural Design

Purpose

The purpose of the Architectural Design Process is to synthesize a solution that satisfies system requirements.

ISO 15288 states that if this process is fully performed, then :

- An architectural design baseline is established,
- The implementable set of system element descriptions that satisfy the requirements for the system are specified,
- The interface requirements are incorporated into the architectural design solution,
- The traceability of architectural design to system requirements is established,
- A basis for verifying the system elements is defined,
- A basis for the integration of system elements is established.

Strengths

Observed that:

- A strongly led, high-level design team had achieved the very rapid development of a system architectural design, expressed as a comprehensive set of sub-system requirements within the ICRS Output Based Specification (OBS) and the Message Implementation Manual (MIM),
- System architectural design documents were reviewed, controlled and managed.

Improvement Opportunities

Observed that:

- There was no evidence that an architectural design process had been defined, documented or deployed.

Recent Improvement Initiatives

- None observed.

2.8 Integration

Purpose

The purpose of the Integration Process is to assemble a system that is consistent with the architectural design.

ISO 15288 states that if this process is fully performed, then :

- A system integration strategy is defined,
- Unavoidable constraints of integration that influence requirements are defined,
- A system capable of being verified against the specified requirements from architectural design is assembled and integrated,
- Non-conformances due to integration actions are recorded.

Strengths

Observed that:

- Supplier integration activities were clearly defined, planned and monitored,
- Integration documents were managed under File-CM ,
- The agency Integration and Test Board had been established to coordinate and facilitate supplier integration testing.

Improvement Opportunities

Observed that:

- The authority's integration strategy - of not accepting or allocating responsibility for overall integration of the principal sub-systems – did not demonstrably minimize the risk associated with integrating a large and complex system.

Recent Improvement Initiatives

- The National Integration Centre with its associated processes has potential to provide agency management and leadership of supplier integration activities.

3 Analysis

3.1 Process Ratings

The appraisal team rated the extent to which the Processes Attributes[12] have been achieved for each of the Systems Engineering Processes[13] sampled, based upon the findings identified in Section 2.

Id	Process Attribute	Use
A 1.1	Process performance	used to measure the degree to which process outcomes are achieved - albeit in an *informal* manner
A 2.1	Performance management	used to measure the degree to which at project-level, the process is performed in a *planned and managed* manner to achieve process outcomes to time, cost and performance
A 2.2	Work product management	used to measure the degree to which process work products are *reviewed, controlled and managed* at project level
A 3.1	Process definition	used to measure the degree to which the process is *defined and coordinated* organisation-wide, in a manner that incorporates proven, best-practice ways of working and lessons learned.
A 3.2	Process deployment	used to measure the degree to which 'defined' project-level processes are tailored from the organisation-wide process definition to meet individual project business needs, and are *deployed and implemented* at project level across the organisation

The appraisal team utilised the following ratings scale defined within ISO 15504:

Rating	Meaning
Fully achieved	• There is evidence of a complete and systematic approach to, and full achievement of, the defined attribute in the evaluated process. • No significant weaknesses related to this attribute exist in the evaluated process.
Largely achieved	• There is evidence of a systematic approach to, and significant achievement of, the defined attribute in the evaluated process. • Some weaknesses related to this attribute exist in the evaluated process.
Partially achieved	• There is some evidence of an approach to, and some achievement of, the defined attribute in the evaluated process. • Some aspects of achievement of the attribute may be unpredictable.
Not achieved	• There is little or no evidence of achievement of the defined attribute in the evaluated process

[12] defined in ISO/IEC 15504
[13] defined in ISO/IEC 15288

Not all Process Attributes were rated against all processes as determined by the sampling approach employed.

Ratings assigned are illustrated below and colour coded as follows:

Fully: F Largely: L Partially: P Not: N Not rated:

The strongest profiles show little or no red or amber, and all blue at Level 1,

	Level 1	Level 2		Level 3	
	A 1.1 Process performance	A 2.1 Performance management	A 2.2 Work product management	A 3.1 Process definition	A 3.2 Process deployment
Project Planning	Largely	-	Fully	-	Largely
Project Control	Fully	Fully	Fully	-	Fully
Decision Making	Largely	-	Fully	Largely	-
Risk Management	Fully	Fully	Fully	Largely	-
Configuration Management	Fully	Fully		Fully	-
Stakeholder Requirements Definition	Largely	-	Fully	-	Partially
Architectural design	Largely	-	Fully	-	Partially
Integration	Largely	Largely	Fully	Fully	Fully

3.2 Analysis of Improvement Opportunities

The improvement opportunities identified in Section 2 are tabulated on the following pages, along with a brief outline of process-related should the improvement opportunity not be addressed, the possible mitigation action, and the potential benefit which would then arise.

Process	Improvement Opportunity	Mitigation action	Potential Benefit
Project Planning	• The effort and resource needed to undertake agency tasks and activities was not proactively estimated and recorded	• Introduce estimating methods to proactively estimate and record the time and resources needed for agency tasks based upon actual resource expenditure • Identify and record good practice and lessons learned from project teams' approaches to project planning • Identify and define performance measures for agency activities	• Reduced potential for delay being introduced through inappropriate prioritisation of tasks within the agency • More timely and efficient matching of staff resources to changing priorities • Better forecast of internal costs to completion • Greater potential to learn from experience across projects
Decision Making	• For decisions which did not need to be included within the governance framework, we found no documented process setting out a systematic approach for selecting the most beneficial course of action where alternatives existed	Introduce a systematic decision making process, and possibly an enterprise-wide decision support tool, within which: • A decision-making strategy is defined, • Alternative courses of action are defined, • A preferred course of action is selected, • The resolution, decision rationale and assumptions are captured and reported.	• Clearer audit trail of reasoning leading to decisions that become more accountable, defensible and better understood

Process	Improvement Opportunity	Mitigation action	Potential Benefit
Risk Management	• Notwithstanding the fact that PCMs, as focal points for Risk Management, were recruited with generic risk management expertise, staff were not trained specifically in the NPfIT Risk Management process • The Issue and Risk Management Guide for Project and agency Managers did not emphasise probability as a means of prioritising risk	• Introduce training, orientation or induction for all staff concerned with identifying or managing risk, emphasising how: – Risks are identified and categorized, – The probabilities and consequence of risks are quantified, – A strategy to treat each risk is specified, – Risks that have become unacceptable are acted upon. • Emphasise to staff the importance of pro-actively seeking to anticipate future risks to the programme – including ones currently thought less likely - by explicitly including probability as a prioritisation criterion • Introduce guidance on the initial identification and prioritisation of risk in terms of probability and impact – so complementing exiting guidance on upward reporting of risk in terms of controllability and consequence • Bring greater clarity and consistency to the different documents[14] setting out the agency's approach to risk management	• Greater capability to anticipate and counter major risk factors having potential to jeopardize programme success • Better and more consistent understanding of the agency's approach to identifying and reporting the significance of key risks

[14] E.g. the *Guide for Risk Owners*

Process	Improvement Opportunity	Mitigation action	Potential Benefit
Stakeholder Requirements Definition	• Individual stakeholder requirements cannot be explicitly traced back to specific stakeholders or stakeholder classes • Arrangements for stakeholder requirements definition were not defined within a documented process • Stakeholder requirements definition had proceeded directly to production of the OBS without the production of an analysed statement of stakeholder requirements	• Consider reverse-engineering[15] a statement of Stakeholder Requirements from the OBS… – with explicit traceability to specific stakeholder classes – with explicit alignment to the Benefits Management Framework	• Increased assurance that we are *'building the right system'* • Firmer basis for acceptance by users of the delivered system from the agency, and improved likelihood of fuller take-up by the end-user community • Greater potential for future user buy-in if proposed System changes are visibly analysed for impact on identified stakeholder classes before being accepted • More efficient implementation of proposed System changes
Architectural Design	• There was no evidence that an architectural design process had been defined, documented or deployed	• Consider retrospectively documenting the process used to develop the architectural design • Consider subjecting current architecture to systematic, rigorous evaluation against a broad range of documented, reviewed and agreed selection criteria – perhaps including performance and end-to-end transaction times, plus user acceptability and other human factors issues	• Clearer assurance that the design architecture is optimum and that stakeholder requirements will be met

[15] *Reverse engineering* involves creating a predecessor lifecycle product or document from a later one – for example re-creating the missing design drawings for a car engine by working from the physical engine itself.

Process	Improvement Opportunity	Mitigation action	Potential Benefit
Integration	• The authority's integration strategy - of not accepting or allocating responsibility for overall integration of the NPfIT principal sub-systems – did not demonstrably minimize the risk associated with integrating a large and complex system[16]	• Appoint an overall system integration authority, • Agree an overall integration sequence, • Align supplier integration processes to the overall integration strategy	• Increased likelihood of the system being delivered to time • Increased likelihood of full functionality being delivered • Improved governance of the programme

[16] Especially a *Network Enabled Capability*

3.3 Analysis of Process Capability

International Standard best practice indicates that to reduce the risk inherent in a programme of this magnitude it is important that the programme operates at a level of process capability that ensures, within key processes, that:

- Processes appropriate to the business need of the programme are defined, publicised and deployed,
- Planning and control of internal agency activities is performed to ensure that staff resources match programme needs,
- Staff receive an appropriate level of coordination training or induction commensurate with their role on the programme,
- Proactive risk management is performed to ensure that future risks are identified early and mitigated,
- Representatives of stakeholders classes are formally and actively involved at a level appropriate to ensure ultimate acceptance and use of the delivered system,
- Integration strategy is defined early in the lifecycle, and that further refinement of the strategy be actively undertaken during all succeeding stages
- Systems engineering decisions are made in a structured and systematic manner, and their rationale is recorded.

We also observed that the agency has:

- Grown rapidly,
- Been subject to aggressive timescales,
- Been tasked to implement a system of major political significance under intense scrutiny,
- Employed extremely high-calibre staff and consultants,
- Adopted strong and forceful leadership,
- Attracted unequivocal political sponsorship and funding,
- Instigated strict contracting arrangements on payment for suppliers.

This naturally leads to agency staff experiencing a strong team dynamic, feeling a strong sense of ultimate success, and perhaps placing less emphasis on process and staff coordination.

Nonetheless, actions taken to address the improvement opportunities identified would give increased assurance of the agency's ability to ensure timely, on-cost delivery of the required capability.

3.4 Interviewee views on Connecting for Health

At the close of each interview, interviewees were asked what they valued and liked most about working for the agency; responses are paraphrased below:

I like:

- The challenge
- The sense of achievement
- The enormity of what we're trying to achieve
- Being part of such a major piece of work
- The dynamic pace
- Being part of something delivering benefits to the NHS
- Being with such fantastic people
- Seeing a result, it's stimulating
- Helping to change the way that health care is developed across the NHS, we will save lives as a result
- Helping bring together the best of both private and public sector
- Being involved in a massive project which I believe in
- The fact that things are moving so fast - and the high profile
- The NHS, the project profile
- Potentially delivering real benefits to patients
- The enthusiasm and evangelism on the programme, people really believe that they are doing something important and useful
- The variety, I'm involved in everything
- Working on a project which will affect *everyone*
- The strong leadership and ministerial commitment which makes things happen
- Being with such very good people, there's a lot of talent
- The different and challenging work, fast paced not stale
- Getting through major procurements in short timescales and delivering in line with political imperatives
- Having the opportunity to help people
- The passion and integrity amongst the staff
- The once-in-a-generation opportunity to make a real difference to the NHS
- I wouldn't be anywhere else; this will change people's lives

3.5 Process Innovation

At the close of each interview, interviewees were asked to identify any process innovation introduced within the agency which might have application within other government departments; responses are paraphrased below:

Contracts

- **Speed of Procurement and contract structure**; the service-oriented contracting strategy, whereby suppliers receive payment only after the systems they have developed are taken up by users, was seen as novel within the agency,
- **Future proofing and protection, technology refresh and re-pricing**; the fact that contracts have been written with a specific provision to ensure that both technology content and price are renegotiated after 2 years was seen as innovative.

Planning and management

- **Use of Enterprise Wide Planning System**; the use of the enterprise wide version of Prima Vera was seen as a major innovation and essential for a programme of this size,
- **All in one place planning, scheduling and document management**; having the Prima Vera and File-CM tools in consistent use across the programme was seen as an important innovation within the agency,
- **Deployment schedule linked to Geographic Information Systems**; having information relating to nationwide deployment of the System accessible to the public through a geographically-oriented graphical user interface was seen as a particularly useful innovation.

Suppliers

- **Involving potential suppliers and architects in system design**; representatives of potential suppliers had been a key part of the overall architectural design team,
- **Co-location with contractors enables prompt mitigation actions**; having agency staff working closely to suppliers was identified as an important innovation,
- **Scaling of micro solutions to macro, industrial strength**; the aspiration to move from the relatively small-scale implementations of IT within individual NHS trusts to a much larger nationwide Information System,
- **Applying cutting-edge technologies to benefit patients**; the innovation was to bring the best of the private sector to bear on the NHS,
- **NIC and other forums where suppliers work together to address technical issues**; the National Integration Centre – a relatively recent innovation – was seen as critical to System integration by interviewees.

4 References

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5 Glossary

ETP	Electronic Transfer of Prescriptions
EWIP	Enterprise Wide Integrating Plan
File-CM	A document management tool
ICRS	The Integrated Care Record Service – now the NCRS
MIM	Message Implementation Manual
N3	The New National Network – of broadband connection throughout the NHS
NCRS	The NHS Care Record Service – formerly the ICRS
NHS	National Health Service
NP*f* IT	National Programme for IT in the NHS
OBS	Output-Based Specification
P^3E	The enterprise wide version of the Prima Vera Project Management tool
PACS	Picture Archiving and Communication System
PCM	Project Control Manager
PSO	Project Support Officer
WBS	Work Breakdown Structure

A Process Capability Levels and Attributes

The following table presents the ISO 15504 definitions of each process Capability Level and Process Attribute:

Capability Level	Attributes	Indicators
Level 0: Incomplete process The process is not implemented, or fails to achieve its process purpose.	… there is little or no evidence of any systematic achievement of the process purpose	• … there is little or no evidence of any systematic achievement of the defined outcomes.
Level 1: Performed process The implemented process achieves its process purpose.	**A 1.1 Process performance** The process performance attribute is a measure of the extent to which the process purpose is achieved.	As a result of full achievement of this attribute: • the process achieves its defined outcomes.
Level 2: Managed process The previously described *Performed process* is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.	**A 2.1 - Performance management** The performance management attribute is a measure of the extent to which the performance of the process is managed.	As a result of full achievement of this attribute: • objectives for the performance of the process are identified; • performance of the process is planned and monitored; • performance of the process is adjusted to meet plans; • responsibilities and authorities for performing the process are defined, assigned and communicated; • resources and information necessary for performing the process are identified, made available, allocated and used; • interfaces between the involved parties are managed to ensure both effective communication and also clear assignment of responsibility.
	A 2.2 Work product management The work product management attribute is a measure of the extent to which the work products produced by the process are appropriately managed.	As a result of full achievement of this attribute: • requirements for the work products of the process are defined; • requirements for documentation and control of the work products are defined; • work products are appropriately identified, documented, and controlled; • work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements

Level 3: Established process The previously described *Managed process* is now implemented using a defined process is capable of achieving its process outcomes.	**A 3.1 Process definition** The process definition attribute is a measure of the extent to which a standard process[17] is maintained to support the deployment of the defined process.	As a result of full achievement of this attribute: • a standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process; • the sequence and interaction of the standard process with other processes is determined; • required competencies and roles for performing a process are identified as part of the standard process; • required infrastructure and work environment for performing a process are identified as part of the standard process; • Suitable methods for monitoring the effectiveness and suitability of the process are determined.
	A 3.2 Process deployment The process deployment attribute is a measure of the extent to which the standard process is effectively deployed as a defined process to achieve its process outcomes.	As a result of full achievement of this attribute: • a defined process is deployed based upon an appropriately selected and/or tailored standard process; • required roles, responsibilities and authorities for performing the defined process are assigned and communicated; • personnel performing the defined process are competent on the basis of appropriate education, training, and experience; • required resources and information necessary for performing the defined process are made available, allocated and used; • required infrastructure and work environment for performing the defined process are made available, managed and maintained; • appropriate data are, collected and analysed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate where continuous improvement of the process can be made.

[17] A standard process is one based upon identified best-practice.

Explanation of capability Levels

Level 0

- At Level 0, process activities are incomplete, with important priorities overlooked or key outputs missing,

Level 1

- Processes characterised as Level 1 may generate work products perfectly satisfactorily, but rely on the heroic efforts of talented individuals to do so. Key staff, both management and technical, are recruited or assigned to a project for the know-how and expertise they bring with them - and this is then relied on for project success.
- Technical working practices are often - in reality - improvised as and when they are needed. Even though procedures may be in place, project staff often adopt whatever seems to them to be the best approach at the time. When delivery pressure is high, procedures can count for little.
- Management working practices are also - in reality - improvised as and when they are needed. Plans may be written, but not be referred to later. Estimating can be ad hoc, and fire fighting can be a way of life.
- Level 1 processes are capable of perfectly satisfactory - even excellent - performance, if they are deployed by talented staff who do not leave at critical stages of the project.
- Level 1 processes represent the highest level of process-oriented risk.

Level 2

- At Level 2, process activities are carried out according to defined ways of working which *out-last* key individual experts.
- At Level 2, projects carefully consider at the outset how they are going to undertake the work - both the technical and management aspects - and then design, define and document reasonable plans and processes for both performing the technical activities and managing the project.
- This involves carefully defining and breaking down the task to be undertaken, carefully estimating resource requirements and timescales for the work to be performed, defining the plan to perform the work, and establishing the necessary commitments.
- Problems are recognised and corrected as they occur.
- This typically involves:
    - Having clear organisational policy on how projects are to be conducted,
    - Having clear leadership and defined responsibilities within the project,
    - Making sure sufficient time, resources, tools and funds are available,
    - Making sure staff are either trained or briefed in required ways of working, and have clearly assigned responsibilities,
    - Using rudimentary measures to enable managers to maintain visibility of the status of the activities - i.e. how things are *really* going,
    - Involving relevant stakeholders in the process,

    - Checking that defined process is actually being followed, typically by having trained specialists audit process activities as well as inspecting work products,
    - Making clear that management view process issues as a priority by being seen to carry out periodic process reviews at both project manager and senior manager level.

- Detailed working practices, methods, tools and techniques are typically defined within each individual project. Project managers who have a personal responsibility to bring a project in on-time, to specification and to budget, still rely on their own expertise and experience to determine exactly how they should achieve this.
- In Level 2 organisations it can also be difficult to introduce measurable improvements reliably and consistently across projects. Projects define their own processes and measures, and in the absence of organisation-wide measurement standards, objective comparison between projects - or even objective evaluation of current performance - may not be possible.
- A key characteristic of Level 2 is *disciplined performance*; all staff - including managers - work faithfully to defined plans and processes. The plans and processes tend to be well written and succinct, highly accessible and usable, defined at an appropriate level of detail and subjected to fairly regular update. Given an appropriately light level of detail, such discipline need not degrade creativity and innovation, but rather provide a framework in which talented staff can produce excellent work without being diverted by co-ordination problems.
- Level 2 organisations still tend to rely on key expert managers, and so can still be vulnerable to key managers leaving at critical stages of the project.

Level 3

- Level 3 organisations are serious about identifying best practice, i.e. actively searching for optimum ways of developing work products and managing process.
- Level 3 organisations establish a process focus within the organisation, responsible for co-ordinating and developing process activities across the organisation.
- Level 3 organisations establish a repository for process assets - tools, techniques, methods, processes etc - and make these assets available to projects. Process assets address:
    - the various *process areas* of the lifecycle: requirements, design implementation etc. Integrated into these technical process areas will be descriptions of management tools and techniques which integrate with them,
    - *lifecycle descriptions* showing how the process components can be ordered (Sequential, concurrent, spiral, incremental, evolutionary etc),
    - *tailoring guidelines* on how best to choose and utilise components, and which elements are mandatory and which are optional,
    - Information on asset use is also collected in a *process database* and a *process library*, and this information is made available to projects,
- Having established a standard set of process assets, (again addressing both technical and management issues), staff are then trained in their use.
- Included in the organisation's standard process asset set are common measures and metrics for use across current and future projects.

- Level 3 organisations *expect* and *require* projects to *tailor* their project process from the organisation's process asset set in a way which is optimised to meet specific project business needs.

- Because both management and technical approaches, metrics, tools, techniques and processes now share a great deal of commonality, and staff are routinely trained in them, the organisation is far less dependent on both key technical and management experts.