Scottish Radiology Transformation Programme (SRTP) Phase 2

Business Case V2.0

Contents

EXECUTIVE SUMMARY

1. NHS CHIEF EXECUTIVES HAVE GIVEN A MANDATE FOR FURTHER TRANSFORMATION OF RADIOLOGY IN SCOTLAND

This Business Case is based on a request made by the National Chief Executive (CE) Group in 2016 to explore solutions for a more sustainable and resilient diagnostic radiology service across NHSScotland. There was recognition that cross boundary working was a central requirement going forward and there were fundamental issues concerning disparate, local approaches around Information Technology (IT) Connectivity, data management and workforce which would need significant focus to allow future collaborations.

These three, interdependent requirements underpin a new paradigm for a sustainable, future diagnostic radiology service in Scotland: The National Radiology Model (hereinafter referred to as 'The Model': (Appendix 1); was approved by CEs in August 2016 and underpinned a business case approved in 2017 to deliver Phase 1 of a new programme, the Scottish Radiology Transformation Programme (SRTP). The SRTP was approved as a ten year change programme, with Phase 1 prioritising work on the fundamental issues of IT connectivity and data - collection and analysis - capability. By the end of the financial year the programme will have successfully achieved national IT connectivity, and a national dataset with regular automated data collection and analysis at a national level. It has also laid the foundations for national workforce solutions, workforce planning and clinical decision support.

This business case details Phase 2 of SRTP which represents the next steps in this ten year programme. Completion of Phase 2 will address some of the urgent demand and capacity issues in radiology and facilitate national objectives (such as stroke diagnosis prior to thrombectomy) whilst paving the way for the full transformational change needed to achieve service sustainability.

This approach is consistent with many of the themes in the Health and Social Care Delivery Plan 2016 and is aligned with Scotland's Digital Health and Care Strategy, Realistic Medicine and Delivering Realistic Medicine, Beating Cancer: Ambition and Action, Healthcare waiting times: Improvement plan and a National Clinical Strategy for Scotland.

2. WITHOUT TRANSFORMATIONAL CHANGE, RADIOLOGY SERVICES IN SCOTLAND ARE UNSUSTAINABLE

The case for further transformational change in Radiology in Scotland is clear. The service continues to face increasing pressures and is at significant risk of failing. This would result in a catastrophic impact across acute and primary care services.

There is an ongoing, year-on-year increase in service demand

The National Records of Scotland predicted in mid 2014 that the Scottish population would grow to 5.4m by 2020. This predicted 2.4% growth was achieved by June 2016 and the population is expected to grow to 5.6m by 2043[1].

As the population has grown, the demand for Radiology services has also increased. The average annual growth in demand has been 3.4% between 2012 and 2018.

We do not have capacity to meet this demand

There is a current vacancy rate of **12.6% or 47.4 WTE**[2] across Scotland for Consultant Radiologists with a current establishment of 377.5[3]. Additional training places have been secured but this is far from sufficient to meet the growing demands.

As a result, waiting times and costs are increasing

Patients awaiting radiology tests for over six weeks has risen from 329 to 7,572 from Nov 2015 to Jan 2019: **A 2,302% increase.**

Total net costs for diagnostic radiology have risen from £244m to £287m over a six year period: **An increase of £43m or 17.62% from 2012 – 2018.**

The RCR[4] reported that expenditure on outsourcing and additional payments had **increased by 297%,** from an estimated £3.5m for 2013/14 to £5.25m for 2014/15 and £10.4m in 2017/18.

Without radiology for diagnostic capability, other clinical services including primary care and acute services cannot make a timely diagnosis or monitor patient progress, which impacts on the ability of clinical services to deliver a treatment plan and appropriate high quality care. **The real risk of**

[1] https://www.nrscotland.gov.uk/files//statistics/nrs-visual/mid-18-pop-est/mid-year-pop-est-18-info.pdf
[2] www.ISDScotland.org/Health-Topics/Workforce/Publications/data-tables2017.asp
[3] NRIIP Medical & Dental Workforce Information, March 2019
[4] RCR SSC (2019) The Clinical Radiology Workforce in Scotland: 2018 Census Report

doing nothing is that radiology services will fail and this will have a catastrophic impact on patient diagnosis and treatment in acute and primary care settings.

3.SRTP PHASE 2 DELIVERS STABILITY AND IS THE NEXT STEP TOWARDS A TRANSFORMED SUSTAINABLE SERVICE

The successful delivery of SRTP Phase 1 has begun to address the challenges outlined above. However, our options appraisal clearly shows that minimal benefit will be realised unless we build on what has already been achieved.

The preferred option (**Option 2 – Enhanced BAU with a new programme aligned to The Model)** commences a new programme of work and delivers a more sustainable service, improved quality and access, a consistent pan Scotland approach and improved staff satisfaction.

Costs for Option 2 are programme team costs **averaging £910k per annum for a 3 year period** and BAU costs averaging £864k per annum **for a 10 year period**. It is estimated that a breakeven point will be reached after 6 years and that following this there would be a **saving averaging £800k per annum in line with recruitment projections from the Scottish Government.**

Option 0 – Do Nothing. Halts all programme activities and meets contractual obligations. This is **not recommended** as very limited benefit would be realised and the crisis in radiology would not be addressed.

Option 1 – Do Minimum. Continues with business as usual as already established by SRTP Phase 1. This is **not recommended** as marginal benefit would be realised and this is not sufficient to address the current challenges.

Option 3 – Enhanced BAU and new programme of work to achieve the model in a shorter timescale. Delivers the benefits of option 2 and also recommends putting in place a national radiology authorising environment and structured change programme to support a paradigm shift being implemented in a shorter timescale. While this could deliver some benefits more quickly by reducing the need for consensus, it is **not currently recommended** as it is felt that the service is not ready for this pace of change and it does not break even within the next 10 years. Increased national coordination within radiology will be required in the medium to long term and is part of the longer term vision to be considered in option 2. Significant challenge and change to existing culture would be required in order to make this option viable in the short term.

The table below highlights key deliverables of Phase 1 and what is being proposed in Phase 2 under the preferred option (option 2).

Table 1: Key deliverables of Phases 1 and 2

	Delivered in SRTP Phase 1	Proposed in SRTP Phase 2 (Option 2)
National IT Connectivity	National cross-boundary reporting (Soliton's Share+) enabling reporters to report on images taken anywhere in Scotland	Establish use of National IT Connectivity as Business as Usual and a platform for the Scottish National Reporting Radiology Service (SNRRS)
National Radiology Information and Intelligence Platform (NRIIP)	National data set stored in a data warehouse. National Radiology Dashboards to facilitate the ability to collate, analyse and share national radiology data	Establish use of NRIIP for benchmarking, performance management and planning Expand breadth of indicators and analytical tools, aligning with other relevant data sets
National workforce solutions	Safe Working Framework to ensure safe operation of the Share+ system Reporting Radiographer pilot National "bank" model for Radiologists. SNRRS Bank pilot commenced, hosted by Golden Jubilee Hospital Contract for fifty workstations for use across Scotland Home working pilot and initial deployment of home workstations Consultant Job Design Framework, standardised approaches to job design Scoping sonographer workforce and supporting breast advanced practice work	Completion of Scottish National Radiology Reporting Service (SNRRS) Bank pilot Establishment of SNRRS as a Business as Usual service Deployment of SNRRS workstations including home workstations Advanced Practice projects. Scoping the potential for other roles as part of strategic workforce planning Developing and implementing new collaborative models to maximise Advanced Practice skills
Clinical decision	Assessed technical and operational feasibility of implementing existing Clinical Decision Support (CDS)	Support to CDS pilot. Development of business case for national rollout of

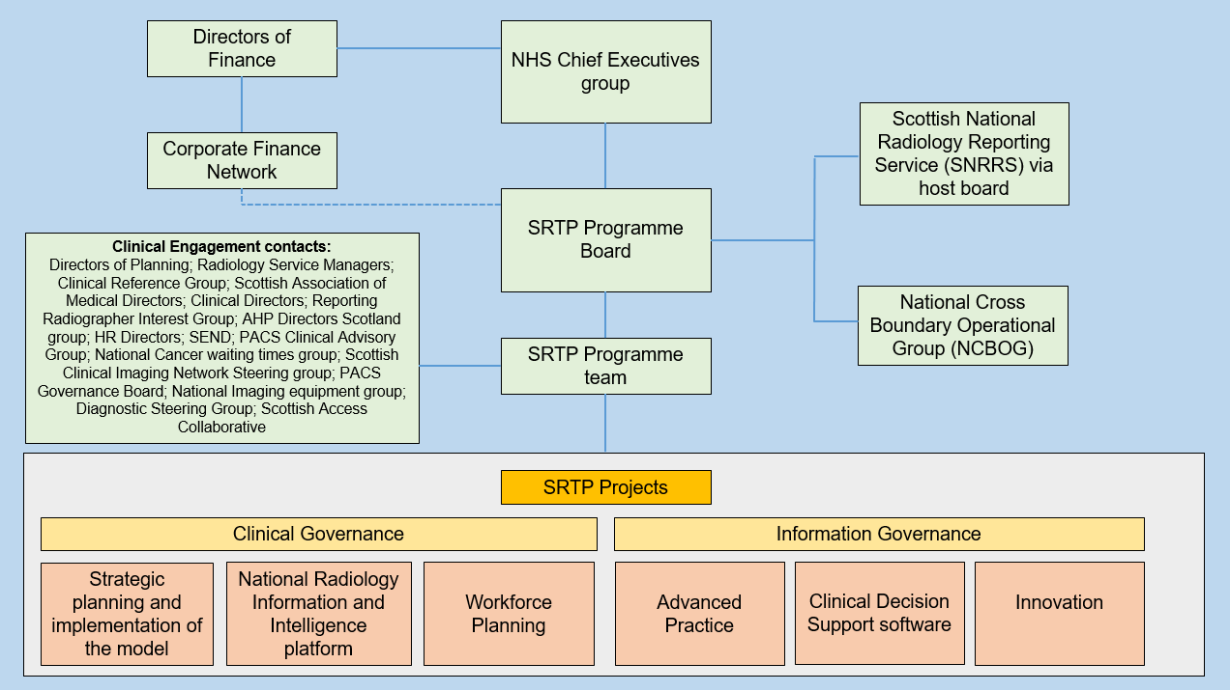
	Delivered in SRTP Phase 1	Proposed in SRTP Phase 2 (Option 2)
support	software. Agreed 12 month pilot across two NHS Boards (2020/21)	CDS
Workforce planning	National Workforce Modelling Tool, standardised workforce planning approach Advanced Practice gap analysis, informs future workforce planning and training initiatives Gained approval for 10 additional Radiologist training places	Further development of workforce planning tool Establishing structures and processes to support planning work as part of business as usual
Artificial intelligence (AI)	Initial assessment of AI timeline and impact (Scottish Health Technologies Group) (Appendix 2)	Assess likely impact of AI on radiology practice, workforce and service provision Identify the likely place of AI image analysis and natural language processing tools in the radiology workflow. Support development of a coordinated approach to testing and implementation of AI
National coordination	Temporary SRTP Programme team Model for the future	Temporary SRTP programme team Ongoing national coordination Planning for delivery of the model and national strategy

4. To achieve and embed change the right governance needs to be in place

Continuing the national approach is recommended in order to maintain momentum and build on existing structures to fully realise programme benefits, in the shortest possible timeframe.

Note that the current governance structure does not involve the new National Planning Board which may have a future role.

Figure 1: SRTP Governance Structure (Appendix 3)



5. Chief Executives are asked to approve this business case

We have been presented with a unique window of opportunity to build on Phase 1 and continue the momentum towards a transformed future service model across Scotland. Since inception, we have built strong working relationships with a range of local, regional and national stakeholders who have helped to influence the Implementation Plan. National, regional and local implementation aligned to The Model is the foundation of a transformed future service. Therefore, CEs are asked to:

a) Approve this Business Case including the Programme Structure, Governance and Reporting arrangements, and BAU arrangements

b) Support the approach that Boards should, where possible, send excess reporting to the SNRRS during SRTP Phase 2 before considering outsourcing

c) Advise a relevant source of investment for both programme implementation and BAU activities.

STRATEGIC CASE

6. SUMMARY OF THE STRATEGIC CASE FOR CHANGE

Cross cutting clinical services such as Radiology weave through patient pathways in different ways with varying levels of reliance on diagnostic imaging and interventional procedures.

Demand for radiology services is forecast to increase by 3.4% per annum. The current workforce is not able to deliver this uplift in activity and it is unlikely that all of this additional workload can be outsourced to private providers. Waiting times and costs are substantially increasing meaning Radiology services are in crisis.

The long term vision, originally outlined in The Radiology Model (Appendix 1) was developed in conjunction with stakeholders to address the challenges facing the radiology service in Scotland and achieve a collegiate solution. The Model was supported by NHS CEs as the strategic direction for radiology over the coming years. A fully costed business case was approved by the NHS CEs in September 2017 authorising the first phase of implementation of the Model. A separate piece of work outside of the SRTP Programme is also underway to describe the Vision and Strategy for Radiology in Scotland.

Thus far, the SRTP has delivered the first three co-dependent, underpinning requirements:

- IT Connectivity; (Soliton Share+ National Radiology Reporting Platform)
- A nationally agreed data set and definitions held within The National Radiology Information and Intelligence Platform (NRIIP); and
- Testing workforce delivery models (based on a multi-disciplinary approach

These outputs in their own right will not deliver transformation of radiology across Scotland but were seen as enablers to allow development of future models of care and service design. There is now an opportunity to accelerate the pace of change and move more quickly towards realisation of The Model.

A fundamental issue facing radiology is a significant gap between workforce capacity, and activity coming through the radiology system, the financial cost of filling this gap has increased from £5.25m[5] to £10.39m[6] in 3 years. Financial constraints and a shortage of radiologists worldwide, leaves services trying to balance a number of pressures at the same time.

[5] RCR SSC (2016) The Clinical Radiology Workforce in Scotland: 2015 Census Report
[6] RCR SSC (2019) Clinical radiology UK workforce census 2018 report

Continuing specialisation within radiology and future nationally delivered services with a diagnostic radiology component require a nationally coordinated approach.

This strategic case builds on the previous business case by setting out the current pressures, detailing work to continue transformation and maintaining the medium to longer term vision of a future sustainable state.

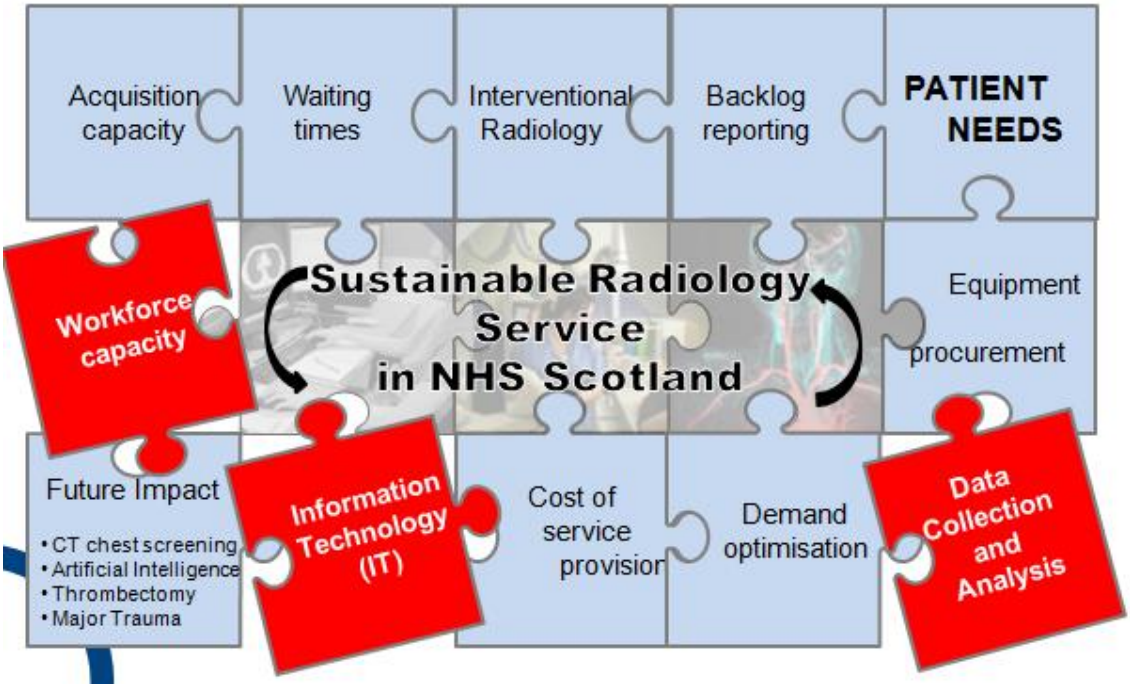
7. THERE IS A NEED TO TAKE A SYSTEMS APPROACH

When considering Radiology in NHSScotland as a whole system it is clear that it is currently out of balance because capacity (workforce and equipment) has been unable to keep up with demand. Increasing demand within a landscape of limited capacity has led to expensive and unsustainable models of service delivery, and has been compounded by board level performance measures which drive territorial approaches to meeting targets.

A range of other initiatives directly involving Radiology, which affect capacity or demand, all contribute to the balance of the system. Currently this range of initiatives are instigated, managed and implemented using a wide range of groups and processes. This approach results in isolated attempts to optimise individual aspects of service, further complicating the fine balance within the system.

A number of innovative workforce models remain which could be developed further to realise the full potential of the IT connectivity implemented in Phase 1. These include a range of mechanisms to attract and support additional workforce capacity to work in Scotland, collegiate approaches to subspecialty pathways and embedding sustainable workforce models.

Figure 2: Key problem areas addressed in Phase 1



It is anticipated that these measures will effectively slow the widening of the workforce gap, while wider transformation of the service model across Scotland takes place. Because of the interdependent nature of the jigsaw pieces, work on the whole Radiology system is required if we are to truly transform and deliver the agreed model.

Systems theory is a useful construct to help navigate the complexities involved with transformation in healthcare giving consideration to the effect of optimising individual elements of a system. It is better to monitor and work on all aspects and be prepared to act, whilst moving the whole system towards a more sustainable and resilient future. This approach assumes a level of flexibility within the system and offers the opportunity to capitalise on the capabilities delivered in Phase 1, to provide an increased level of flexibility in support of this approach.

Systems theory is based around engagement and how changes affect local circumstances, taking the temperature and developing a common understanding of the issues and direction of travel. This takes time and sustained effort to be successful with trust and momentum building along the way.

Cultural and governance obstacles remain in the way of delivering the Model and it is recommended here that CEs support a planning process which firmly establishes an implementation plan over the coming years, using a systems approach to mould an appropriate schedule.

Transforming services, to achieve sustainability and resilience, remain the clear objectives, recognising that significant change takes time. Project delivery can be described and measured in terms of objectives, milestones, outputs and outcomes however, achievement is rooted in the will within teams to contribute and deliver. Cultural issues and human factors are a major determinant of teams' willingness to change.

The single most important factor in the success of delivering these objectives, is building the conditions for change. Developing trust and openness between individuals and therefore services, is often cited as the central pillar for that change. With a backdrop of financial constraints and reduced workforce capacity, all contributing to growing service pressures, this presents as a particularly difficult issue to contend with.

Evidence from other networked Radiology services across the UK is clear that building and maintaining professional relationships is at the core of developing successful cross boundary services. With this in mind, future phases of work will require a particular focus on an ongoing and consistent approach to build on project work by developing and maintaining relationships across Radiology in NHSScotland in order to achieve the desired change.

There is a compelling case for change, a strong business need to consider a 'Once for Scotland' approach, continuing to implement The Radiology Model delivered on a local, regional and national basis.

8. RADIOLOGY SERVICES ARE CRITICAL BUT UNSUSTAINABLE

Diagnostic radiology has evolved over the last century from the plain film x-ray to the modern suite of digital imaging services and differing diagnostic procedures that are integral to the provision of healthcare across Scotland. Available in a wide range of healthcare settings, diagnostic radiology services provide a key diagnostic function in the support and delivery of a number of patient pathways, which facilitate timely diagnosis for patients and improve patient outcomes. Equitable access to a robust, quality and timely imaging service is vital for clinicians involved in both emergency and elective care to ensure optimal outcomes for their patients. Co-location of diagnostic radiology is an absolute requirement for the provision of Accident and Emergency (A&E) as well as acute medical, surgical and orthopaedic clinical services.

Historically, radiology services have evolved on a hospital by hospital basis and in response to increasing local demand including that originating from primary care.

The radiology service in Scotland is unsustainable in its current format due to a number of challenges which are adversely impacting on a timely diagnosis for patients and a resultant impact on patient outcomes. These include a decrease in available workforce and an increasing trend towards subspecialisation and a rapid increase in demand for services.

Without radiology diagnostic capability, other clinical services including primary care and acute services cannot make a timely diagnosis, which impacts on the ability of clinical services to deliver a treatment plan and appropriate high quality care. This in turn impacts on other services leading to higher hospital admission rates and increased hospital lengths of stay.
The risk of doing nothing beyond what has been achieved during the first phase of the SRTP is that radiology services will continue to fail in terms of meeting demand.

9. DEMAND IS INCREASING

Demand for radiology services is forecast to increase by 3.4% per annum.

Figure 3: NHS Scotland examination trends by modality, baselined from 2013/14

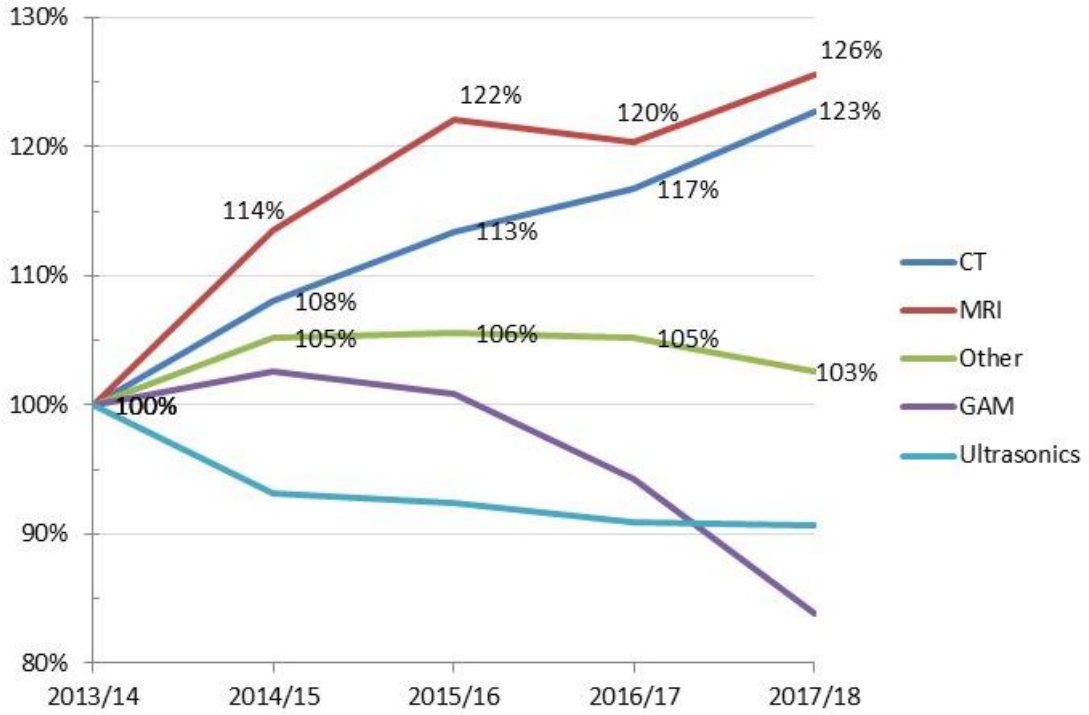


Figure 4: CT activity trend by board, from ISD R120X reports, baselined on 2010 activity

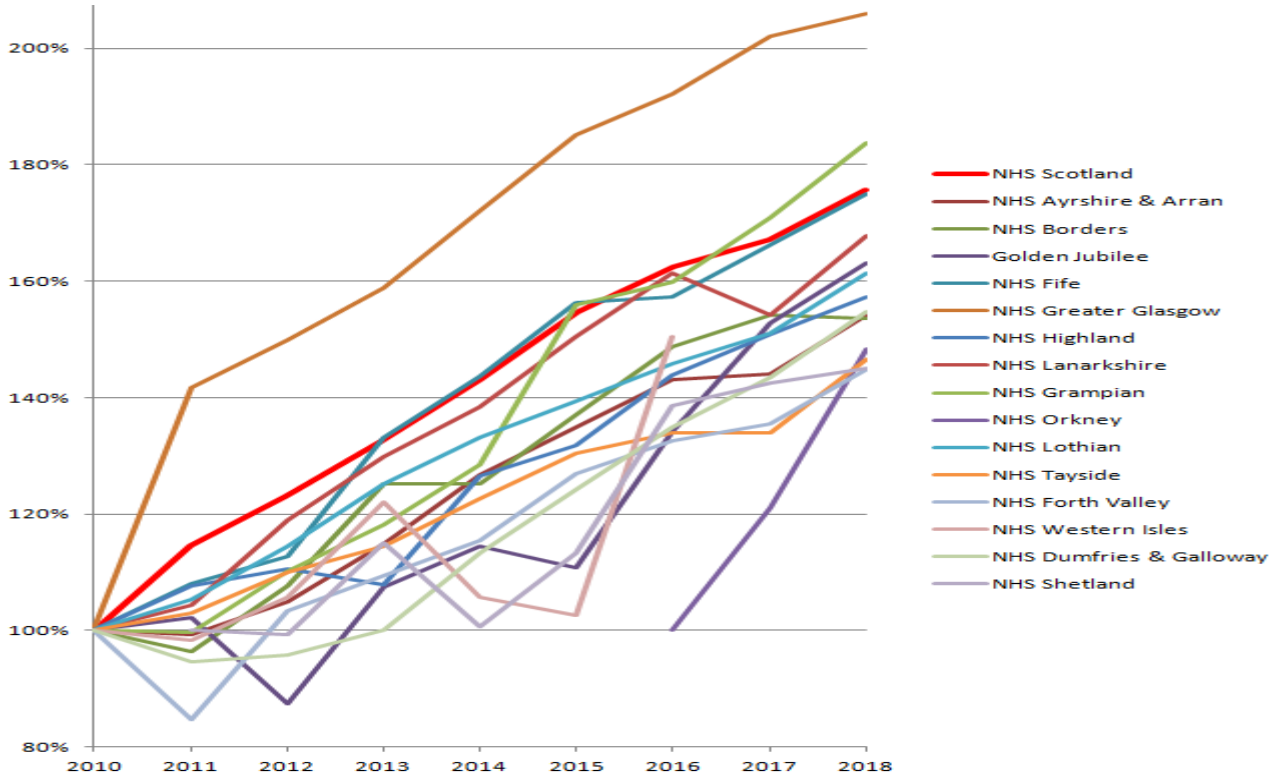
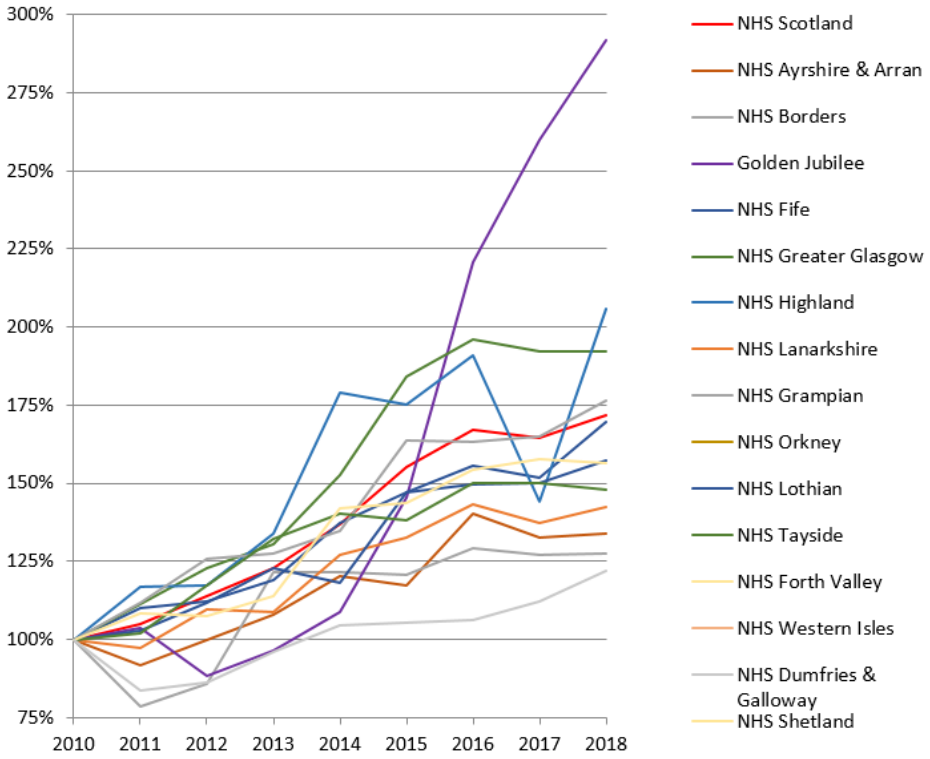


Figure 5: MRI activity trend by board, from ISD R120X reports, baselined on 2011 activity



There is increasing patient expectation around access to and delivery of services, with a growing emphasis on choice. An ageing population leads to increased co-morbidity and coupled with improved technology this leads to increased demand based on the number of options in relation to diagnosis, treatment and ongoing monitoring. New guidelines relating to patient diagnostic pathways for cardiac, cancer and stroke will result in additional demand for Computerised Tomography (CT) and Magnetic Resonance Imaging (MRI) examinations.

10. THERE IS NOT SUFFICIENT CAPACITY TO MEET DEMAND

Workforce shortages continue to challenge capacity, adversely affecting the ability to meet increasing demand; resulting in delays to diagnosis and treatment and increasing use of outsourcing companies.

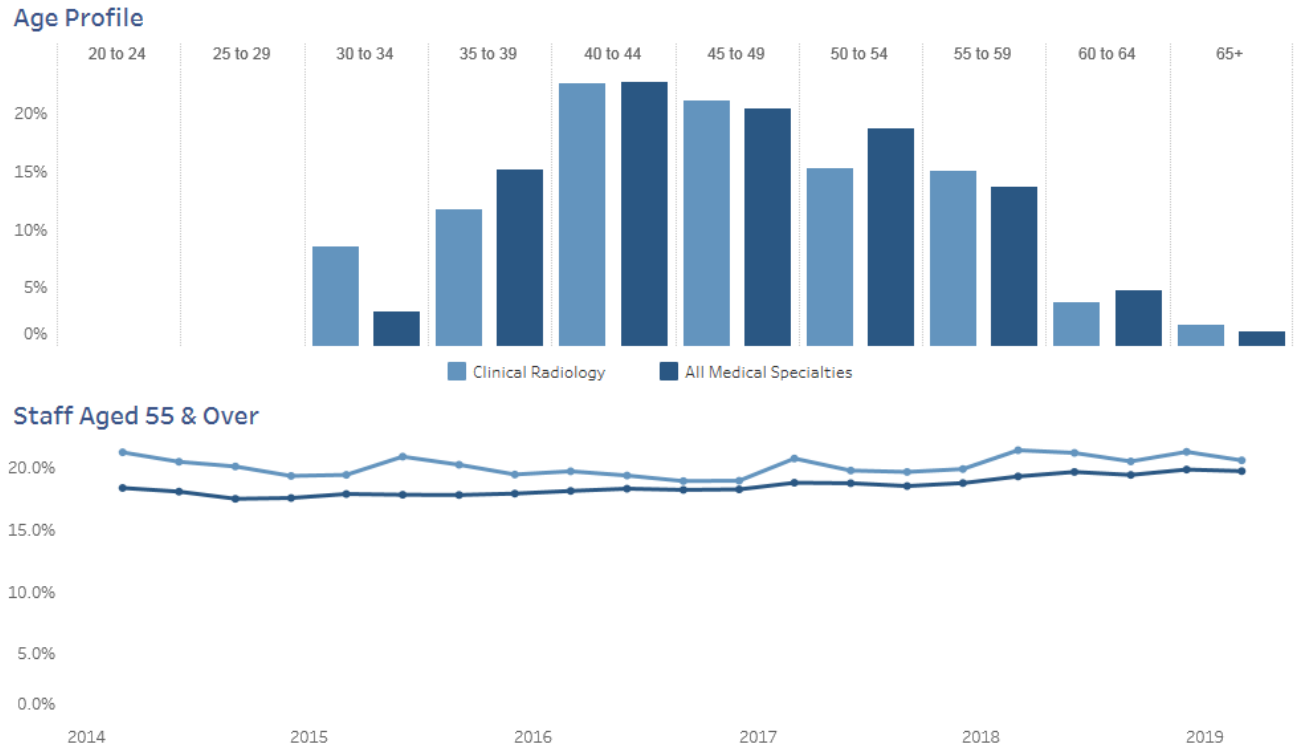
A Data Capture Exercise[7] undertaken by the Shared Services Radiology Programme in September 2016 identified an increasing trend in the number of Consultant Radiologist vacancies across

[7] Shared Services Radiology Programme (2016) National Radiology data Capture Exercise

Scotland. In 2016 there were 22.1 WTE posts vacant, (Appendix 4) however this figure had increased to **47.4 WTE vacancies in Mar 2019** [8] which represents **a 214% increase.**
These vacancies are greatest within remote and rural areas and the situation will exacerbate over the coming years due to approaching retirals.

The age profile in the Radiologist workforce, with anticipated retirements over the next two years, indicates an exacerbation of the current situation. SG Health Workforce/NES Medical Specialty profiles highlights the age profile of consultant radiologists and the percentage aged over 55, in comparison to other specialities.

Figure 6: Age profile of consultants in radiology vs. all specialties at March 2019



The **RCR[9] estimate that by 2025 between 30–36% of current consultants will have retired**. **By 2030**, the figure is expected to be **47–53%.**

Vacancies are not spread evenly across NHS Boards and, in recent years, there has been migration of established Consultants from smaller and more remote NHS Boards to the larger urban centres. This migration is creating significant challenges to service sustainability for some NHS Boards.

[8] NRIIP Medical & Dental Workforce Information
[9] RCR SSC (2016) The Clinical Radiology Workforce in Scotland: 2015 Census Report

Similar challenges exist in other radiology workforce groups (Radiography) and in particular in the discipline of Sonography.

11. Radiologist Training Places

There are currently insufficient Radiologists being trained at post-graduate level[10] to fill the capacity gap. This is compounded by a limited number of medical students which feed the junior doctor supply and in turn the full range of medical specialty training schemes.

Trainees and other non Consultant grades (including academic non Consultant posts) make up only 29.7% of the Radiologist workforce[11] (this compares to an average of 60.3% for all medical specialties in Scotland[12])

This figure raises questions of future replenishment and sustainability of numbers in the Consultant workforce.

In addition, Radiology trainees are not sufficiently exposed to remote and rural hospital placements during their training. This has a twofold effect; one is that once qualified, the trainees are less likely to apply for Consultant posts in remote or rural hospitals and secondly, trainees do not contribute to out of hours rota's in remote and rural hospitals increasing the intensity of out of hours work for Consultants, making recruitment and subsequent retention difficult.

This situation is aggravated by the net export of Radiologists at the end of their training to posts elsewhere in the United Kingdom and overseas.

One of the early successes that SRTP Phase 1 contributed to was an expansion in radiology training places. However, agreed additional radiologist trainees will not result in a significant increase in capacity for some years[13] (Appendix 4) and there is evidence to suggest that demand on services will have increased further by that point, meaning that even with the additional trainee numbers converting into substantive posts within the service, these will not be sufficient to match demand.

[10] RCR SSC (2017) Proposal for Additional Medical Specialty Training Intake Numbers 2017 2018 - Radiology
[11] RCR SSC (2019) Clinical radiology UK workforce census 2018 report
[12] NRIIP datamart as at March 2019 – using SWISS,TURAS & ISD (M)36
[13] RCR SSC (2019) Clinical radiology UK workforce census 2018 report p27 shows increase in mean length in radiology specialist training. The effect of the 2017 increase in Scottish trainee numbers won't be seen until 2024

12. Sub-specialisation

There is a continuing and accelerating trend towards sub-specialisation within radiology. This reduces the proportion of general Radiologists available and disproportionately disadvantages smaller / more rural NHS Boards who by their very nature (population) struggle to provide sufficient activity in each subspecialty, to sustain individual interests.

The necessary collaborative working between networks of Radiologists that is required to support sub-specialisation cannot be delivered within the existing individual hospital and Health Board based service delivery models. Some of these networks may require regional, pan regional or national approaches to maintain skills and provide safe levels of service.

13. Radiologist Recruitment

Recruitment to Consultant Radiologist posts is currently carried out at individual board level, with a recent test of change carried out using a single international recruitment process, with candidates interviewed for specific board posts.

Board level recruitment is in many ways a competitive process whereby applicants can negotiate with individual boards around structure of the role they are applying for. The ability of individual boards to construct an attractive enough job plan, in what is essentially a buyer's market may be compromised by factors such as the ability to satisfy applicants' subspecialty interests within a board.

Joint posts between health boards may allow greater flexibility in structuring more attractive posts. This type of arrangement is often difficult to negotiate as a result of the way in which posts fit together to satisfy local needs and also how job planning has evolved over time within existing teams.

The ability to more easily construct job plans across wider geography would provide managers and staff with more flexibility and possibilities to construct a range of more attractive roles, albeit more complex to manage as a single coordinated process. For example; roles where a proportion of a job plan could be assigned to cover areas of interest and across a wider geography (regionally or possibly nationally for selected roles). The SRTP Phase 1 IT platform will allow some of this to be delivered virtually.

14. Undergraduate Radiographer training

Capacity planning for Radiographers at national level is currently uncoordinated being a profession which is not controlled in terms of numbers. This leads to a workforce supply which is not directly

related to service need, placing limitations on the ability of service to maintain adequate workforce planning approaches, covering the range of acquisition and Advanced Practice skills.

Availability of clinical placements is currently determined by local circumstances. This then determines the numbers of individuals able to train within the system and is therefore a crucial factor in workforce supply. NHSScotland would best be served by aligning available clinical placements to the needs of the service as part of an overarching multi-disciplinary workforce plan for Radiology in Scotland.

Overall there is a Radiographer workforce shortage within NHSScotland, ultimately there needs to be a more responsive system that generates workforce in response to demand but there also needs to be a strategy to increase workforce numbers in the short term.

A more collaborative approach and firmer arrangement with the three Higher Education Institutes around clinical placements and numbers being trained would serve Scotland better. Thought should also be given to retention strategies for Radiographers trained in Scotland, particulary as they relate to the availability and resourcing of Advanced Practice.

SRTP should link with parallel SG workstreams to produce a unified Radiology Workforce Strategy.

15. Advanced Practice (AP) in Radiography

Advanced Clinical Practice in diagnostic Radiography is very well established in other parts of the UK and has a substantial evidence base that indicates significant opportunity in Scotland. Radiographers have expanded their role over the years to encompass some aspects of image reporting. However, there is a wide variation in employment practices for AP's across the country, including their scope of practice and ability to dedicate time to AP roles. The net effect of this variation is that this workforce resource is not being utilised to capacity and the transferability of skills across NHS Boards is limited.

As with undergraduate training, clinical placements pose a similar problem. Larger NHS Boards find it easier to support training due to higher levels of activity in particular areas of AP and also a larger multi-disciplinary staff group who are able to support those trainees. Co-ordination of placements across a wider geography and linked to a national workforce plan would be of benefit.

Managers cite backfill arrangements as a major issue in terms of their ability to release staff to train, and therefore engage in a structured Advanced Practice (AP) programme. Again this is a function of a lack of fundamental capacity (graduate Radiographers), as a major issue in terms of releasing staff for AP training.

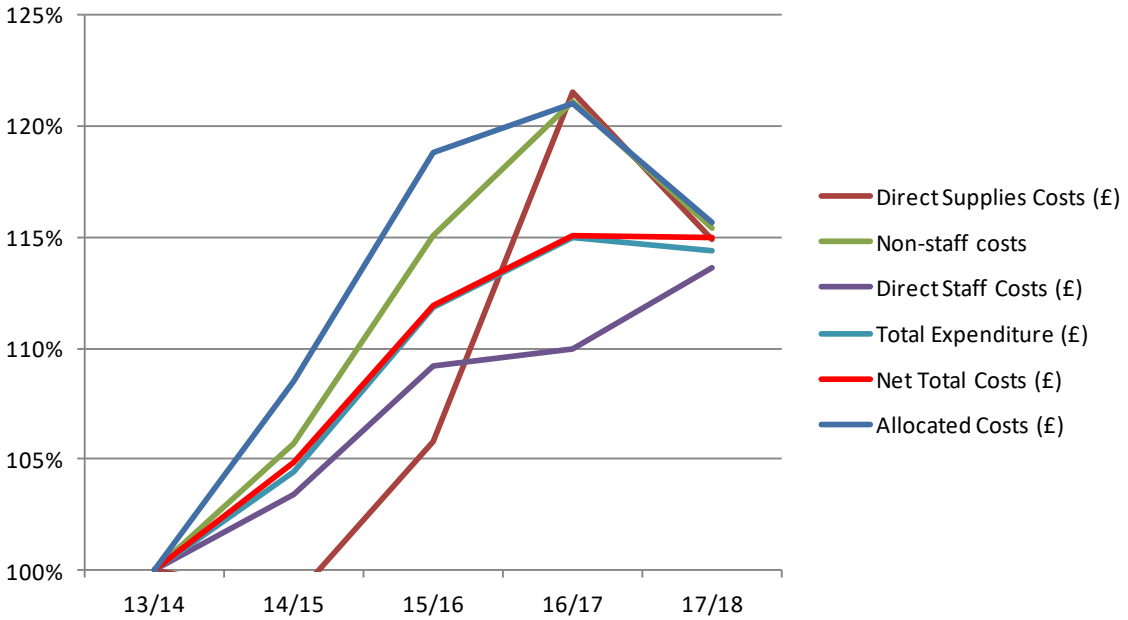
Advanced Practice expansion depends on a number of factors that are outside the remit of the programme, giving further reason to link with other workstreams.

16. COSTS AND WAITING TIMES ARE INCREASING

Costs of the service are rising at an unsustainable rate due mainly to the cost of outsourced reporting, but also the compounding effect of increased demand on services as evidenced by increasing activity for CT and MRI (Figure 3).

The total net costs for diagnostic radiology are circa. £280m per annum[14]. These costs are largely growing in an unplanned, unbudgeted way and are escalating. The chart below demonstrates a five year trend in radiology service costs and activity data gathered by PHI of the radiology information available within the Cost Book.

Figure 7: % increase trends baselined to 2013/14



This shows continuous growth in the total net cost of a number of examinations for a range of radiology services; from **£249m in 2013/14 to £287m in 2017/18**: A **15.25% increase** over a four year period.

The structure of NHS Boards has evolved historically and the accountability for both financial, performance and quality targets remain within individual NHS Boards; there has been little cross boundary or regional working to address challenges in Radiology although some small scale models are beginning to emerge. The potential to accelerate these types of model is now possible following Phase 1 of the SRTP.

[14] Scottish Health Service Costs (Cost Book) years ending 31 March 2018, 2017, 2016, 2015 and 2014,

Increasing demand on services increases report turnaround times and also waits for imaging appointments. Coupled with reduced capacity and variation in terms of capacity to deal with demand within board, there continues to be widespread outsourcing of image reporting to the private sector, the payment of additional sessions at enhanced rates to existing Consultants and also the employment of agency and locum staff.

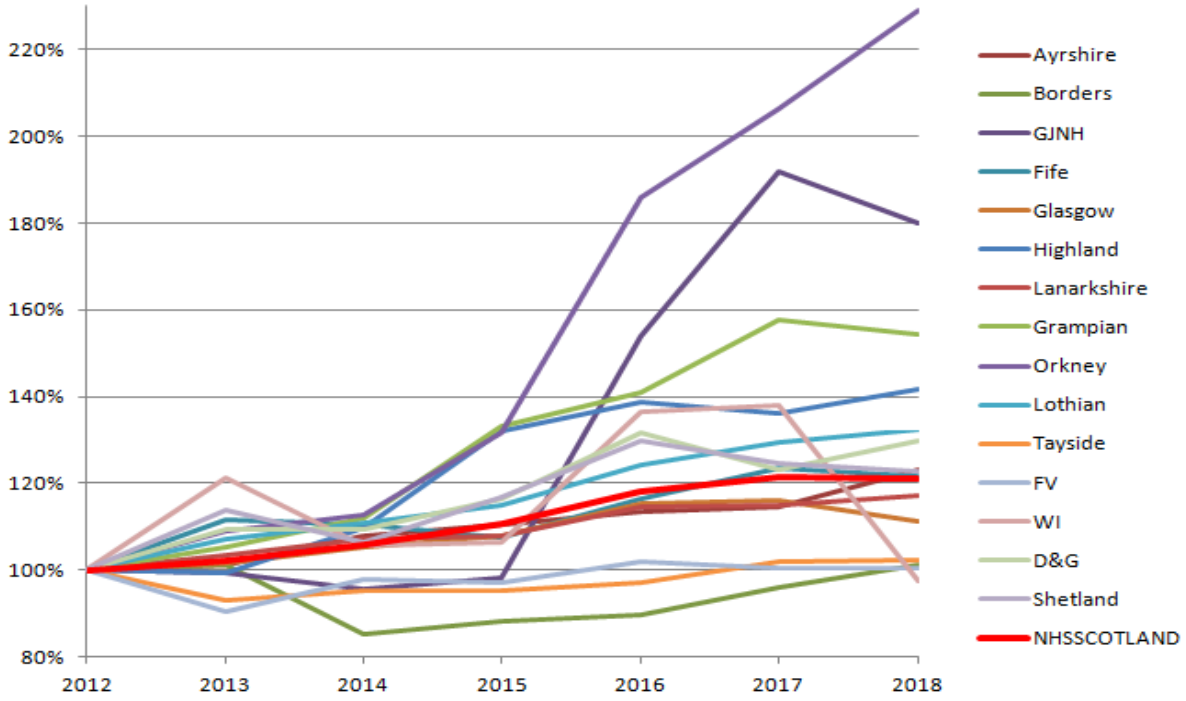
The RCR reported that expenditure on outsourcing and additional payments had increased from an estimated £3.5m for 2013/14 to £10.4m for 2017/18: **This is a 297% increase.**

- 2013/14 £3.5m – 2014 RCR census
- 2014/15 £5.25m – 2015 RCR census
- 2015/16 £6.3m – data capture exercise as part of SRTP Phase 1
- 2017/18 £11.6m – 2018 RCR census and NSS Procurement

It is anticipated that these costs will continue to escalate due to a crisis within the service and the implementation of quick fix solutions in some NHS Boards. These quick fixes are implemented out of necessity and quickly become the new norm, potentially compromising a national approach.

The following chart shows the increasing cost of Radiology broken down by Board, baselined on 2012 data.

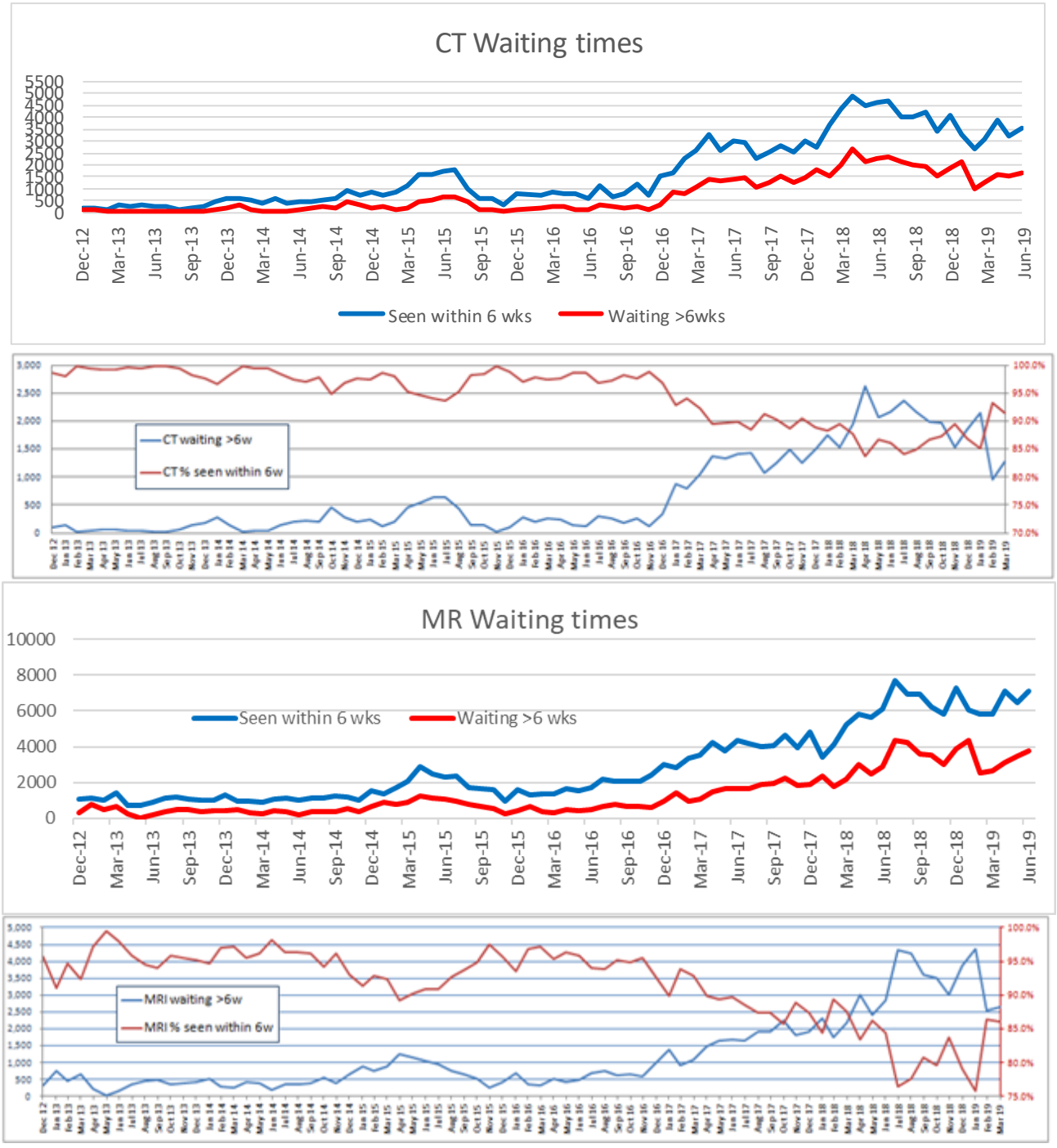
Figure 8: Increasing costs of radiology, baselined on 2012 data



Whilst cost is not the main driver for transformation here it has obvious significance in terms of making best use of resources.

The increasing use of outsourcing companies add to spiralling costs and workforce shortages result in delayed diagnosis and treatment. Figure 9 demonstrates a trend of increased numbers of patients waiting[15] more than 6 weeks for treatment in both CT and MR.

Figure 9: Compliance with waiting times



[15] NSS ISD (National Services Scotland Information Services Division) 2017

In the period from November 2015 to June 2019, for imaging services the:

total number of patients waiting has **increased by 69.31%** (38,583 to 65,326);

number of patients **waiting more than 4 weeks by 699%** (2,605 to 18,207); and

At 30 November 2015 there were **329 patients waiting more than 6 weeks** which has risen to **8,337 waiting over 6 weeks at 31 March 2019.**

These increases illustrate the pressure radiology services are currently under and in particular the recent difficulties in meeting Waiting Times Targets. Over the coming years the Radiology Datamart and dashboards will provide the opportunity to further refine cost book data and ensure cost comparisons are more accurate than currently possible. In so doing the toolkit available to planning and management functions across Scotland is significantly enhanced, which in turn supports improved option appraisal and decision making processes.

In conclusion the workforce crisis is not going away. Phase 1 has put in place enablers which support new ways of working and there is now the opportunity to support a workforce model which is more flexible and collaborative. This new approach would better serve those Boards where recruitment is difficult and ensure a more sustainable level of service for the Scottish population as a whole.

17. SRTP Phase 1 laid the foundations for transformation

The SRTP was established in September 2017 to work with boards and manage implementation of the first steps towards transformation in Radiology. The programme has delivered enablers for transformation in the new IT and data capabilities at a national level, whilst establishing a number of workforce related solutions which utilise that new capability. The main aims of the programme (Phase 1) were to put in place the enablers for change, make best use of existing resource, alongside realising capacity within the existing workforce through the establishment of the SNRRS as an adjunct to improving sustainability across NHSScotland. By running tests of change these initiatives have shown that pooling activity beyond health board boundaries within the Share+ system and coordinating reporting capacity across NHSScotland, to report on that activity, can work. Much more is required to establish the positive elements of these tests of change as business as usual and maximise the benefits for improved patient outcomes.

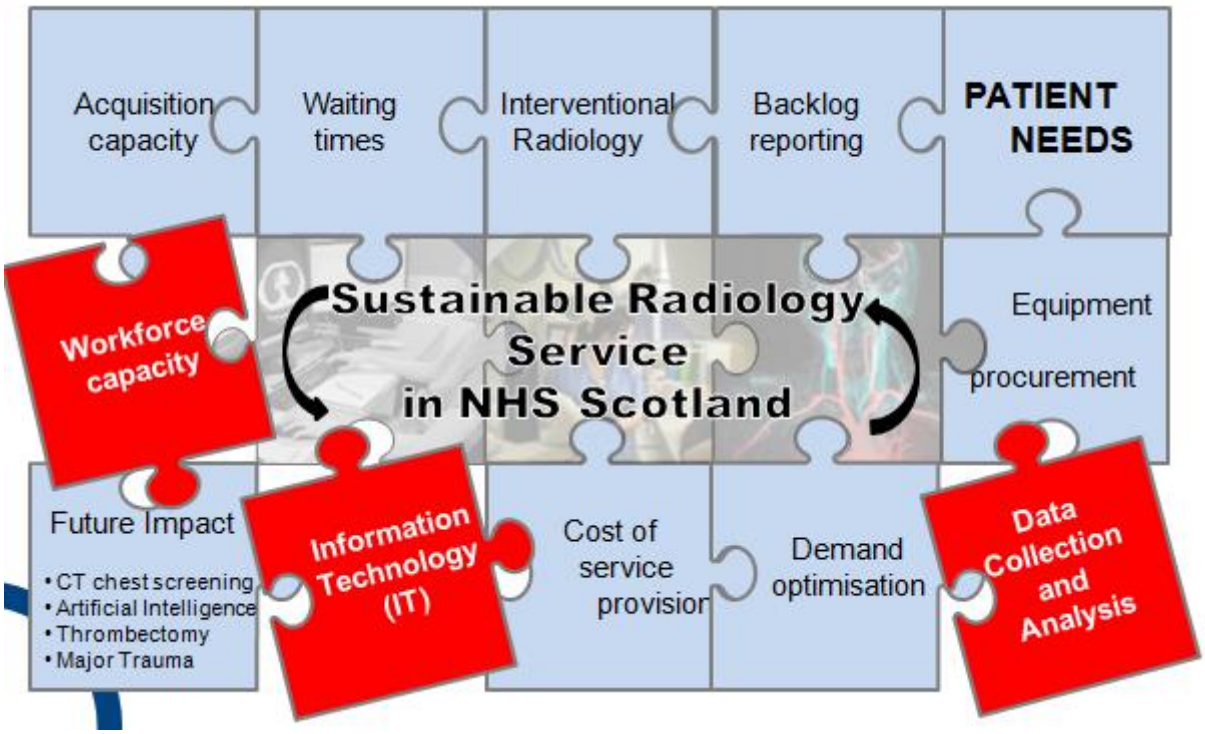
Specific projects delivered to date include:

- National IT Connectivity (between RIS and PACS)
    - National cross-boundary reporting (Soliton's Share+) enabling reporters to report on images taken anywhere in Scotland
- National Cross Boundary Reporting Bank and Payment Model
    - National bank model for Radiologists. Virtual hub (SNRRS Bank) pilot commenced, hosted by Golden Jubilee National Hospital
- Reporting Radiographer Pilot

- Pooled, national capacity reporting from new IT

- National Workforce Modelling Tool
  - Standardised workforce planning approach
- Advanced Practice gap analysis
  - Informs future workforce planning and training initiatives
- Additional Workstation Deployment
  - Removing barriers to cross boundary reporting
- Home Working Pilot
  - Providing ability for flexible working
- National Radiology Information & Intelligence Platform (NRIIP)
  - Improved planning and management
- Consultant Job Design Framework
  - Standardised approaches to job design
- Funding for Clinical Decision Support Software Pilot
  - Supports reduction in demand

Figure 2: Key problem areas addressed in Phase 1 (also on page 11)



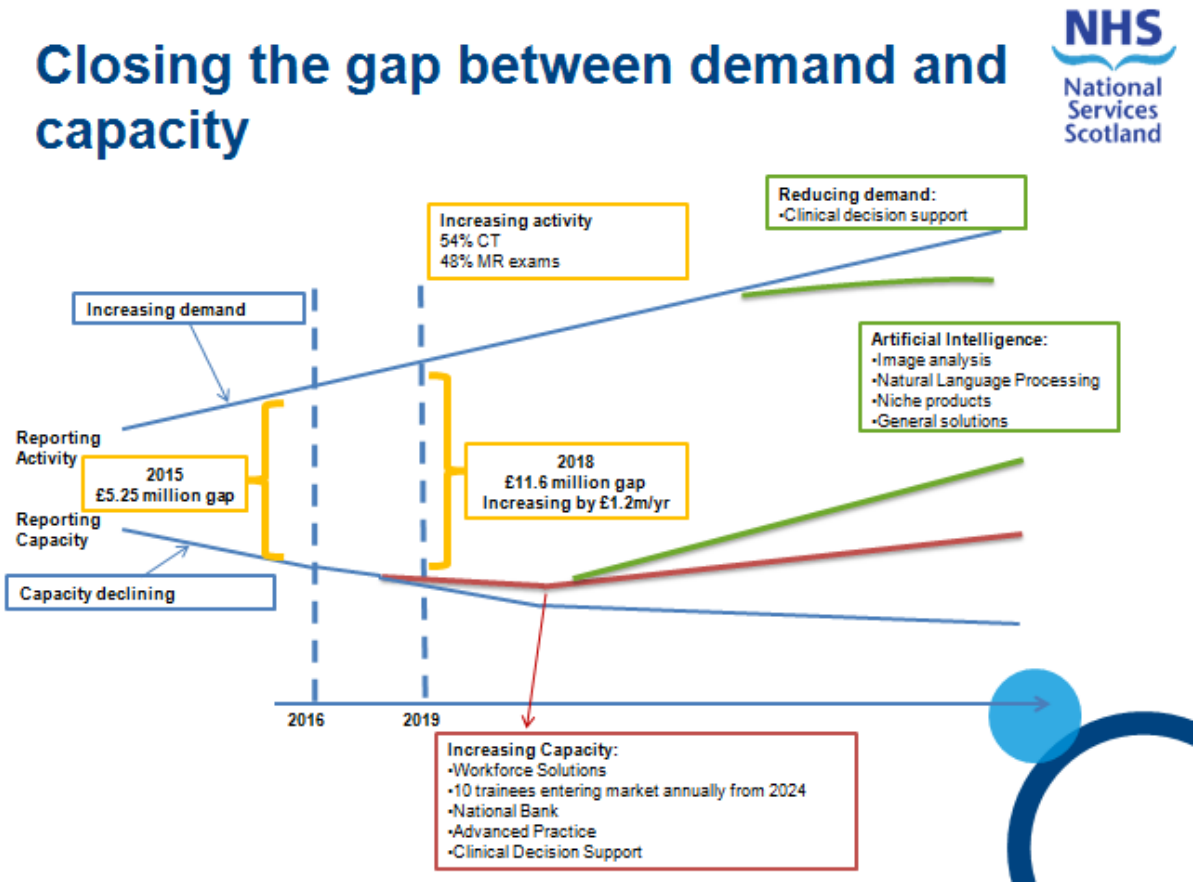
The SRTP (Phase 1) has focussed on some fundamental aspects of the system and a range of other initiatives continue to consider ways of optimising specific areas.

18. THERE ARE FURTHER OPPORTUNITIES TO BE EXPLOITED

Radiology has an, as yet unrealised, opportunity to make use of the new technology implemented in SRTP phase1 and develop an integrated multi disciplinary workforce, to continue delivery of the new national service model and develop further innovation. Projects in Phase 1 provide services with an opportunity to uncouple the requesting and capturing of images from the associated reporting and mobilise the available workforce to greater effect. Separation of acquisition of images from reporting already happens in terms of the timing: that is, images are captured at one point in time and reported upon at a later time. However, separation of acquisition of images and reporting in terms of location generally only happens at local (Health Board) level. The new IT connectivity supports this separation and enables reporting at a different location across a much wider geography, to happen more easily.

Further innovative workforce models remain unexplored and these could be developed further. These include a range of mechanisms to attract and support additional workforce capacity to work in Scotland (retirees, trainees, overseas initiatives, home working etc.), collegiate approaches to subspecialty pathways in the form of communities of practice (or networks) and embedding sustainable workforce models to maximise Advanced Practice capacity. The implementation of some of these projects is dependent on the successful outcome the Scottish National Radiology Reporting Service (SNRRS) pilot with Golden Jubilee National Hospital (GJNH), and we now need to move into a phase of further testing where required, embedding into business as usual where appropriate.

Figure 2: Closing the gap between demand and capacity



19.IT

The current radiology IT Solution comprises a national Picture Archiving and Communications System (PACS) which captures radiological images and reports from thirty-one local PACS instances. Additionally, each Health Board operates a local Radiology Information System (RIS) for each major hospital site which stores waiting lists, requests and booking data as well as the reports on individual radiological images. These solutions in each NHS Board are complex however successful in their remit of providing radiology services locally, but there exists considerable opportunity to enhance these mechanisms with the ability to work from a wider base in support of patients.

The SRTP has successfully implemented a new model of being able to report on images from anywhere in Scotland, by linking all RIS systems to a new system, Soliton's Share+ solution. This enables reporters to focus on areas with high waiting times and in Boards with limited resources in particular subspecialties (load balancing). However, a national model for coordinating resources to get the best use out of the Share+ system is required to achieve full benefits for NHS Scotland.

During implementation of the new national system it became apparent that there were significant difficulties with interfacing Share+ and multiple existing local RIS versions. A coordinated approach to RIS would increase flexibility, support more rapid introduction of future service needs and allow improved integration as NHSScotland moves to an open platform digital architecture.

The voice recognition (VR) software used to enable efficient radiology reporting is currently licensed locally in each Board. This model prevents portability of the voice recognition functionality when vendor specific software components in, for example, local PACS and RIS are replaced. A new national enterprise license has been secured which enables unlimited reporters to use this technology on Share+.

20.Artificial Intelligence

Artificial Intelligence (AI) is on the horizon as a support to radiology service capacity. AI image analysis is already being developed as a product which generates a report. Natural Language Processing (NLP) of human generated reports will reduce error rates and improve consistency. Other products in development will automate:

- Rostering
- Booking
- Pathway management

Current clinical views indicate a likely timescale for significant impact on the service of 5-15 years (independent AI reporting), although some commentators consider AI may be of assistance in

specific areas right now. Pilots in certain areas are underway and benefits are perceived across a number of others.

With growing interest in this type of technology and undoubtedly unrealised potential, a structured national approach to assessing and planning rollout would be of benefit to NHSScotland to gain maximum benefit as quickly as possible. The Scottish Health Technologies Group (SHTG), part of Healthcare Improvement Scotland (HIS) has been engaged to begin the process of assessing the different types and potential impact of, technologies currently available or in development. SHTG has scoped work on AI and the report is included in Appendix 2. Phase 2 will see this progressed and aligned to priority areas of work.

21. DATA

There is huge variation in the delivery of radiology services across NHS Boards ranging from imaging rates by population to staffing and acquisition capacity (previous data from the Scottish Clinical Imaging Network (SCIN) showed imaging rates which could vary by 100% depending on board and modality). This variation may be appropriate however, without the ability to interrogate standardised national data and align with other datasets then the question about warranted versus unwarranted variation will remain unanswered.

The SRTP's National Radiology Information and Intelligence Platform (NRIIP) will evidence the challenges above by introducing mechanisms to provide comparative analysis on a local, regional and national level. The challenge will be how to integrate this functionality into planning work (act on evidence) and interpret the data on an ongoing basis. Previous data collection and analysis exercises were time limited and sporadic, resulting in boards and services continuing to rely on local methods. The opportunity now exists to build on regular automated data collection and provide meaningful analysis which can in future be articulated with other data sources as part of patient pathway analysis (e.g. imaging data analysis as part of detailed cancer pathway work).

22. OPTIMISING DEMAND

A major challenge to Radiology services is the level of demand and the rate at which this demand is increasing. Demand optimisation is providing appropriate imaging which balances the use of resource with patient outcomes. This level is broadly where referrers and Radiologists accept that appropriate forms and levels of imaging should be carried out.

Referrer education and relationships between referrer and radiologist are the key determinants of appropriate requesting. Within a climate of extremely limited resource, maintaining those relationships within a culture which has the time to optimise demand is difficult.

Clinical Decision Support software solutions are available that can guide referrers to appropriate imaging using guidelines developed by the Royal College of Radiologists (RCR). This provides the

opportunity for education of referrers serving to optimise referral pathways, thus reducing the number of unnecessary or inappropriate imaging requests and minimising the need to discuss referrals.

23. Advanced Practice in Radiography

Advanced Practice (AP) could sustainably add value and predictable capacity to the system (e.g. Sonographers, Reporting Radiographers). Evidence from across the UK shows that Advanced Practice is viable wherever there is a clinical need.

An integrated national / regional workforce approach provides the opportunity to create an AP structure and career pathway which is less dependent on local factors by explicitly linking AP staff in communities of practice to train and sustain service.

A national approach to AP using communities of practice could overcome the problem of achieving a “critical mass” of resource in smaller and rural Board ares allowing the advantages of AP to these areas.. The issue of backfill can be met with Assistant Practitioner implementation and by ensuring a good workforce supply of Radiographers.

The new IT connectivity allows activity to be pooled and directed to AP’s, where previously they relied on local access to reporting activity which was limited in some boards and could also be variable depending on Radiology trainee numbers and their stage of training.

During Phase 1 a new service model was developed to provide national cross-boundary plain film reporting performed by Reporting Radiographers, overseen by Consultant Reporting Radiographers and Radiologists from across Scotland. Although the pilot provided successful outcomes in the form of safe working practices, increased reporting capacity and the testing of an innovative new solution, in order to really deliver the potential benefits, reporting Radiographer numbers and utilisation need to be expanded rapidly.

Additionally, during phase 1 the SRTP engaged with the Allied Health Professionals (AHPs) Transforming Roles programme. This programme developed a process to support a national approach to Advanced Practice for AHPs and which has used reporting Radiography as one of its three transforming roles pilots. Both programmes are moving towards a national approach to reporting Radiography Advanced Practice.

Initial work during the first phase of the SRTP indicates that significant capacity gains could be achieved by training and employing more Sonographers across Scotland. Increasing numbers has proven difficult in the past for a variety of reasons:

- The supply of graduates to release Radiographers to train is inadequate
- There is often no budget for training and backfill
- Local budgets normally separate medical and other workforce

- Maintaining a balance between Radiologist and Sonographer training
- Maintaining Radiologist skill sets

A national approach to increasing numbers would benefit local services if linked to graduate supply and coordination of clinical and academic training across the country.

24. THE CASE FOR TRANSFORMATIONAL CHANGE IS CLEAR

In summary, the current landscape within the radiology service remains unsustainable. Demand is outstripping capacity, costs are growing in an uncontrolled fashion and if future demand projections come to fruition the situation will only be exacerbated.

Phase 2 is moving towards a whole system approach with coordination of effort across initiatives, to avoid duplication of effort and clearly signal that radiology needs a once for Scotland approach if it is to come back into balance and best serve the population as a whole.

The risk of doing nothing beyond what has been achieved during the first phase of the SRTP is that radiology services will continue to fail in terms of meeting demand.

Option 2 described in the Economic case is the preferred option. This delivers a national programme to leverage the enablers implemented in SRTP Phase 1, with some travel towards the 10 year model for radiology. It also delivers a degree of national leverage and oversight through central coordination.

Figure 3: A sustainable Radiology Service

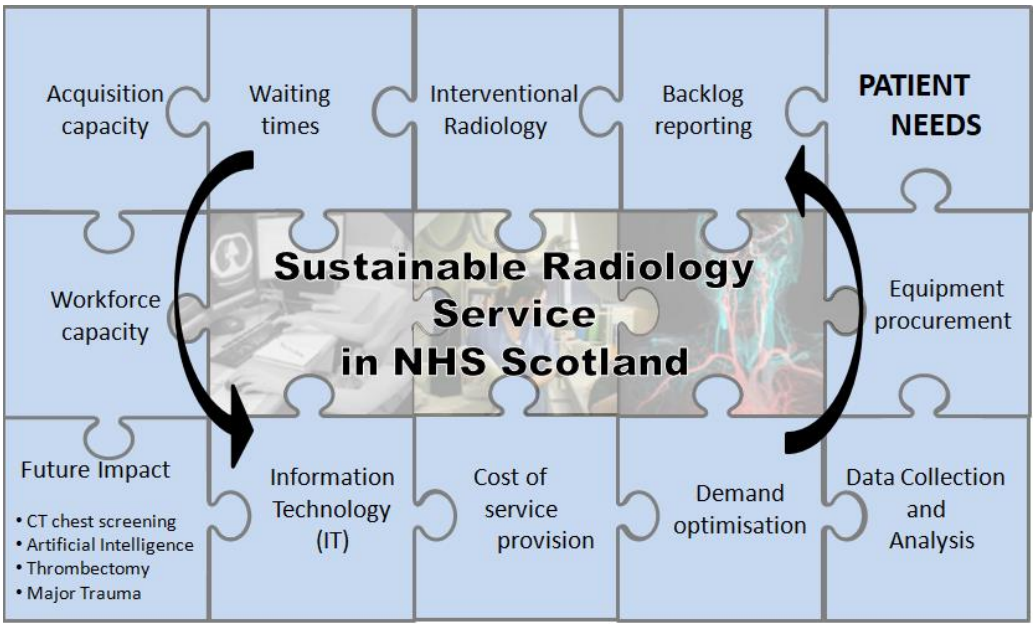
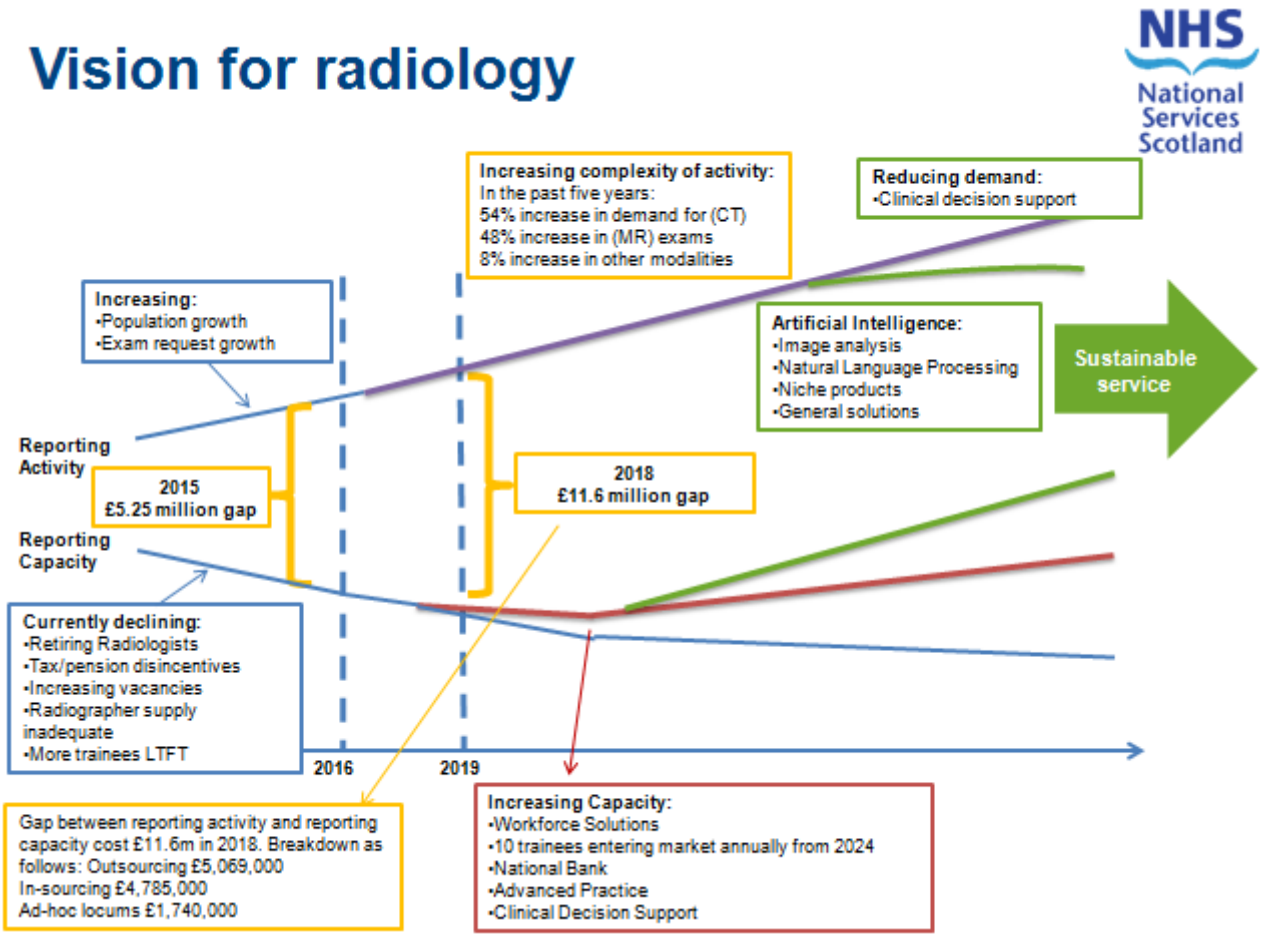


Figure 4: A sustainable Radiology Service



There is a compelling case for change, a strong business need to consider a 'Once for Scotland' approach, continuing to implement The Radiology Model delivered on a local, regional and national basis.

ECONOMIC CASE

The Economic Case aims to propose and evaluate solutions to the challenges documented in the Strategic Case and to compare any viable options with the “do nothing” option.

The original Radiology Model (Appendix 1) developed in 2016 documented a range of benefits to be realised through the delivery of the model and many of the same assumptions documented still hold.

Advice has been sought from a number of key stakeholder groups in relation to the development of the business case and the Economic case has been developed in keeping with this advice.

The Economic Case describes options to move forward the change agenda in Radiology. These align with the agreed Radiology Model however, vary in scale, benefits forecast and cost. These options reflect the discussion at the national Chief Executives group in May 2019, where there was an ambition to continue work but recognition that the ability to deliver rapid change may be limited at this time.

Phase 1 of SRTP was based on implementing enabling solutions in three areas:

- IT Connectivity
- Data
- Workforce

This business case sets out options to exploit these initial building blocks, and to progress towards a state where transformational change is possible in Radiology. NHS Scotland has made a substantial investment in Phase 1, therefore, it is imperative that this investment is exploited to support transformation in Radiology and realise the benefits anticipated.

The SRTP team recognised that engagement with the Radiology community around the future direction of transformational change would be essential to identify potential solutions and opportunities beyond the lifetime of SRTP Phase 1. A visioning event (March 2018) and two conferences were held (June 2018 and March 2019) in addition to a range of other engagement events across Scotland. These engagements have taken simple concepts, examined associated challenges and derived workable solutions.

Additionally, there has been continuous engagement on the direction of travel for radiology in Scotland and on how future phases of the SRTP could deliver functions that will support the journey to that future model. Further details can be found in Appendix 5.

25. Options Appraisal

An options appraisal was undertaken and to ensure that any options for a future programme can be compared, the “Do Nothing” and “Do Minimum” options are included. The components of these options were defined from the work undertaken in SRTP Phase 1 and by a prioritisation process. Further details can be found in Appendix 6.

26. Option 0 - Do Nothing

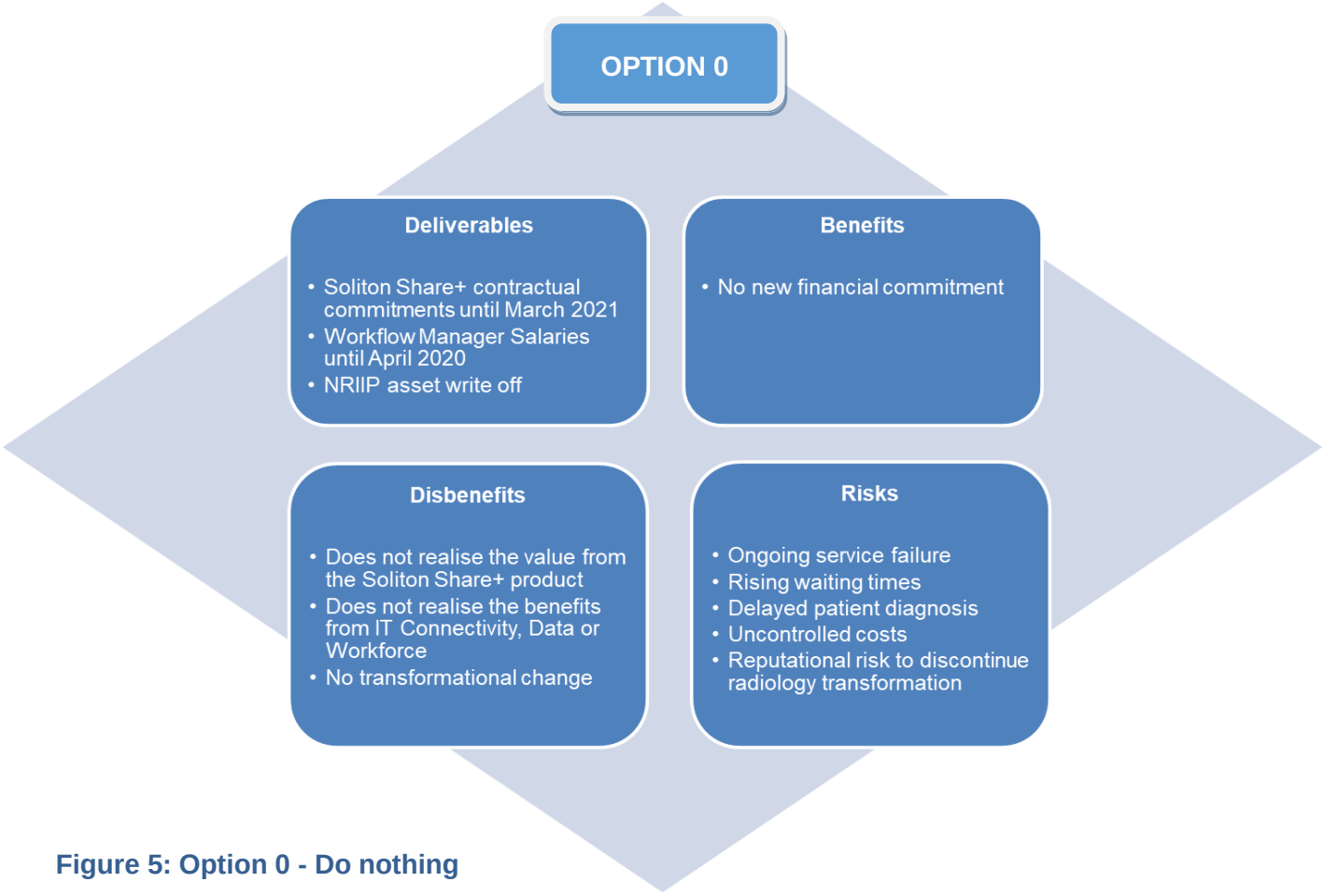


Figure 5: Option 0 - Do nothing

This option is to walk away from or cancel all programme activity and describes costs associated with the minimum legal requirements.

There are a number of contractual obligations for products procured through the 2017 SRTP business case, and staffing costs that were anticipated for the running of the reporting service. This option delivers only technical capability, and loses the ability to utilise that capability. A significant proportion of benefit from the investment to date would be lost. The hardware and systems

deployed to date would be left running for the remainder of the contract allowing boards to utilise functionality if they wish, but with no central support or management of cross boundary workflows.

This option is the lowest cost model available. It ensures all contractual commitments are met, including IT support provided by 3rd party suppliers. All project work that has not been initiated will not progress including the SNRRS Bank pilot and the CDS pilot. Activity in the reporting system would cease unless Boards undertake to use the technical functionality and develop a system to manage and govern workflows themselves (resourcing this work would then shift to being a Board responsibility).

The SNRRS Bank pilot hosted by GJNH would not proceed in this option and the CDS pilot could only proceed if boards agreed to resource and support pilot work from April 2020. Technical implementation of the software is scheduled for 2019/20 and so will happen during Phase 1 transition, which was agreed through the programme board and funded as part of Phase 1.

With this option, in order to cover the average annual increase in demand (12,000 reporting hours), each and every year there would be a requirement for a further 8.2 WTE Consultant Radiologists. This is additional to all current staff and current outsourcing/in-sourcing/locum costs. Work in phase 2 will mitigate these pressures.

27. Option 1- Do Minimum

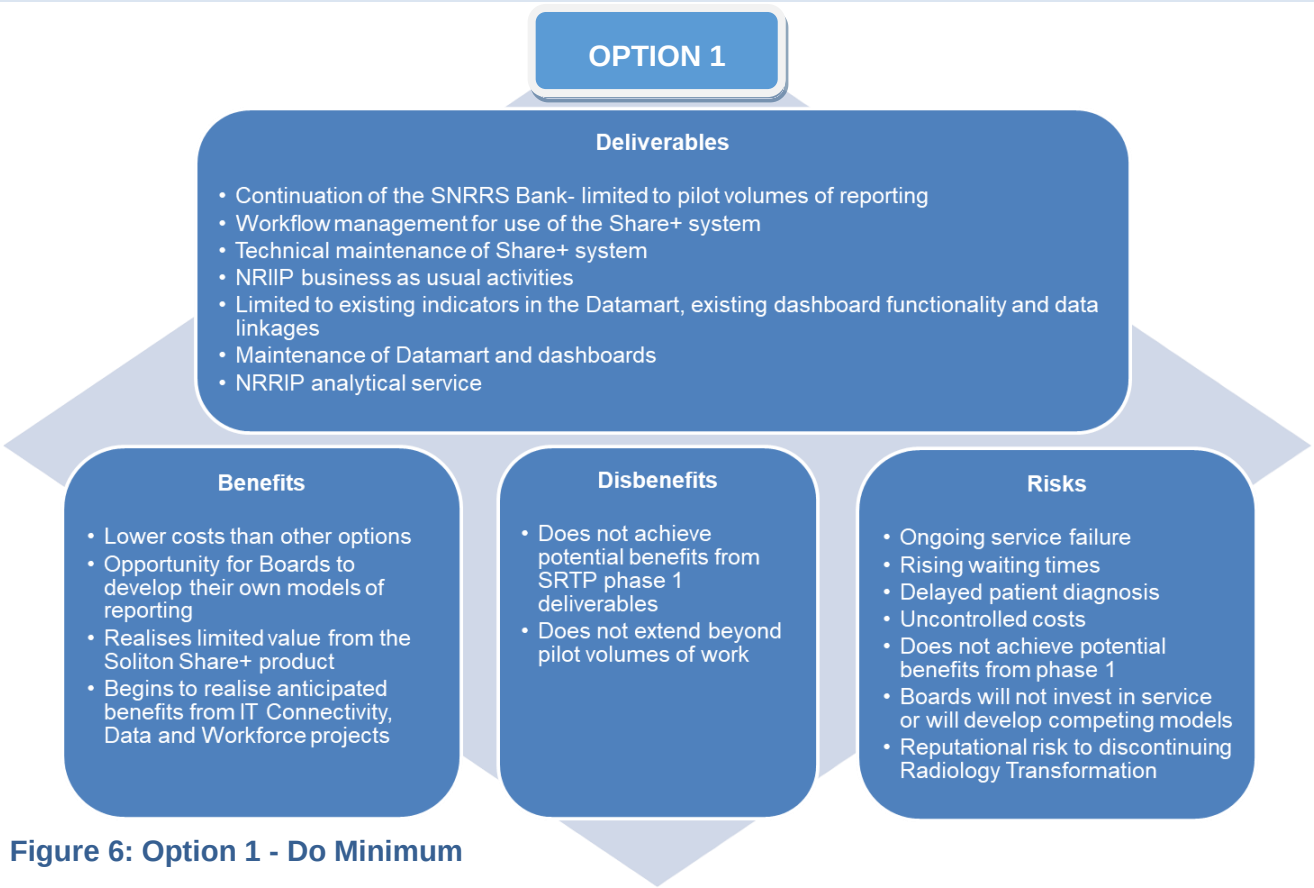


Figure 6: Option 1 - Do Minimum

This option takes forward the business as usual functions as agreed by the national Chief Executive group as part of the original business case in 2017. This entails:

- Management of the Scottish National Radiology Reporting Service (SNRRS)
- Contract management and IT support for Soliton Share+
- Maintenance of the NRIIP dashboards and datamart

This option is relatively low cost, it enables some benefits to be realised from Phase 1 capabilities and project pilots to be evaluated at their conclusion (during 2020/21). This option ensures all contractual commitments are met and provides the framework for a limited set of projects to be sustained through a business as usual model with recurrent funding.

It maintains the IT and data systems delivered by Phase 1 as well as staffing to support a limited reporting service (SNRRS).

28. Option 2 - Enhanced Business As Usual with a New Programme aligned to the Model

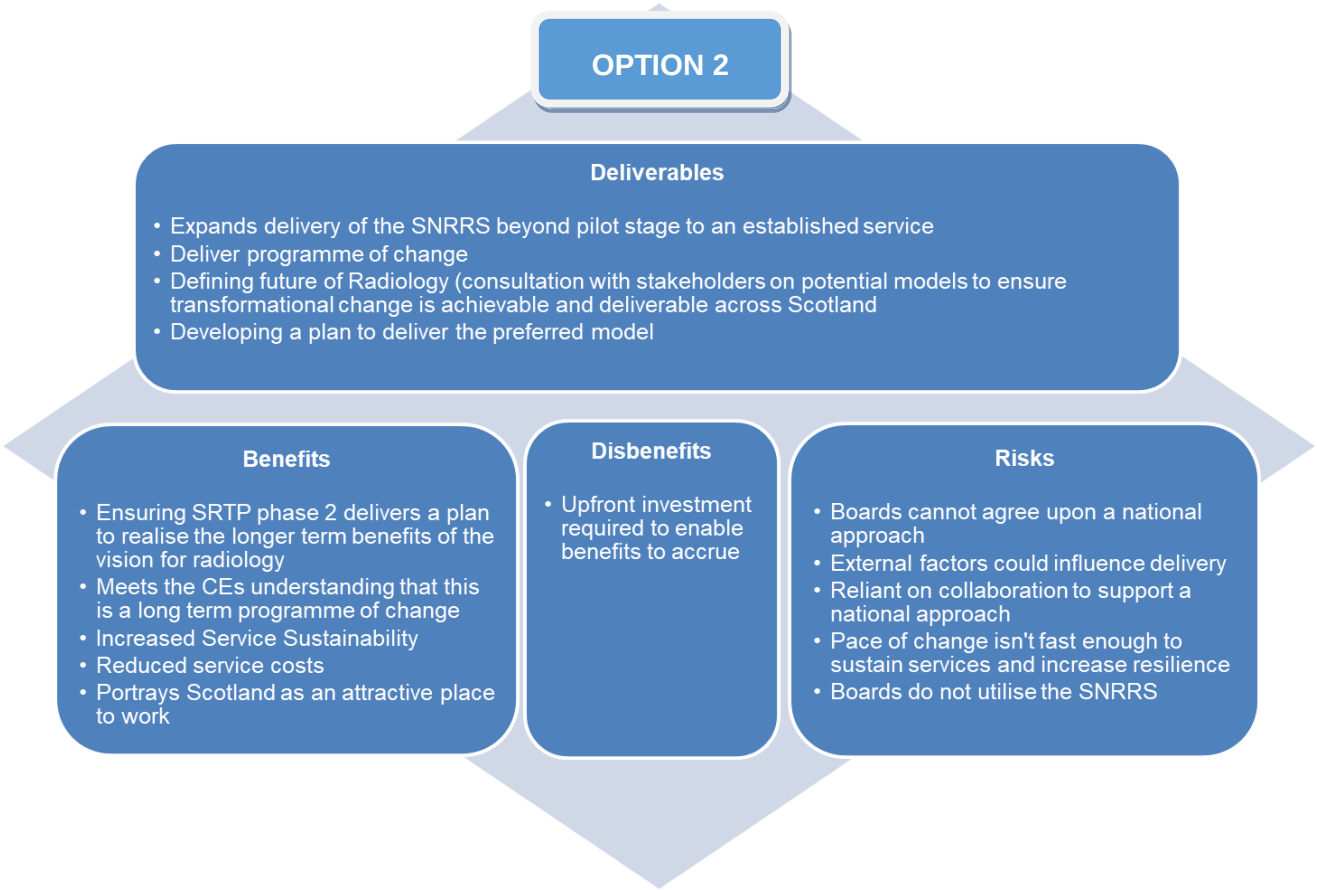


Figure 7: Option 2 - Enhancing BAU with a new programme aligned to The Model

This option describes a new programme of work that comprises a prioritised selection of projects whilst sustaining business as usual activities. This option reflects direction provided by the National Chief Executives group and has been presented at a high level to stakeholder groups in advance of developing a costed business case.

This option includes an extended Business as Usual (BAU) function beyond that detailed in option 1 – Do Minimum. BAU in this option provides a number of additional functions central to the ongoing need to maintain momentum and lead transformation, for a range of initiatives relating to radiology services and not limited to programme level activity. This option seeks to support delivery of overall benefits by building on projects started in Phase 1 and sees work continue on the longer term implementation of The Model.

The scope of projects proposed in Phase 2 includes (more detailed information can be found in Appendix 7):

- Artificial intelligence (AI)
- SNRRS Solutions
- Advanced Practice (AP)
- Workforce Planning
- NRIIP
- Clinical Decision Support (CDS)

This option will have a focus on continuing the 10 year transformation programme, maintaining the long term goal of implementing The Model in a measured way and planning for future phases of work.

This option includes a specific project to continue development of the future service model, ensuring engagement with a wide range of stakeholders. This will be a discreet planning project with regular reporting to a strategic national group such as the National Chief Executive Group to ensure any plan developed remains aligned to national objectives and strategic direction.

29. Option 3 - Enhanced BAU and new programme of work to achieve the Model in a shorter timescale

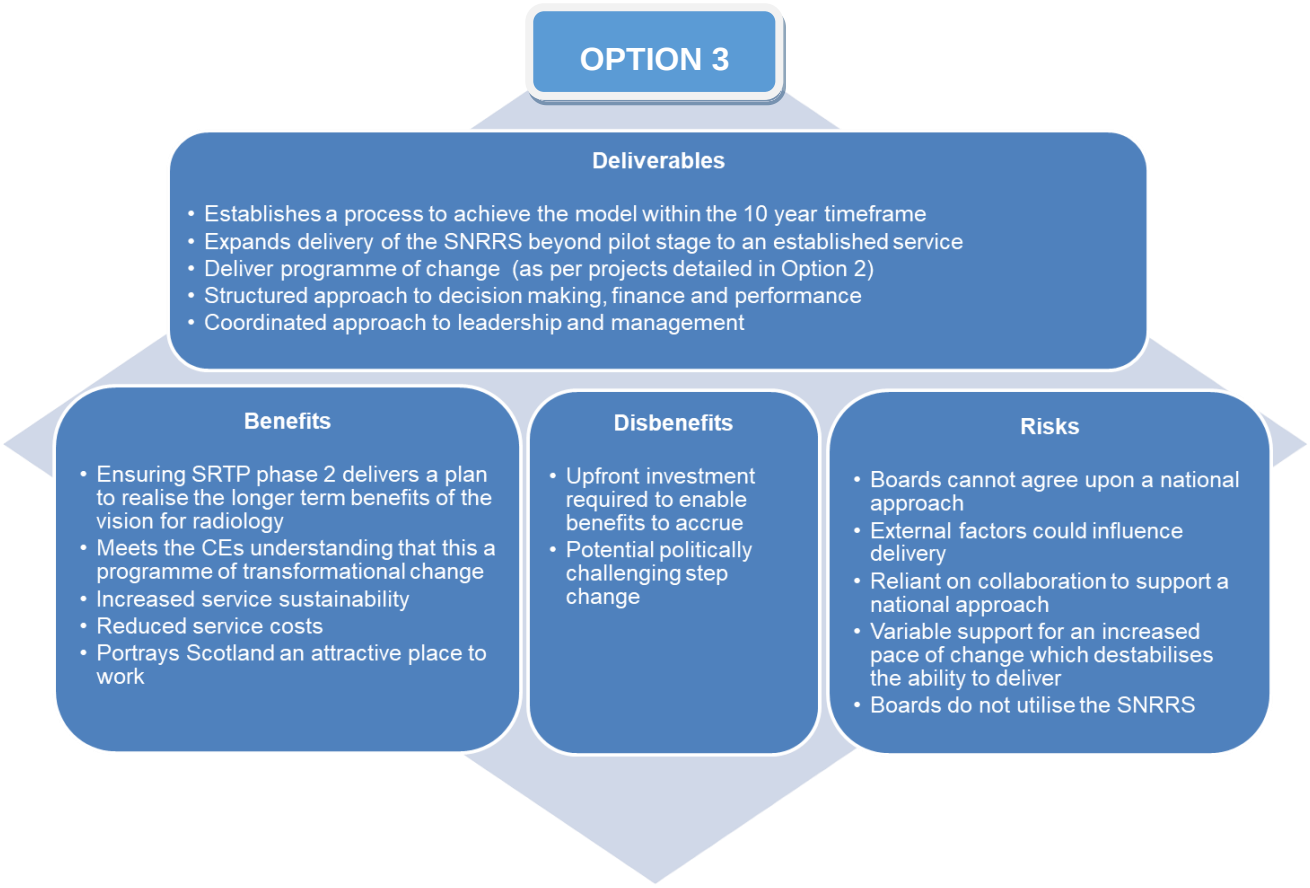


Figure 8: Option 3 – Enhanced BAU and new programme of work to develop achieve The Model in a shorter timescale

The transformation of radiology was recognised as a 10 year programme of work. This option will deliver the BAU service described in option 2, the new programme of work described in Option 2, and will schedule a series of projects aligned to achieving The Model more rapidly than in Option 2. It recognises the skills and time required to work on cultural and governance aspects of change, alongside the detailed planning which will be needed. This option elevates ambition to establishment of a national / regional team which is realistically resourced to plan and manage the changes required and increasingly deliver the benefits described in the Model.

This option would set out an implementation plan by the end of year 1 and incrementally implement the model based on that plan thereafter. The shift in emphasis in this option is towards tangible planning and a commitment to implementation of the Model, as opposed to Option 2 which is more cautious and implemented incrementaly.

Option 3 focuses on changing the authorising environment for implementation and proposes an oversight group with authority to align strategic plans across radiology and change the delivery model throughout Scotland where appropriate.

A wider programme of work will support delivery of Option 3 and with a commitment to implement the plan over the coming years, an operational delivery function (SNRRS) as well as a programme function are proposed. A leadership team will be required to drive this work forward, with both clinical and managerial resource. This team would support both the BAU and programme activity to make best use of resources and would ideally be hosted in the same organisation.

This option effectively delivers a substantive national Radiology team which is resourced to support The Model and other related initiatives, both at detailed planning stage and into implementation and establishment of BAU.

30. Benefits of long term transformational change

The following section describes the anticipated benefits to be delivered through the implementation of transformational change over a number of programme phases. The first phase was intended to deliver new products and capabilities, Phase 2 will support services to embed these new business operations to ensure benefits can be realised in the future. The benefits defined in the first SRTP business case can be found in Appendix 8.

The benefits roadmap (Appendix 9) shows the anticipated benefits from Phase 1 and 2 of the Radiology Transformation programme.

These benefits were defined by extrapolating the potential cost reductions, productivity improvements, and enablers for improved planning, over several years. The benefits are also based on a financial model that anticipated significant take-up of the Share+ system on a national basis relative to current outsourcing models. Whilst the Share+ system is potentially a useful enabler to reduce outsourcing costs, additional efforts are required to realise the benefits documented in the road map.

For example, the SNRRS Bank pilot will provide evidence and learning for how the system can be used to orchestrate cross boundary workflows on a national basis. It is postulated that evaluation of the pilot will reveal growing benefits realisation by diverting reporting work, currently sent to the private sector, to the SNRRS. Boards will be asked, where possible, to send their excess reporting to the SNRRS during SRTP Phase 2 before considering outsourcing. It is anticipated this will generate a revenue stream which will underpin the overhead costs of running the SNRRS and those overheads will reduce proportionally as volume through SNRRS increases.

Longer term benefits of transformational change can be realised by taking forward the projects documented in this business case. By extending the scope of the SNRRS to include other pools of reporters, the programme can provide a national service to all Boards, thus beginning to realise some of the benefits documented in the original business case.

It is important to note that effort has been put into establishing a cross boundary reporting capability, however, this only mitigates one issue in one part of the radiology system. Sustainability and resilience rely on the whole system working together in a responsive and cohesive way. This will take action across the other areas of the system to deal with the root causes of the current crisis which are fundamentally increasing demand and lack of capacity. These root causes are multi factorial and require systematic planning and support at all levels to implement solutions if NHSScotland is to overcome them and deliver the radiology Model.

31. Monetary Costs and Benefits of Options

In order to show the option which provides the best Value for Money (VFM), the anticipated financial impact is demonstrated by calculating a net present cost (NPC) for each option in-line with Scottish Capital Investment Manual (SCIM) guidance. The approach taken and the assumptions made in deriving the revenue cash flows are explored in the following sections.

Baseline data was derived from a thorough data capture exercise undertaken by the Radiology programme team in 2016, taken from information published from the Information and Statistics Division (ISD) Cost Book, or from the National Radiology Information and Intelligence Platform (NRIIP). To verify the data held from the data capture exercise, six Boards (representative of 77% of total NHS Scotland Radiology Service costs and examinations) were asked to refresh aspects of data, including outsourcing, insourcing and overall cost profiles of their services, to ensure that the data held was consistent with current assumptions (Appendix 10).

For the purposes of the economic appraisal, each option is presented as the incremental change from the baseline, with cost movements applied accordingly to reflect changes arising under each option.

Baseline Position

Table 2: Baseline Position

Cost Element	10 Year Cost (20/21 to 29/30) £m
Substantive Pay Costs	1692.1
Non-Substantive Pay Costs	65.5
Non Pay Costs	579.7
Total Baseline	**2,602.9**

The key assumptions to forecast the baseline position are:

1. Pay inflation of 1% per annum
2. Baseline refresh based on data return from 6 boards (77% of number of exams and costs for NHS Scotland Radiology)
3. Growth based on 3.4% per annum, largely fulfilled by outsourcing

The full list of assumptions used within the economic case can be found Appendix 10.

Cost of doing nothing

The total 10 year cost of doing nothing for NHS Scotland Radiology Services between 2020-21 and 2029-30 is forecast to be £2,681.3m. This includes the baseline cost of £2,602.9 plus additional demand forecast to cost £78.5m:

- CT £46.4m
- MR £23.0m
- Plain Film £9.0m

OPTIONS

The table below summarises the financial impact of each option, detailing the incremental cost movements over a 10 year period 2020-21 to 2029-30, with a 3.5% discount factor applied.

Table 3:Summary of financial impact of Options

	Option 0 (£m)	Option 1 (£m)	Option 2 (£m)	Option 3 (£m)
Programme Costs	1.3	8.9	11.4	21.4
Cost avoidance	0.0	-10.1	-15.0	-16.2
Net Impact	1.3	-1.2	-3.6	5.2
Net Present Cost (NPC) / Net Present Value (NPV)	1.2	-0.9	-2.5	4.7
NPC /NPV Rank	3	2	1	4

Option 2 has the most favourable net impact (£3.6m) with Programme Team / BAU costs totalling £11.4m over the 10 year period, providing a return of £15m. However, it should be noted that this forecast benefit would mitigate additional demand pressures and avoid cost (see Baseline) rather than provide Cash Releasing Efficiency Savings (CRES).

The following table provides more detail in terms of the type of cost and profile.

Table 4: Type of cost and profile

		Year 1	Year 2	Year 3	Year 4+
	Option 0	**£000**	**£000**	**£000**	**£000**
SRTP Programme	SRTP Programme Team	0.0	0.0	0.0	0.0
Business As Usual	IT	376.8	384.3	392.0	127.8
	Total Option 0	**376.8**	**384.3**	**392.0**	**127.8**
	Option 1				
SRTP Programme	SNRRS Year 1 Pilot Support & Development	273.3	94.5	97.4	0.0
	Programme Team Total	**273.3**	**94.5**	**97.4**	**0.0**
Business As Usual	SNRRS	52.0	202.4	206.9	206.9
	Data collection and analysis	186.3	191.0	195.9	195.9
	IT	527.2	518.1	481.1	435.2
	BAU Total	**765.5**	**911.5**	**883.9**	**838.0**
	Total Option 1	**1038.8**	**1006.0**	**981.3**	**838.0**
	Option 2				
SRTP Programme	Programme Support Team	336.7	343.6	350.7	0.0
	SNRRS Year 1 Pilot Support & Development	254.6	94.5	97.4	0.0
	Workforce Planning	81.4	83.8	28.8	0.0
	Clinical Decision Support	40.1	81.9	83.6	0.0
	Advanced Practice	147.6	151.2	155.0	0.0
	Artificial Intelligence	40.1	53.9	54.8	0.0
	NSS PHI / BI Team	0.0	123.7	127.4	0.0
	Programme Team Total	**900.5**	**932.7**	**897.5**	**0.0**
Business As Usual	BAU Leadership and Management	26.0	26.0	76.0	78.0
	SNRRS	30.4	181.7	187.2	154.9
	Data collection and analysis	186.3	191.0	195.9	195.9
	IT	527.2	518.1	481.1	435.2
	BAU Total	**769.9**	**916.8**	**940.2**	**864.0**
	Total Option 2	**1670.4**	**1849.5**	**1837.7**	**864.0**
	Option 3				
SRTP Programme	Strategic Development	159.4	163.1	166.9	0.0
	Programme Support Team	375.1	437.6	446.1	0.0
	SNRRS Year 1 Pilot Support & Development	292.1	133.2	137.2	0.0
	Workforce Planning	81.4	83.8	28.8	0.0
	Clinical Decision Support	53.1	81.9	83.6	0.0
	Advanced Practice	147.6	151.2	155.0	0.0
	Artificial Intelligence	53.1	53.9	54.8	0.0
	NSS PHI / BI Team	0.0	123.7	127.4	0.0
	Programme Team Total	**1161.8**	**1228.4**	**1199.6**	**0.0**
Business As Usual	BAU Leadership and Management	882.3	886.9	891.7	991.7
	SNRRS	30.4	181.7	187.2	187.2
	NRIIP	186.3	191.0	195.9	195.9
	IT	527.2	518.1	481.1	435.2
	BAU Total	**1626.2**	**1777.7**	**1755.9**	**1810.0**
	Total Option 3	**2787.9**	**3006.1**	**2955.5**	**1810.0**

A further breakdown of the roles can be seen in Appendix 11.

32. Non-Monetary Benefits

A key component of any formal appraisal process is the assessment of non-monetary or qualitative benefits that are likely to accrue from the options under consideration.

Where possible, costs and benefits should be valued in monetary or quantitative terms; however, this is not always cost-effective or practical. Very often, qualitative factors are crucial in informing the decision-making process. It is therefore important that the option appraisal process captures these non-financial costs and benefits and presents them alongside the quantitative measures.

A set of non-monetary benefits criteria to assess the options outlined in the 2017 SRTP business case were identified by the Subject Matter Expert (SME) in conjunction with radiology stakeholders to measure the relative benefits through the lifetime of the programme and may not all be achievable in each phase. These criteria are still relevant for this business case and are listed in Appendix 12 along with a weighting assigned as to their relative importance as defined by the clinical and service need.

33. Results of Non-Monetary Benefits Options Appraisal

The proposed options were assessed against the benefits criteria and results can be seen below. The assessment was undertaken by a subset of Radiology stakeholders who were asked to assess each of the options utilising the non-monetary benefits criteria.

Table 5: Weighted Options Appraisal

Benefits Criteria	Do nothing	BAU only	New Programme for Radiology & Development of New Vision	Enhanced BAU and benefits in shorter timescale
	Option 0	Option 1	Option 2	Option 3
	Weighted score	Weighted score	Weighted score	Weighted score
Sustainable and resilient service	50	115	225	234
Improved quality and access to services	60	125	205	222
Standardised, consistent approach pan Scotland	21	45	117	137
Improved wellbeing of staff	12	27	65	64
Modern fit for purpose infrastructure	16	46	86	89

TOTAL SCORE	159	358	698	746
Ranking	4	3	2	1

33.1 Interpretation of results of non-monetary benefits Options Appraisal

The new programmes proposed in Options 2 and 3 were compared with Option 0 (Do Nothing), and Option 1 (BAU Only). A subset of radiology stakeholders were asked to assess each of the options utilising the non-monetary benefits criteria. The results of the Options Appraisal can be seen in above.

As demonstrated in the table above, Option 3 scored highest in the ranking for non-monetary benefits with a clear distinction between the scores of the first two more limited options and the last two options.

Option 3 is necessarily less defined as it casts a vision further into the future and will need refinement over time as Phase 2 moves into future phases of work, as yet not described in detail. Therefore, it is likely that scoring reflects the current understanding of what a future sustainable service looks like, rather than a reliable empirical indicator of benefit.

Another factor which may have affected scoring is that there was no scoring of options around pace of change. Effectively Options 2 and 3 deliver the same benefits (The Model) with Option 3 advocating measures to secure change in a shorter period of time.

34. Identifying the Preferred Future Option

Four options have been defined based on engagement with stakeholders and guidance from chief executives on the broad structure of those options. Each option describes a possible approach to Phase 2 which reflects the current fiscal and cultural environment. Therefore, the range of options was designed around availability of funding and readiness of the service.

Option 0 – "Do Nothing"

This is the most basic option available, provides the lowest costs as it based purely on outstanding contractual costs and does not utilise SRTP Phase 1 capabilities. This is the lowest scoring option in terms of potential benefits.

Option 1 – Do Minimum

This option supports the main SRTP outputs on a limited basis and ensures completion of all project pilots. This is the second lowest scoring option in terms of potential benefits.

Option 2 – Enhanced BAU with a new programme aligned to The Model

This option commences a new programme of work for Radiology, whilst building upon the Phase 1 outputs described in Option 1. It also ensures the development of a new longer term vision and future transformation and implementation. It is the second highest scoring option in terms of potential benefits.

Option 3 – Enhanced BAU and new programme of work to achieve The Model in a shorter timescale

This option ensures progression of the new programme described in Option 2, utilisation of the BAU outputs in Option 1, whilst firmly committing to development of an implementation plan and embarking on that implementation plan during Phase 2. This scored as the highest option.

Choosing the Preferred Future Option (Appendix 13)

Following the scoring of benefits of each option, they were weighted against the relative costs of implementation. As a result, Option 3, though providing greater non-financial and financial benefits than Option 2, would require significant additional structure and therefore additional cost to support.

Option 3 would provide more benefit in a shorter timescale however anecdotal evidence to date suggests that the radiology community and Chief Executives do not currently have a consistent level of appetite to support this option at this time.

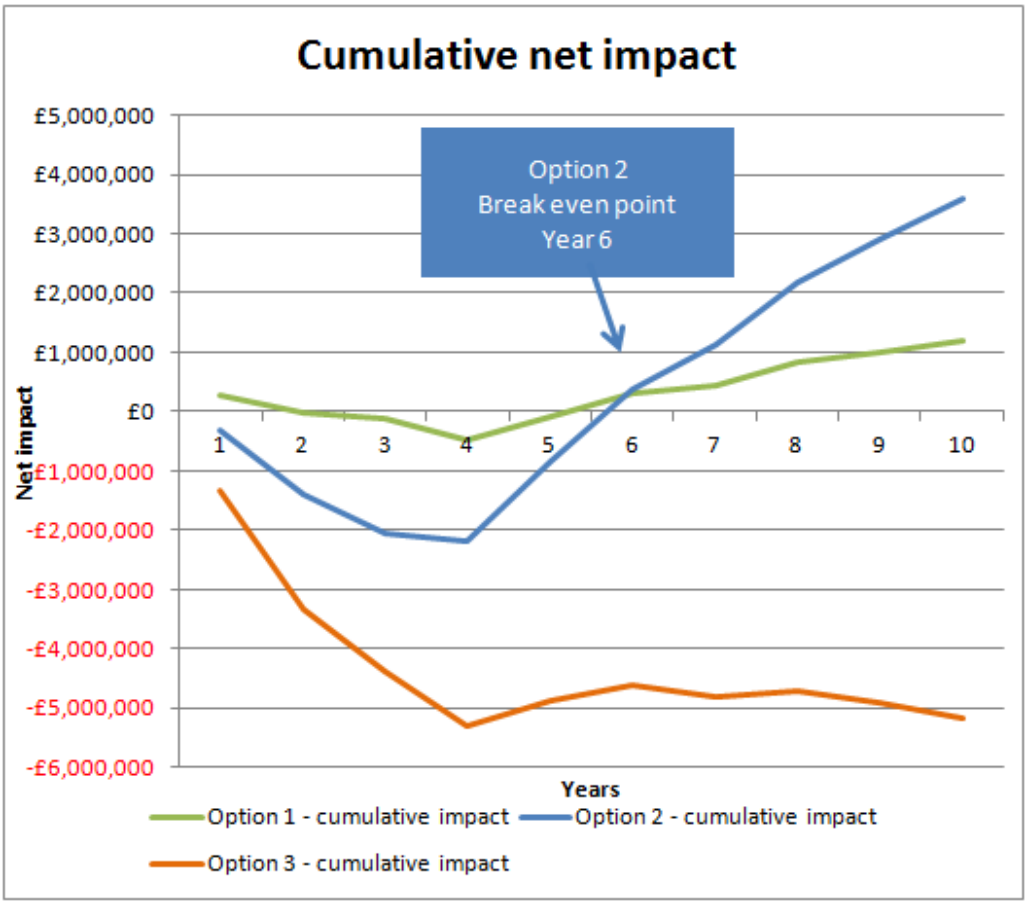
The table below shows the cost per benefit point with Option 2 ranking as the preferred option due to being the only option with a saving per benefit point.

Table 6: Cost per benefit point

	Option 0	Option 1	Option 2	Option 3
NPC / NPV £000	1,188	-900	-2,511	4,742
NPC Rank	**3**	**2**	**1**	**4**
Weighted Benefit Score	159	358	698	746
WBS Rank	**4**	**3**	**2**	**1**
Combined Cost/ Saving per Benefit Point £000	7.5	-2.5	-3.6	6.4
Overall Rank	**4**	**2**	**1**	**3**

The breakeven point is year 6 for Option 2 , as seen in figure 9 below. The Financial Model can be found in Appendix 14. It is worth noting that benefits for AI and CDS will be identified as part of work done in Phase 2 and are not yet quantified. These projects should positively affect both options 2 and 3 in the future.

Figure 9: Breakeven point for preferred future option



35. SUMMARY

Option 2 delivers projects to leverage the enablers implemented in SRTP Phase 1, with direction of travel towards the 10 year model for radiology. It is lower cost and lower risk than option 3, but does not provide the step change for transformation of radiology in Scotland within this phase of the 10 year journey.

Option 3 sets radiology on a faster course for transformation across Scotland. It provides the greatest potential non financial and financial benefits however, at much greater cost.

Option 2 is recommended as it has a lower cost with only marginally lower level of benefits.

COMMERCIAL CASE

There is currently no plan for any procurement as part of SRTP Phase 2.

Any capital funding for individual future projects will be requested through separate business cases to ensure they are appropriately informed following either the outcome of pilots still to be completed or of the shorter term scoping projects for which staffing has been planned within programme costs. This may be the case, in time for CDS or AI implementation.

FINANCIAL CASE

36. INTRODUCTION TO SRTP PHASE 2 FINANCIAL CASE

The purpose of the Financial Case is to demonstrate the affordability of the Preferred Option and set out any investment requirements.

This section will set out the financial profile and investment consequences of the Preferred Option. Given that the implementation of this Business Case impacts all territorial NHS Boards and some special NHS Boards, there has been no attempt to artificially produce a balance sheet or statement of consolidated net expenditure for Radiology services in Scotland. Instead, the financial consequences are documented below, focusing only on the relevant costs.

Board specific investment issues are not discussed in great detail but the assumption is that upfront central funding would be made available to cover initial investment requirements; that NHS Boards would pay for the recurrent costs of these based on a fair measure such as users, volumes or NRAC; that any financial benefit from reduced outsourcing would be retained at NHS Boards level. These are assumptions in absence of an agreed national investment framework for Shared Service projects and should be discussed further during implementation.

The source of up front revenue investment has not yet been confirmed. The assumption is that investment would come via Scottish Government and will be considered as part of the Spending Review. The Business Case seeks endorsement by the CEs to confirm the investment route. The SRTP aligns with many of the themes in the Health and Social Care Delivery Plan 2016 including;

- "…resource is spent where it achieves the most and focusing on prevention and early intervention"
- " …support innovation and technology capacity-building at national, regional and local levels by facilitating, encouraging and empowering those who work in health and care to identify innovation challenges and develop partnerships to deliver solutions".

37. NON-RECURRING INVESTMENT

The economic appraisal showed that the Preferred Option was more than cost neutral when compared to the 'Do Nothing' option. However, an initial upfront investment is required to enable the benefits to accrue. The table below outlines the investment required in the early years for Option 2 and recurrent revenue costs are summarised in the section below.

Table 7: Upfront cash flow of option 2 (Revenue funding)

Upfront cash flow of option 2 (Revenue funding)	Year 1 £000s	Year 2 £000s	Year 3 £000s	TOTAL £000s
Programme Support Team	336.7	343.6	350.7	**1031.0**
SNRRS Year 1 Pilot Support & Development	254.6	94.5	97.4	**446.5**
Workforce Planning	81.4	83.8	28.8	**194.0**
Clinical Decision Support	40.1	81.9	83.6	**205.6**
Advanced Practice	147.6	151.2	155.0	**453.8**
Artificial Intelligence	40.1	53.9	54.8	**148.9**
NSS PHI / BI Team	0.0	123.7	127.4	**251.0**
National Leadership	26.0	26.0	76.0	**128.0**
SNRRS	30.4	181.7	187.2	**399.4**
Data Collection & Analysis	186.3	191.0	195.9	**573.1**
IT *	527.2	518.1	481.1	**1526.4**
Total Revenue Funding	**1670.4**	**1849.4**	**1837.9**	**5357.6**

Non Recurring Costs

*It should be noted that Option 0 “Do Nothing” has a BAU IT cost as below – this is largely in relation to Radiology Workstation costs which are leased from Carestream under the existing contract. This business case assumes that workstations will be refreshed every five years but that they would continue to be procured via the existing managed technical service contract so therefore no capital investment is required under this leasing arrangement. The impact of IFRS 16 in terms of accounting treatment and funding requirements has not been considered as part of the case.

Table 8: Non Recurring Costs

Do Nothing – Option 0	Year 1 £000s	Year 2 £000s	Year 3 £000s	TOTAL £000s
IT – Revenue*	376.8	384.3	392.0	1153.1

Thus, upfront revenue investment of circa £5.4m will be required over the initial 3 year period (with £1.2m relating to IT / Infrastructure costs as per the 'Do Nothing' Option). Any capital funding for individual future projects will be requested through separate business cases to ensure they are appropriately informed following either the outcome of pilots still to be completed or of the shorter term scoping projects for which staffing has been planned within programme costs. This may be the case, in time for CDS or AI implementation.

38. Recurrent Revenue Impact

Costs

After the initial investment in the SRTP Programme and creation / enhancement of the required infrastructure to support and deliver transformational change, the preferred option results in a recurring revenue cost of £0.9m as below:

Table 9: Recurrent costs of option 2

Recurrent costs of option 2	Year 4 onwards £000s
National Leadership	78.0
SNRRS	154.9
Data Collection & Analysis	195.9
IT	435.2
Total	**864.0**

The assumption is that NHS Boards would contribute towards these annual running costs using an appropriate and fair method such as NRAC or volumes.

Savings / Cost Avoidance

It is anticipated the initial investment and ongoing requirement of £0.9m in the service will result in net savings, mainly through a reduction in the level of outsourcing required resulting in an avoidance of cost.

Table 10: Option 2 Anticipated Savings Summary

Option 2 Summary *	10 Years £m
Option 2 Gross Saving / Cost Avoidance	(15.0)
Option 2 – Programme & BAU Investment	11.4
Option 2 Net Revenue Saving	(3.6)

Allowing time for the infrastructure to be put into place, it is estimated that the savings would gradually increase over an initial 4 year period to annual cost avoidance of £2m from year 5 onwards. From year 4 onwards, the estimated cost avoidance is greater than the required investment in year resulting in a favourable net impact.

Table 11: Option 2 Anticipated Savings Summary

Items	Year 1 £m	Year 2 £m	Year 3 £m	Year 4 £m	Year 5 onwards £m	10 Year Total £m
Option 2 Gross Saving / Cost Avoidance	(1.4)	(0.8)	(1.2)	(0.7)	(2.0)	(15.0)
Option 2 – Programme & BAU Investment	1.7	1.8	1.8	0.9	0.9	11.4
Option 2 Net Revenue Saving	0.3	1.1	0.7	0.2	(0.9)	(3.6)

Regarding the annual increase in demand, savings for Option 2 have been calculated based on a number of initiatives that would result in a reduction in the amount of reports outsourced to private providers. Due to CTs being the most expensive exam to outsource, additional resource will focus on this initially before moving to MRI and finally Plain Film.

Note that it was assumed that it would take 5 years to realise the full benefits of each. These initiatives include:

- Staff increasing to 11PAs/wk – assumption that in boards where on average, WTE consultants work less than 11PAs/wk, 50% would take up the opportunity for additional work paid at the new Consultant Bank Rate which compares favourably to outsourcing rates

- Retiree reporting – assumption that 50% of the average 10 retirees/year will work 2 PAs/week for 2 years after retirement paid at the new Consultant Bank Rate which compares favourably to outsourcing rates
- Reporting from in-sourcing/locums – assumption that on average 1/3 of the annual average increase in demand will be reported at double the standard hourly rate which compares favourably to outsourcing rate
- Reporting from newly hired consultants – assumption that 50% of the annual additional demand will be undertaken by newly hired consultants
- Reporting radiographers – assumption that additional reporting radiographers will be hired to increase the capacity of plain film reporting to 20% of all plain films (within their scope of practice). This will in turn create capacity for radiologists to report on CT/MRI
- It was assumed that any new staff will report for 80% of the week. In reality, this will allow current staff to increase the number of reporting sessions and reduce the number of other duties as these will be spread across all consultants. E.g. duty radiologist
- It was also assumed that overall, new staff would be hired in line with the Scottish Government projections of newly qualified consultants remaining in Scotland (80%) and taking retirees into account.

The savings have not been modelled at NHS Board level due to the number of local factors that could influence the values. This means that the net financial impact on a Board by Board basis is not presented.

Growth in Demand

The net saving under option 2 will partially offset a small proportion of the overall cost pressure forecast for NHS Scotland Radiology Services between 2020-21 and 2029-30 of £78.5m which is largely being driven by a growth in demand (estimated to be 3.4% per annum).

The Model provides a platform to improve the resilience of the service and capitalise fully on the potential financial gain from any additional resource that can be put into the system. However, The Model, in itself, does not solve the fundamental issue that demand for radiology services has outstripped supply of sufficiently qualified staff and hence why the cost of the service has increased by having to pay a premium for the reporting of an increasing amount of images.

The growth in demand and costs reflects the assumption that increase in demand is outstripping increase in capacity for the reporting of images.

39. SUMMARY

Overall, approving Option 2 should result in net savings as compared to the 'Do Nothing' option. However, a request for upfront investment is required to achieve the projected avoidance of cost. It is proposed that the on-going costs would be funded by Boards based on a fair measure to be agreed. Likewise, the projected savings from the programme would be retained at Board level but this has not been forecast Board by Board in the absence of an agreed National Framework.

This investment creates and enhances the required infrastructure and platform to deliver additional savings through further transformational projects and activities (which would be assessed through separate business cases).

The revenue investment required over the 10 year period is:

Table 12: Funding Request

Investment	Year 1 £000s	Year 2 £000s	Year 3 £000s	Year 4 Onwards £000s	Year 1 – Year 10 Total £000s
Revenue	**1,670**	**1,849**	**1838**	**864**	**11,405**

The investment requirement is significantly higher in the first 3 years then reduces thereafter once the infrastructure has been established and developed with a net saving / cost avoidance from year 4 onwards.

The source of up front revenue investment has not yet been confirmed but the assumption is that investment would come via Scottish Government and will be considered as part of the Spending Review. It is proposed that the on-going costs and efficiencies would be accounted for at a Board level with the basis still to be agreed. The Business Case seeks endorsement by the CEs to confirm the investment route.

This investment should produce average annual savings of £0.9m from year 4 onwards with an overall net saving of £3.6m over the 10 year period

MANAGEMENT CASE

This section sets out how the SRTP Phase 2 Business Case will be managed in terms of:

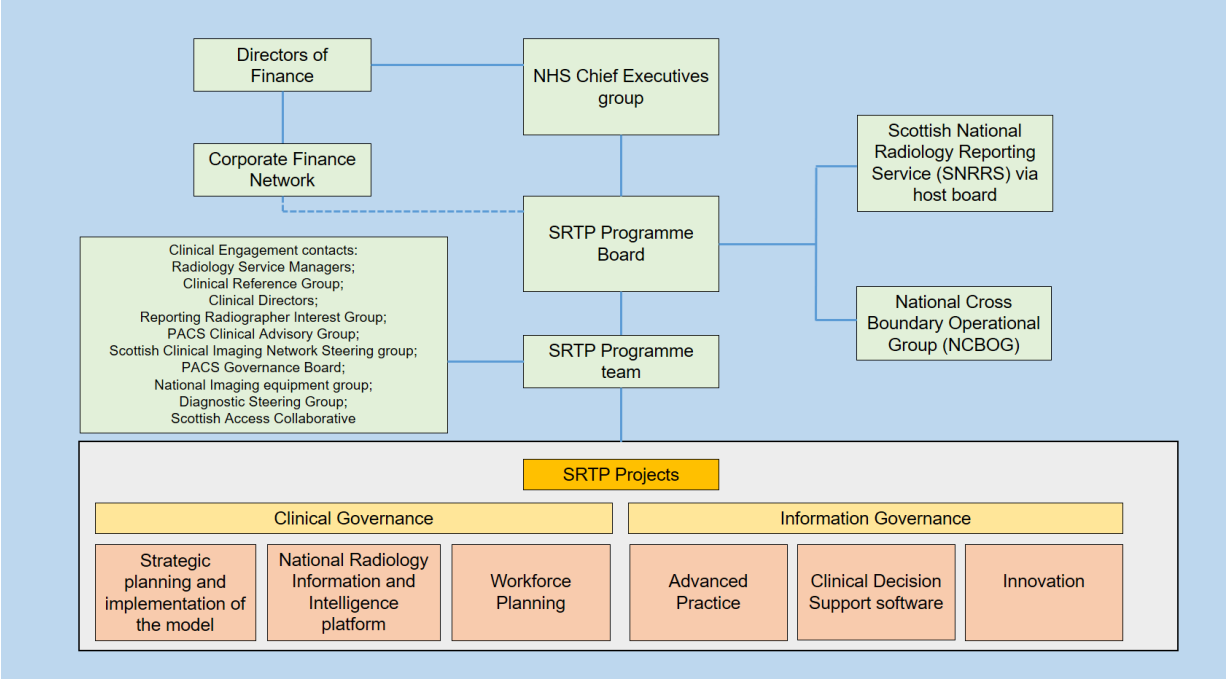
- The team required to deliver the programme
- Governance arrangements, along with respective roles and responsibilities
- Implementation plan and key areas of focus
- Strategies for the management of risks and changes
- Benefits Realisation
- Approach to programme evaluation

40. PROGRAMME IMPLEMENTATION STRATEGY

This section sets out the arrangements that would be put in place to implement the SRTP Phase 2 Business Case.

The team will adopt best practice programme and project management including governance and reporting arrangements.

Figure 1 below shows the overall governance structure of the programme SRTP Governance Structure (Appendix 3)



The governance, programme roles and responsibilities for the implementation of Phase 2 can be found in the table below.

Table 13: Roles and Responsibilities

Roles	Responsibilities
Governance Roles	
NHS Board Chief Executives	The SRTP Programme Board is accountable to NHS Board Chief Executives.
SRTP Programme Board	Responsible for agreeing and owning the vision for transformation of Radiology Services • ensure that the programme successfully delivers The Model for Radiology Services in Scotland • supports the programme implementation team in delivering The Model by providing direction, clinical expertise and a route • supports the implementation of a national approach • provides continued commitment and endorsement in support of the Programme Director at programme milestones • endorse, advise and support the Programme Director • confirms successful delivery and sign-off at the closure of the programme
Senior Responsible Owner	Overall decision maker for the programme. Owns the vision of the SRTP Phase 2 Business Case.
Programme Delivery Roles (yr 1-3)	
Programme Director	Accountable for the programme, together with personal responsibility for ensuring that it meets its objectives and realises the expected benefits from implementing the preferred option. The Programme Director: • delivers the vision of the SRTP Programme, is 'champion', providing clear leadership and direction throughout its life • provides overall direction and leadership for the delivery and implementation of the preferred option • is accountable for the programme's governance arrangements by ensuring the programme, including its investment, is established and managed according to appropriate requirements and quality • manages the interface with key senior stakeholders and ensuring that interfaces and communications with all stakeholders are effective

	• maintains the alignment of the programme to the NHS Scotland strategic direction • supports the Programme Manager • determines and manages risks to the programme • manages the programme budget, including risk allowance • secures relevant approval for the strategy and delivery plan
Medical Director/ Subject Matter Expert	Responsible for providing service expertise. The Medical Director/ Subject Matter Expert • provide visionary, strategic and technical leadership • use their medical knowledge to engage and work with stakeholders at a senior level within NHS Scotland • responsible for effective and timely communication with identified clinical stakeholders to secure buy-in and ensure a service focus • responsible for assisting with risk and issue identification, agreeing any mitigation or corrective actions for resolution, and effective and timely communications of programme risks and issues • responsible for prioritising and progressing actions within the programme • assessment of the future commercial market place
Programme Manager	Responsible for leading the development of the business case. The Programme Manager: • manages the programme on a day-to-day basis • plans and designs the programme and proactively monitors its overall progress, resolving issues and initiating corrective action • defines the programme's governance framework • prepares and updates the delivery plan • delivers effective coordination of the projects and their interdependencies • ensures the maximum efficiency in the allocation of resources to deliver the preferred option • ensures the deliverables meet the programme requirements and are to the appropriate quality, on time and within budget • line manages the associated Project Manager(s)
Project Manager	Responsible for ensuring the projects are completed within the specified tolerances of time, cost, quality, scope, risk and benefits. The Project Manager: • prepares baseline project management documentation

	• leads and manages the project team • manages the production of required products, with responsibility for overall progress and use of resources and initiating corrective action where necessary • line manages the associated Project Support Officer(s)
Project Support Officer	Responsible for supporting the programme and projects.The Project Support Officer: • establishes document control procedures • updates project documentation such as project plans, risk and issue registers • supports workshop sessions • acts as secretariat for Project and Programme Board(s) and working groups • coordinates project documentation prior to publication • provides support with the creation / development of project communication documentation (e.g. newsletters) as needed • supports the project manager in the day to day running of the project. They will also be allocated specific roles during the project lifecycle.
Clinical leads, Radiographer lead, Sonographer lead, Radiographer	These part time roles will provide support to specific projects within SRTP Phase 2 within their area of expertise.
Workforce Lead	Responsible for specialist HR and workforce guidance The Workforce Lead: • advises on workforce/HR policy and procedure • provides workforce/HR expertise and guidance • supports engagement and consultation process with Staffside and appropriate professional bodies • advises on the challenges with regards to the local application of national policies to ensure consistency
BAU Roles	
Executive Lead	Once business as usual has been established, this role is accountable for ensuring the smooth running of the SNRRS and that it meets the agreed KPIs. The Executive Lead:

	• is accountable for the SNRRS service • is responsible for the continuous growth of the service in line with the needs of the NHS • ensures that KPIs are met and reported to relevant forums • establishes strong links with each of the health boards and actively encourages use of the SNRRS over outsourcing providers
Service Manager	This part time role will provide oversight of all workflow activities.
Workflow Manager	Owns and manages the workflow process for the SNRRS Bank. The Workflow Manager: • is responsible for designing and developing the workflow process for all uses of the SNRRS • manages the workflow process between the host board, the reporters and the donating boards • works collaboratively with boards to manage risks and resolve issues • provides the direct link between the supplier, the reporters, boards and host board • will develop the business as usual processes for SNRRS
Workflow Administrator	The Workflow administrator will be responsible for: • providing administrative support to the Workflow Managers • monitoring the National Reporting application on a daily basis Role to be further developed as part of the pilot
Data collection and analysis	Various roles responsible for the development/application of the Datamart and Dashboard
IT support	Responsible for the ongoing support required for the IT connectivity delivered in SRTP Phase 1

A detailed breakdown of the proposed team is included in Appendix 11 and detail of the funding requirement is outlined in the Economic Case.

40.1 Implementation Plan

The economic case and strategic case reflect timescales, people and financial resources required to support implementation of the SRTP Phase 2 Business Case.

A high level timeline has been developed (Appendix 15), which highlights the phasing of activities over the next three years. The timeline is subject to change dependent upon the CEs approval.

40.2 Key areas of focus within the SRTP Phase 2 Business Case

Workforce planning and Information utilisation

This business case proposes establishment of a small business unit as part of the Phase 2 BAU team, which will work with radiology data to suit the needs of workforce planning, performance and transformation. The technical elements will sit with NSS Business Intelligence (support dataset and maintain datamart and dashboards).

Scottish National Radiology Reporting Service (SNRRS)

Cross boundary reporting is one way of introducing more flexibility within the system. The SNRRS is an embryonic national service model which supports clinical image reporting across the country. It has been developed as part of testing the new IT connectivity through the Reporting Radiographer and home working pilots and includes governance arrangements and procedures to support safe cross boundary flows of work.

Phase 2 proposes a range of new ways of working which will require testing and embedding into the established SNRRS. Business as usual functions are likely to be managed through a host board if the SNRRS Bank pilot is successful and approval is gained. The Golden Jubilee National Hospital is the host board for the pilot in Phase 1 as described earlier.

Technological Innovation

Clinical Decision Support (CDS) and Artificial Intelligence (AI) are the main technological innovations on the horizon for radiology.

Clinical Decision Support – CDS has been the subject of an ongoing project in Phase 1 and is nearing pilot stage. Limited resource is being sought to support running that pilot in year 1 of Phase 2. Assessment of further implementation will be based on the evaluation of this pilot and will require a separate business case, once technical implications and cost benefits are better understood.

It is proposed that the CDS steering group continue under the auspices of Phase 2 governance as a subgroup, much as it has during Phase 1.

Artificial intelligence – early scoping work carried out by the Scottish Health Technologies Group (SHTG) (Appendix 2) indicates that assessment of priorities and future pilot work will best be guided by the established engagement and approval groups in radiology, but working in partnership with expert groups already working in this space (“i-caird” / stroke research etc).

A period of detailed scoping and engagement will be required to assess which innovations would be of benefit to roll out across Scotland and to plan an implementation approach with appropriate partners across the system (Digital Health Institute (DHI), etc.). The role of the team in Phase 2 will be to coordinate input and propose an implementation plan and national approach. Ownership of

this work could be within an organisation such as the DHI working closely with a specialist radiology group, however it is proposed that options are considered as part of year 1 work.

Following the scoping phase, a separate business case for funding to support pilots or rollout will be required.

41. Risk Management Strategy

The Risk Management Strategy to support the SRTP Phase 2 Business Case has been developed as part of Phase 1 and can be found in Appendix 16 .

There are three key roles in the risk management process and these are summarised in the table below. It is anticipated that risks will also be identified and mitigation will be supported by the wider SRTP team and project groups. The responsibility for managing the risk register will be agreed by the SRTP Phase 2 team.

Table 14: Risk Management Roles

Area	Description	How Assessed
Risk Management Lead	Manages the process for identifying, reporting and managing the risks. Escalation point for programme risks.	Programme Director, Medical Director, SRO, SRTP Board
Risk Manager	Brings together key risk owners to co-ordinate the identification and assessment of risks. Maintaining the risk register on a day to day basis. Escalation point for project risks.	Programme Manager
Risk Owner	Responsible for developing and implementing risk mitigation measures for the risks relating to the Programme.	Project Manager

42. Change Management Strategy

The Change Management Strategy to support the SRTP Phase 2 Business Case has been developed as part of Phase 1 and can be found in Appendix 17.

The Programme Director is responsible for change management and is accountable to the SRTP Programme Board.

Change management includes managing the process for identifying changes, collating and storing documentation to support the change, maintaining the change register and arranging the relevant reviews and next steps.

43. Benefits Realisation

A full benefits realisation strategy was developed and documented in Phase 1 of the SRTP. The strategy outlines the approach to Benefits Management and Benefits Realisation, the governance expectations, how benefits will be prioritised and measured, and the roles and responsibilities of those involved in realising the benefits.

This strategy defines the process for identifying, quantifying, documenting and tracking benefits, the categories to be used and the governance arrangements.

The strategy will enable the SRTP Programme Board to ensure that:

- A Benefits Management Plan is established
- The benefits of the SRTP are accessible and understood by all stakeholders and reliable, up to date information is available
- Full consideration is taken of the impact on the benefits required to be realised, before key decisions are taken by the SRTP Programme Board
- There is clarity around roles and responsibilities
- There are processes in place to review and update expected benefits at key stages
- There is a framework in place to assure NHS Chief Executives of the ability to deliver the benefits expected

Benefits will be measured and monitored as SRTP Phase 1 outputs are embedded into business as usual activities. The benefits fall under four categories:

Table 15: Benefit Categories

Benefit Category	Description
Financial Benefits	These benefits are defined and measured in financial terms, such as cost savings, cost avoidance, revenue and profit
Non Financial Benefits	These benefits are defined and measured in non-financial terms and may include changes in key performance indicators or customer satisfaction survey
Quantitative Benefits	These benefits can be quantified but not easily in financial terms

Qualitative Benefits	These benefits cannot easily be quantified but are equally as relevant

All project-level outputs have benefits profiles documented in the SRTP Phase 1 Benefits Realisation Matrix (Appendix 8).

44. Programme Evaluation

Benefits which were identified as part of Phase 1 work, will be realised incrementally as boards utilise the SNRRS and outputs from Phase 1. The National Radiology Information and Intelligence Platform (NRIIP) as a product of Phase 1 will provide the functionality to assess data which will enable benefits realisation activities. Assessment of programme objectives will be conducted through the programme closure report to ensure all objectives were met and lessons learned documented.

Evaluation of the programme will be reported back through appropriate governance including the Programme Board and Chief Executives, but this is not an exhaustive list.

APPENDICES

Rationale

Current service is unsustainable

The Vision

A collegiate solution

Ability for radiology staff to work across Scotland

Agreed national:
- HR contracts
- clinical governance
- QA

Integrated compatible IT Systems supporting:
- image acquisition, transfer and requests
- data sets and definitions
- transfer of reporting
- agreed patient pathways and protocols
- workforce optimisation
- de-coupling of image capture and reporting
- separation of scheduled and unscheduled activity for both image acquisition and reporting

Objectives

Sustainability of service

Increased resilience of Service

National Radiology Model

Benefits

Cross boundary reporting

Improved waiting time performance

Co-ordinated approach to out of hours

Support for remote and rural boards in hours reporting

National approach to radiology reporting

More effective use of the workforce

Ability to identify demand, capacity and equipment

Reduced shortfall in reporting capacity

Achieving the recognised standard for radiology reporting

Improved quality of service planning by availability of comparable data

Flexibility to adapt to emerging clinical service change

Increased throughput and quality due to de-coupling of scheduled/ unscheduled reporting of images

Sustain image acquisition close to patient

Sustain expert radiology opinion to local clinicians

Cost avoidance

Cost savings

Virtual rationalisation

Constraints/ Dependencies/Risks

Constraints/Dependencies

Agreed data sets

Agreed data definitions

National RIS functionality

Ability to report cross boundary

Production of national:
- HR policy
- clinical governance model
- QA model
- integrated comparable IT system
- patient pathways/protocols

Risks

Unsustainable radiology services

Mismatch between demand and capacity

Inability to meet waiting times

Increased costs of private sector for reporting

Recruitment, retention issues

Delayed diagnosis leading to poor patient outcomes

Radiology Model Investment

	(£m)
Capital	0.67
Revenue	2.45
Non-recurring	
TOTAL	3.12

Desired Outcomes

Ensure continuing good outcomes for patients. Sustainable, equitable, access to robust, timely services

Appendix 2. Scottish Health Technologies Group report on Artificial Intelligence

External document prepared by SHTG, part of Health Informatics Scotland (HIS).

Topic exploration

Topic explorations are designed to provide a high-level briefing on topics. The main objectives of this briefing paper are to:

1. Inform discussions
2. Determine the quantity and type of evidence available on a topic
3. Assess whether further review work is required

Topic:	
Date/ Version:	**25/07/19 V3.0**
Topic exploration undertaken by:	Rohan Deogaonkar

1.The decision problem

Describe the decision problem that the topic referrer is seeking to address as you understand it.

Technological advances in computing power and data storage have led to the increased use of artificial intelligence (AI) for purposes of image analysis. The field of radiology is expected to benefit immensely from recent developments in AI, ranging from traditional machine learning algorithms to more advanced deep learning systems which employ neural networks. The implementation of AI in radiology over the next decade will significantly improve the quality, value, and depth of radiology's contribution to patient care and population health, and will revolutionize radiologists' workflows. It is anticipated that AI applications will lead to – workforce optimisation through automation of tasks; improved workflow efficiency through computer aided detection and diagnosis; better disease characterisation through imaging biomarkers; developments in radiomics; and strengthening of data protection.

Given the challenges around recruiting qualified radiology professionals within the NHS, it is imperative that technological solutions which improve existing workforce capacity and exploit the diagnostic/prognostic power of imaging are integrated within workflows. The range of radiology activities impacted upon by AI is large and some applications/technologies are further along the development pathway whilst others are still at their infancy. As part of horizon scanning, there is a need to distinguish between applications which are fit for deployment versus those still in the early research phase.

Provide concise information about the patient population and technology of interest.

Population

Patient condition/disease of interest. Include any information on demographics or other criteria that help define this group e.g. care setting. Basic epidemiology data can be included from ISD.

Potentially any patient undergoing a CT/MRI/ultrasound scan.

Intervention

Describe the technology or intervention to be investigated. Detailed descriptions are not needed unless the intervention is particularly complex or likely to be unfamiliar to colleagues in ERC. If a medical device or procedure, consider at what stage of development the technology is at in relation to the IDEAL Framework. If possible, give an idea of where in a patient pathway, the intervention is intended for use.

AI is a broad term which in radiology refers to methods which excel at automatically recognizing complex patterns in imaging data and providing quantitative, rather than qualitative, assessments of radiographic characteristics. Data aggregation is a key property of all AI systems, as the aim is to transform highly heterogeneous data into data that is homogenous and has an inferred structure. Traditional machine learning (ML) identifies patterns that are present in training sets. In those traditional approaches, it is necessary to compute "features" that are thought to be important factors, which are then used as inputs to train systems to classify images as positive or negative. ML algorithms evolve as they are exposed to more data. Nearly all ML algorithms used to analyse the pixel data of radiology examinations ''learn'' to give a specific answer by evaluating a large number of exams that have been hand-labelled. This highlights two challenges: 1) adequate labeling of key imaging findings (tedious and time-consuming process); 2) appropriate definition of ground truth (e.g. radiology report, pathology report, clinical outcomes).

Deep Learning (DL) refers to a subfield of representation learning which relies on multiple processing layers, which does not require a human to identify and compute the critical features. Instead, during training, DL algorithms "learn" discriminatory features that best predict the outcomes. This means that the amount of human effort required to train DL systems is less and may also lead to the discovery of important new features that were not anticipated. DL networks have many layers; most systems now have 30 to 150 layers, compared with traditional artificial neural networks which would fail if they had more than about 3 layers. The various layers in these algorithms are used to detect features ranging from simple (e.g. lines, edges, textures, intensity) to complex (e.g. shapes, lesions, or whole organs) in a hierarchical structure. When images are the input, it is typical to use convolutions as input layers. In many cases, one or two convolutional layers will be followed by a pooling layer. A popular pooling function is max pooling which takes the maximum value of the convolutional layer for the region of the image. In this way, max pooling layers identify the most predictive feature within the sampled region and reduces the resolution and memory requirements of the image. It is common to have several groups of convolution and pooling. Numerous network architectures have been developed for general purpose image classification (eg, VGG16, Inception, ResNets). These networks have been typically designed to perform image classification on very large and diverse datasets (eg, ImageNet). Training a neural network involves prompting the algorithm to guess, compare, change weights for a better guess, and compare again, for thousands or millions of

incrementally better guesses, finally reaching a point where more guesses either cease to improve results, or the change in improvement becomes too small to matter.

To be adopted in clinical practice, AI applications must address unmet needs or improve on existing solutions. Clinical AI applications may be conceived as diagnostic tests inserted into existing clinical pathways. AI applications can offer an alternative to current triage (e.g. triage of unread x-rays based on the highest probability of disease determined by an AI algorithm); could replace radiologist input completely (e.g. estimation of bone age by AI software found to consistently provide better performance than a radiologist); or could be an add-on to workflow (e.g. otherwise time consuming activities for patient subgroups best left to ML algorithms).

Alternatively, AI in clinical practice can also be conceptualised in terms of disease characterisation, with applications specifically being used for detection (e.g. identify anomalies within images) or segmentation (defining boundary organs) or classification (e.g. presence of pulmonary embolism in CT scan).

A third way to approach clinical applications is based on classes of use cases. Some of the commonly conceived use cases are: Sorting of normal images from abnormal images; deep-learning based computer aided detection (CAD); Workflow optimization; Quality assurance; Grading and classification; Natural language processing (NLP) and knowledge management.

Radiographic images, coupled with data on clinical outcomes, have led to the emergence and rapid expansion of radiomics. Radiomics is a field of study in which high-throughput data is extracted and large amounts of advanced quantitative imaging features are analysed from medical images. Signals buried within images can be used to augment the traditional radiologic interpretation and gain insights into the structure, behaviour and therapeutic response profile of a disease. Early radiomics studies were largely focused on mining images for a large set of predefined engineered features that describe radiographic aspects of shape, intensity and texture. More recently, radiomics studies have incorporated deep learning algorithms which feature representations automatically from example images and can account for both intra-and intertumour heterogeneity. This has motivated an exploration of the clinical utility of AI generated biomarkers based on standard- of-care radiographic images, and is particularly important when evaluating treatment response in the setting of metastatic disease. To increase the efficiency and fidelity of a radiomics technique, one has to understand which structural or metabolic imaging biomarkers are the best surrogate end points for disease progression and outcomes. Some of the better developed radiomic methodologies exist in the realm of lung cancer diagnosis and prognostication, as well as radiation therapy planning.

Commercializing an AI image analysis product requires understanding the clinical need, or use case; the business case; and new methods of product regulation, verification, and monitoring. There are existing examples of automated segmentation and CAD tools that are not used in clinical practice despite decades of refinement. To overcome barriers to clinical adoption, AI image analysis products must be integrated seamlessly in the clinical workflow and be able to interface with picture archiving and communication system (PACS) software, which may otherwise act as a gatekeeper in the value chain. Further, although AI technology is meant to be broadly applicable, each modality of imaging data (e.g. radiographs, ultrasound, CT, MRI) and disease area will require development of specific strategies for optimal performance. Optimal neural network design and training parameters can vary greatly between data types.

Comparator(s)

Describe the most relevant alternative(s) to the technology being investigated – this should include the current comparator in Scotland. These can be extracted from the topic referral form or from literature identified during the topic exploration. If possible verify that the comparator suggested by the referrer is

relevant for Scotland.

Generally speaking, the comparators are existing clinical workflows which involve manual/non-automated interpretation and verification of radiographic images. In the absence of AI based tools/platforms, radiology will continue to be limited to trained physicians visually assessing medical images for the detection, characterization and monitoring of diseases. More specific comparator(s) can be identified based on the particular AI application or use case being considered.

Outcome(s)

What are the key outcomes of interest to the topic referrer? Do these include appropriate clinical and patient outcomes?

Contingent on use case.

2.Description of evidence available

Briefly describe the best quality evidence available on this topic and give an indication of volume and currency of the evidence. Include mention of any relevant work undertaken previously by HIS or SHTG. A comprehensive literature review is not required, only an indication of the best quality available evidence for further consideration.

There is a fairly large and recent literature base in relation to AI in radiology, but individual studies are largely restricted to proof of concept, validation, and retrospective cohort analysis. Reviews would appear to be focused either on the specific computational method employed or a particular application/ use case. These are listed in the secondary literature section below. No systematic reviews or meta-analyses were identified.

In Scotland, research activity in this area is spearheaded by the *SINAPSE* consortium of universities. More recently, the *iCAIRD* consortium which is a pan-Scotland collaboration of 15 partners from academia, the NHS, and industry has successfully secured funding but details on specific activities are scarce. Some commercial and clinical practice applications are available and have been listed below.

3.Ongoing work in the UK and EUnetHTA

Note ongoing research or projects (if aware of any) on this topic at HIS, NICE, the NHS in Scotland and EUnetHTA.

No ongoing evaluations or HTA's being undertaken by HIS, NICE, NHS or EUnetHTA.

4.Brief literature search results

The following sources are suggestions for topic exploration searches. Note that it may not be necessary to search all sources for every topic.

Resource	Results
Previous HIS projects on this topic ***Check if any team within HIS has conducted/ is conducting work on this topic.***	None
UK guidelines and guidance	
SIGN	None
NICE ***Check for guidelines, technology appraisals, diagnostics, interventional procedures, and medical technologies guidance***	NICE website searched using terms artificial intelligence, machine learning, radiology A medtech innovation briefing was found for VIDAvision for lung volume analysis in emphysema. VIDAvision is a suite of imaging analysis software applications that provides quantitative CT (QCT) lung volume analysis from CT datasets. https://www.nice.org.uk/advice/mib148 A medtech innovation briefing was found for automated radiation dose monitoring software, describing 8 software technologies that analyse patient-level radiation doses from different imaging modalities and examination type. https://www.nice.org.uk/advice/mib127
Guidelines International Network (GIN) ***Check for UK guidelines e.g. Royal College Physicians***	Did not check

Secondary literature and economic evaluations	
ECRI ***Logins are available from KMT. Use the search option to identify relevant content. Evidence reports and special HTA reports are the most applicable products.***	None
Cochrane library ***Check for Cochrane reviews***	No radiology relevant reviews identified with search terms artificial intelligence, machine learning, and neural networks.
HTA database ***Limit results to published HTAs using the options on the right of the screen.***	None
Medline ***Check for systematic reviews, meta-analyses, economic evaluations. Use the SIGN search filters for these study designs. Do***	Lundervold (2019) reviews application of deep learning specifically in MRI. Overview of how deep learning has been applied to the entire MRI processing chain, from acquisition to image retrieval, from segmentation to disease prediction. https://www.sciencedirect.com/science/article/pii/S0939388918301181 Fazal et al (2018) – A review of computer aided detection (CADe) of suspicious lesions in mammography; and CAD of lesions & nodules in lung cancer. As well as challenges of CADe. https://www.sciencedirect.com/science/article/abs/pii/S0720048X18302250

not add date limits.	Although not a review, Shaikh et al (2018) contains useful references on the applications for clinical radiomics (e.g. image interpretation, direct image analysis, precision medicine) and defines a strategy for translation of radiomics techniques to commercially implementable enterprise solutions. Part 1 - https://www.ncbi.nlm.nih.gov/pubmed/29366600 ; Part 2 -https://www.sciencedirect.com/science/article/pii/S1546144017316137 LItjens et al (2017) surveyed over 300 publications (2012 -17) on the use of deep learning for image classification, object detection, segmentation, registration, and other tasks. Concise overviews are provided of studies per application area: neuro, retinal, pulmonary, digital pathology, breast, cardiac, abdominal, musculoskeletal. Amongst the studies reviewed, organ (substructure) segmentation was the most prevalent task/activity, MRI was the most prevalent imaging modality and greatest application was for pathology and brain imaging. https://www.sciencedirect.com/science/article/abs/pii/S1361841517301135 Shen et al (2017) reviews the application of deep learning in medical image analysis with particular focus on successes in - image registration, detection of anatomical and cellular structures, tissue segmentation, computer-aided detection and computer-aided disease diagnosis/prognosis. https://www.annualreviews.org/doi/abs/10.1146/annurev-bioeng-071516-044442 Lee et al (2017) provides a review of radiomic studies on lung cancer which quantify several different variables relevant to the imaging assessment of lung malignancy. It summarizes the state of the art for clinical applications for the different classes of currently available radiomic features – morphological, statistical, regional and model-based. https://www.ncbi.nlm.nih.gov/pubmed/27638103 Lubner et al (2017) discusses potential oncologic and non-oncologic applications of CT texture analysis (CTTA). CTTA allows objective assessment of lesion and organ heterogeneity beyond what is possible with subjective visual interpretation. Pre-treatment CT texture features are associated with histopathologic correlates such as tumour grade, tumour cellular processes such as hypoxia or angiogenesis, and genetic features such as KRAS or epidermal growth factor receptor (EGFR) mutation status. In addition, and likely as a result, these CT texture features have been linked to prognosis and clinical outcomes in some tumour types. CTTA CT texture analysis has also been used to assess response to therapy https://www.ncbi.nlm.nih.gov/pubmed/28898189 Isin et al (2016) provide a review of automatic brain tumour segmentation methods using deep learning. 12 studies using deep learning or traditional glioma segmentation methods identified. Performance was compared using DICE scores. Manual segmentation peformed best on core tumor (all tumor components except edema); deep learning methods performed comparably or better to manual for whole tumour and active tumour (only

	active cells) segmentation. https://www.sciencedirect.com/science/article/pii/S187705091632587X
Primary studies (only if insufficient secondary evidence found)	
Commercial / Open source solutions	Gibson et al (2018) describe the open-source NiftyNet platform. Because medical image analysis poses unique challenges for deep learning (variation in data availability, dimensions/size, formatting) NiftyNet provides a high-level deep learning pipeline with components optimized for medical imaging applications (data loading, sampling and augmentation, networks, loss functions, evaluations, and a model zoo). NiftyNet comprises an implementation of the common infrastructure and common networks used in medical imaging, a database of pre-trained networks for specific applications and tools to facilitate the adaptation of deep learning research to new clinical applications with a shallow learning curve. Three illustrative medical image analysis applications built using NiftyNet infrastruc- ture: (1) segmentation of multiple abdominal organs from CT; (2) image regression to predict CT attenuation maps from brain MRI; and (3) generation of simulated ultrasound images for specified anatomical poses. Future applications under development include image classification, registration, and enhancement (e.g. super-resolution) as well as pathology detection. https://www.sciencedirect.com/science/article/pii/S0169260717311823 Yang et al (2017) describe Quicksilver - a fast, open source deformable image registration method. The proposed approach allows patch-wise prediction, without a substantial decrease in registration accuracy, resulting in fast and accurate deformation prediction. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6036629/ TexRAD uses algorithms to extract and quantify texture features in pre-existing medical images. These texture features have been successfully used to demonstrate diagnostic, prognostic and predictive intelligence in scientific research with particular significance in oncology. TexRAD LUNG is the first clinical application of TexRAD in quantifying texture in PET/CT images to assess complexity of lung tumours. https://fbkmed.com/texrad-landing-2/ DIADEM (Brainminer) is an automated system for analysing MR brain scans, providing the clinician with an easily interpreted report that aids their diagnosis of dementia. It uses a patented machine learning algorithm that identifies 150 separate regions of the brain. It then compares each region to its expected size, based on the patient's age, intercranial volume and other factors. The regions are combined into functional lobes to provide a clinically meaningful summary. Within each lobe the most clinically significant regions are individually reported. DIADEM connects directly to the hospital PACS, automatically detecting new MR scans that are suitable for processing. The report is automatically pushed into the PACS for review. http://www.brainminer.co.uk/products.html Nuance mPower – radiology report database which employs Natural Language Processing algorithms. Greatest utility appears to be for radiologists seeking clinical decision support

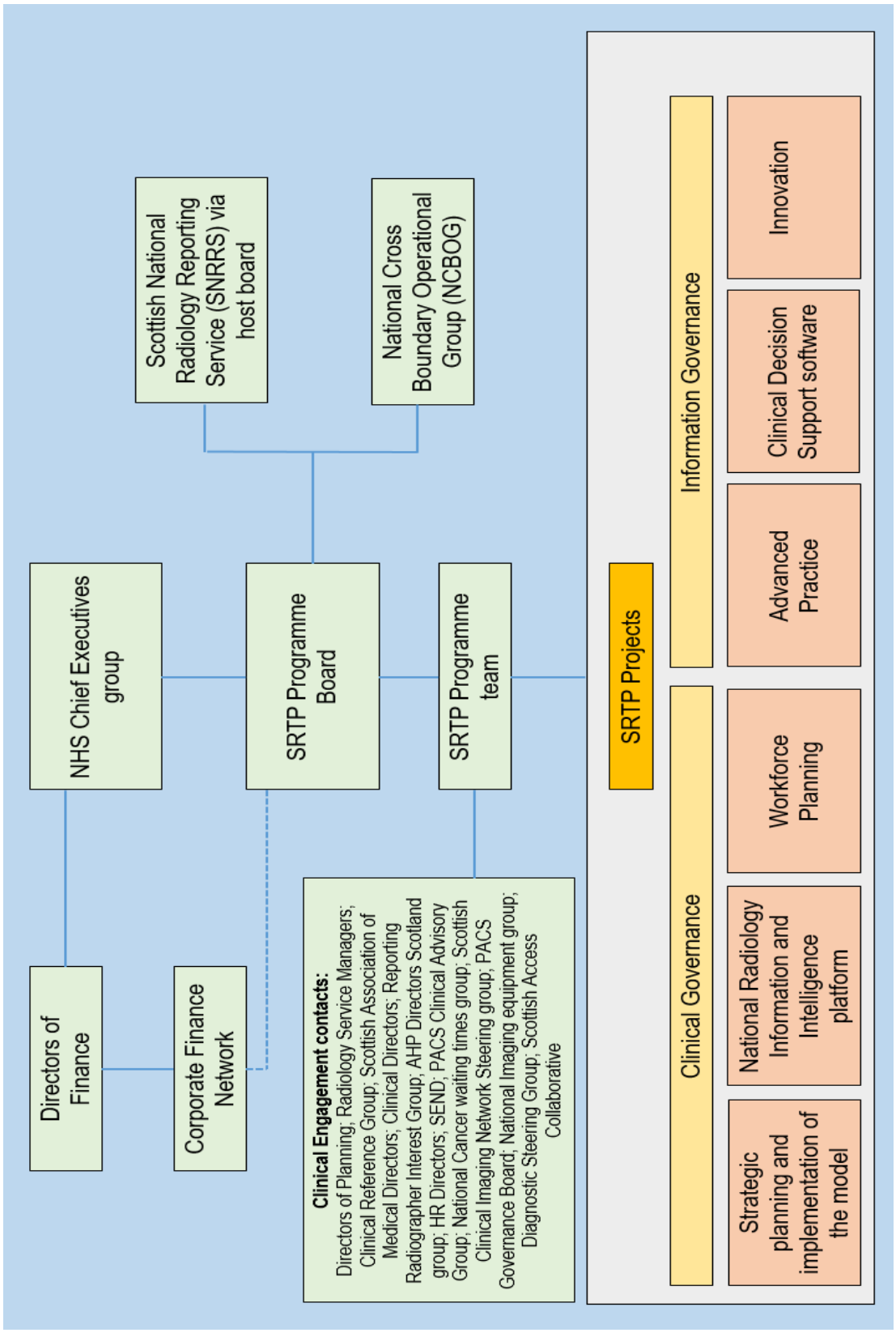
	and follow-up recommendations for complex cases. Currently, mPower algorithms are powered by access to reports from over 500 providers in North America and Europe. Also has ability to monitor compliance by tracking critical results, identify errors/mismatches within reports and radiology department volume-analytics.
Cochrane library ***Check for RCTs in the trials database***	Not relevant
Ongoing secondary research	
EUnetHTA Planned & Ongoing Projects database ***Check for any planned projects by EUnetHTA members on similar topics. You will need to register for an EUnetHTA login to access this resource.***	None
PROSPERO database ***Check for recent systematic review protocols.***	Not relevant
Ongoing research (only if insufficient secondary evidence and primary studies found)	
Various	*Industrial Centre for Artificial Intelligence Research in Digital Diagnostics (iCAIRD):* A pan-Scotland consortium of 13 partners from across academia, the NHS, and industry. iCAIRD's medical imaging research will include developing solutions for more rapid treatment for stroke, expert chest x-ray reading, and partly automated mammogram

Sources	analysis for breast cancer screening. The centre will also carry out digital pathology research to achieve rapid and more accurate diagnosis in gynaecological disease and colon cancer. Limited information available on the nature of research in progress and phase of development. http://www.sinapse.ac.uk/ *DeepLesion* is a NIH Clinical Centre hosted dataset of more than 32,000 medical images, large enough for scientists to train a deep learning neural network and create a large-scale lesion detector with one unified framework. DeepLesion is unlike most lesion medical image datasets currently available, which can only detect one type of lesion. The database has great diversity – it contains all kinds of critical radiology findings from across the body, such as lung nodules, liver tumors, enlarged lymph nodes, and so on. https://nihcc.box.com/v/DeepLesion *MALIBO* - Development and evaluation of machine learning methods in whole body MRI with diffusion weighted imaging for staging of patients with cancer (MAchine Learning In whole Body Oncology). Phase 1: Development of ML pipeline 'A' for automatic anatomic labeling in WB-DW-MR of 50 healthy volunteers using segmentation techniques. Phase 2 training: 150 scans from NIHR STREAMLINE (colorectal/lung cancer, CRUK MELT (lymphoma)& MASTER (lymphoma/prostate cancer) main studies with established disease stage will be used to train machine learned detection of metastases. Interim sensitivity tested in 40-50 scans. Phase 3 validation: 217 scans from the primary studies will be read by radiologists with +ML 'C' using sequential viewing of sequences; internal pilot in first 50-70. DA will be measured against the main study reference standards and RT +/- ML will be recorded. http://wp.doc.ic.ac.uk/bglocker/grant/malibo-machine-learning-in-whole-body-oncology/ https://www.sciencedirect.com/science/article/pii/S0009926019300741?via%3Dihub *MALIMAR* - Development of machine learning support for reading whole body diffusion weighted magnetic resonance imaging (WB-MRI) in myeloma for the detection and quantification of the extent of disease before and after treatment (MAchine Learning In MyelomA Response). Phase 1 (training): WB-MRI scans from a cohort of 160 myeloma patients (120 with active disease) from a single centre and 40 age-relevant healthy volunteers (HV) will be used to develop a ML detection tool to recognise active myeloma. Phase 2 (validation): Sensitivity and RT assessment using WB-MRI -/+ ML in 203 active myeloma 100 inactive myeloma and 50 HV.Phase 3 (disease quantity): A ML quantification tool will be developed then tested on WB-MRI of 60 patients having scans before and after myeloma treatment on iTIMM trial. Quantification score RT and categorisation of response will be assessed +/- ML https://www.fundingawards.nihr.ac.uk/award/16/68/34

Date of search:

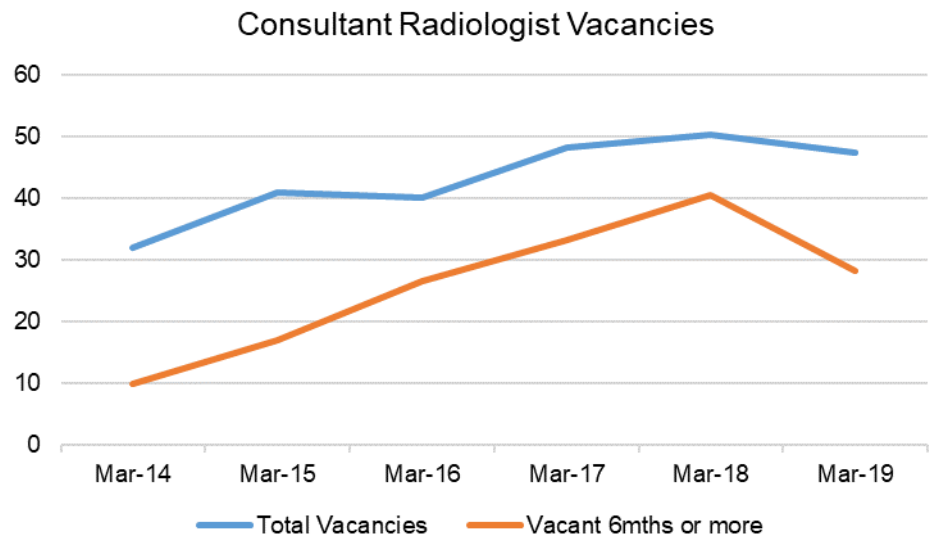
Concepts used:

Appendix 3. SRTP Governance structure

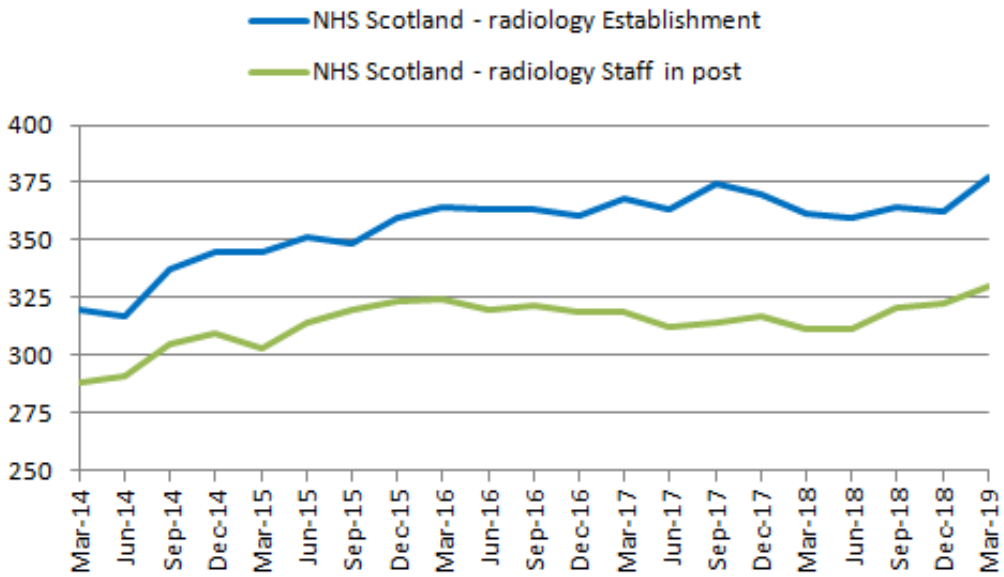


Appendix 4. Consultants in Scotland

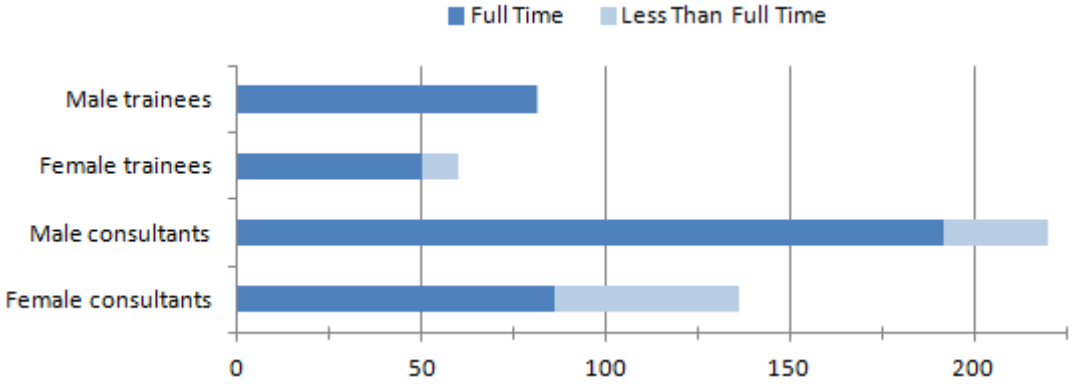
Consultant Radiologist Vacancies



WTE radiology staff in post against establishment for the service



Headcount of staff, by gender, in full time or Less Than Full Time role:



Radiology is a consultant led service, there are no Foundation Year doctors within the service.

RCR analysis of specialist training in Scotland

Forecast flow of trainees starting between 2013-15 (averages):

- ↓21 doctors per year started specialist training in radiology
- ↓19 doctors are forecast to complete training and gain CCT
- ↓12 (64%) are expected to be appointed to consultant clinical radiology posts in Scotland
- ↓11 whole time equivalent posts are filled after some then choose to work less than full time.

The wte of 11 posts are filled from 21 wte starting specialist training, 53% conversation rate

SG Health Workforce/NES Medical Specialty profiles

Future supply/demand forecasting for radiology, Retirement Projections 2017-2027 and expected CCT output.

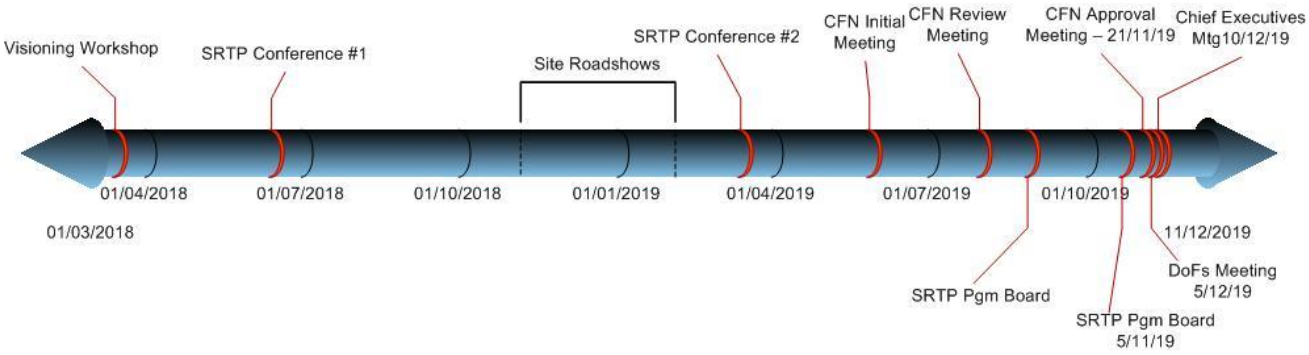
Year	Number of consultants reaching age 61	Estimated CCT output *
2017	10	27
2018	9	21
2019	12	21
2020	6	29
2021	13	27
2022	9.4	26
2023	15	26
2024	9	30
2025	9	30
2026	12	30
2027	9	30
2028	11	30

* based on 6 year average length of training and establishment of 129 (at all stages of training) growing by 10 trainees per year for 5 years from 2018 by expansion at ST 1

This does not account for current consultants taking up new LTFT contracts.

Appendix 5. SERVICE ENGAGEMENT

Figure 10: Key engagement milestones in Phase 1



Beyond these major events and engagement milestones the SRTP Leadership Team has attended national executive groups such as:

- Nurse Directors
- Medical Directors
- Directors of Planning
- Regional Implementation leads
- Scottish Government
- Chief Executives

Individual contact has been maintained between the SRTP Medical Director and individual board clinical leads and also between the Phase 1 Programme Director and executive leads at local, regional and national levels. Various projects have been developed from these interactions and are examined in the Economic Case.

Appendix 6. Options Appraisal

At the second SRTP Conference by asking delegates to choose the highest priorities for transformation in Radiology in facilitated sessions. Other projects were considered but were not prioritised for inclusion during consultation for this phase. The table below refers.

Project options	Scoring	Rank	Recommendation
National Clinical Decision Support Software	49	1	Continue in Phase 2
Advanced Practice	45	2	Continue in Phase 2
Radiology Reporting Bank	36	3	Continue in Phase 2
Radiology Reporting Service	23	4	Continue in Phase 2
Artificial Intelligence Scoping & Pilots	14	5	Phase 2 new project
Radiology Information & Intelligence Service	13	6	Continue in Phase 2
National Reporting IT Platform	9	7	No action - complete
Speciality Reporting Networks	8	9	Not prioritised now
Academy Model	8	9	Not prioritised now
Consultant Radiologist Job Design	7	11	No action - complete
PACS Re-procurement	6	12	Underway (NSS)
Radiology Out of Hours Reporting Service	4	13	Not prioritised now
Recruitment & Matching	4	13	Not prioritised now
National Vetting IT Platform	3	15	Not prioritised now

Appendix 7. Option 2 – Project scope

Scottish Radiology Reporting Service Solutions

A national bank model for Radiologists to perform additional sessions has been established to pool resource and act as a mechanism to manage workflow and pay for additional Radiologist sessions in a standard way. This will take the form of a virtual hub (SNRRS Bank), to be hosted by Golden Jubilee National Hospital, enabling Radiologists to volunteer for additional sessions paid using the newly agreed national consultant rate. The pilot will start in Q3 2019 and is scheduled to run for 12 months.

Stakeholders indicated that home working and additional workstations would be central to implementing cross boundary reporting. Phase 1 of the SRTP has therefore established a contract to access fifty workstations for use across Scotland and ran a small pilot to consider the implications of more widespread home working utilising the new IT connectivity and these additional workstations.

The above pilots, along with previous work in Phase 1, will provide the evidence and safe working environment which will allow a national cross boundary reporting service to be established as business as usual. The proposed service will be more cost-effective than the current private-sector outsourcing model that all Boards employ and have the advantage of providing an alternative method of managing backlogs of image reporting within the NHS.

Advanced Practice

Advanced Practice (AP) in Radiography was identified as a priority piece of work from stakeholder engagement. Phase 1 has successfully proven a model of cross boundary reporting by Radiographers. The AP project has worked closely with the Scottish Access Collaborative on Radiographer AP in breast pathways and with the Scottish Clinical Imaging Network (SCIN) on this and other aspects of developing the AP workforce. In addition, Phase 1 has begun to scope the Sonographer workforce.

There are a number of possible AP roles which could support establishment of a sustainable multidisciplinary workforce. These are currently developed across some NHS boards however in a limited way which at times doesn't fully maximise benefits. There is significant interest in a national approach to assessing need, training and then employing staff in different ways to maximise AP skill sets.

This business case proposes projects around Radiographer Reporting, Sonography and scoping the potential for other roles as part of strategic workforce planning. Continuing to work alongside the Scottish Clinical Imaging Network and initiatives such as the Scottish Access Collaborative, to assess need across Scotland, Phase 2 will seek innovative ways to increase overall capacity and evolve the workforce to suit changing need within the service.

Workforce Planning

The availability of systematic and standardised service data allows for more robust workforce planning across the Radiology system in Scotland. The enduring problem of matching workforce capacity to service demand relies on up to date service data. Monitoring activity and workforce trends alongside service developments, provides the ability to model future workforce needs and inform training schemes (Radiologists and Radiographers) and recruitment / employment models.

This business case proposes further development of an existing workforce modelling tool and establishing a small team to support this planning work on an ongoing basis.

National Radiology Information and Intelligence Platform (NRIIP)

Our stakeholders worked to define and agree a national data set and definitions. This data is now stored in the National Radiology Information and Intelligence Platform (NRIIP) within the National Services Scotland (NSS) Corporate Data Warehouse (CDW) and will facilitate the ability to collate, analyse and share national radiology data through the National Radiology Dashboards. This will enable local, regional and national service planning and improvement.

Stakeholders have identified opportunities to expand the breadth of indicators and analytical tools available through the dashboards, which will allow more meaningful analysis of activity by comparing with workforce, acquisition capacity and other relevant indicators. This business case proposes building on work already done to better serve the needs of local service and strategic planning.

Clinical Decision Support (CDS)

Phase 1 of the SRTP has explored the technical and operational feasibility of implementing existing Clinical Decision Support software. A pilot project has been agreed which will use an off the shelf product and test use out in two NHS Boards over a period of a year (2020/21). The project will assess the impact on demand, of providing this type of support, to referring clinicians.

This business case proposes support for that pilot during 2020/21 and also scoping work to assess implementation of CDS across Scotland, beyond the pilot. A further business case will be required to support national implementation given the significant unknowns in terms of products available at that time and benefits from investment.

Artificial Intelligence (AI)

Interest in AI has grown over recent years, with professionals and vendors both keen to develop and test technology across a range of areas. In Radiology there are a number of potential uses of AI and some are already being tested under systematic conditions as part of initiatives in Mammography and Stroke etc. Early work by the Scottish Health Technologies Group (SHTG)

commissioned during Phase 1, indicates the different functions and range of potential uses in Radiology.

There is a growing need to assess priorities and plan activity in this area if duplication of effort is to be avoided and maximum benefit realised for NHS Scotland. Given the potential for AI to support Radiology services over the coming years it will become more important to understand the likely impact and build that into planning work going forward.

This business case proposes a collaborative approach to scoping and planning AI over the coming years, allowing service priorities to drive investment and further activity. It also proposes working closely with countries across the UK, who all face the same lack of capacity and are similarly keen to assess AI potential.

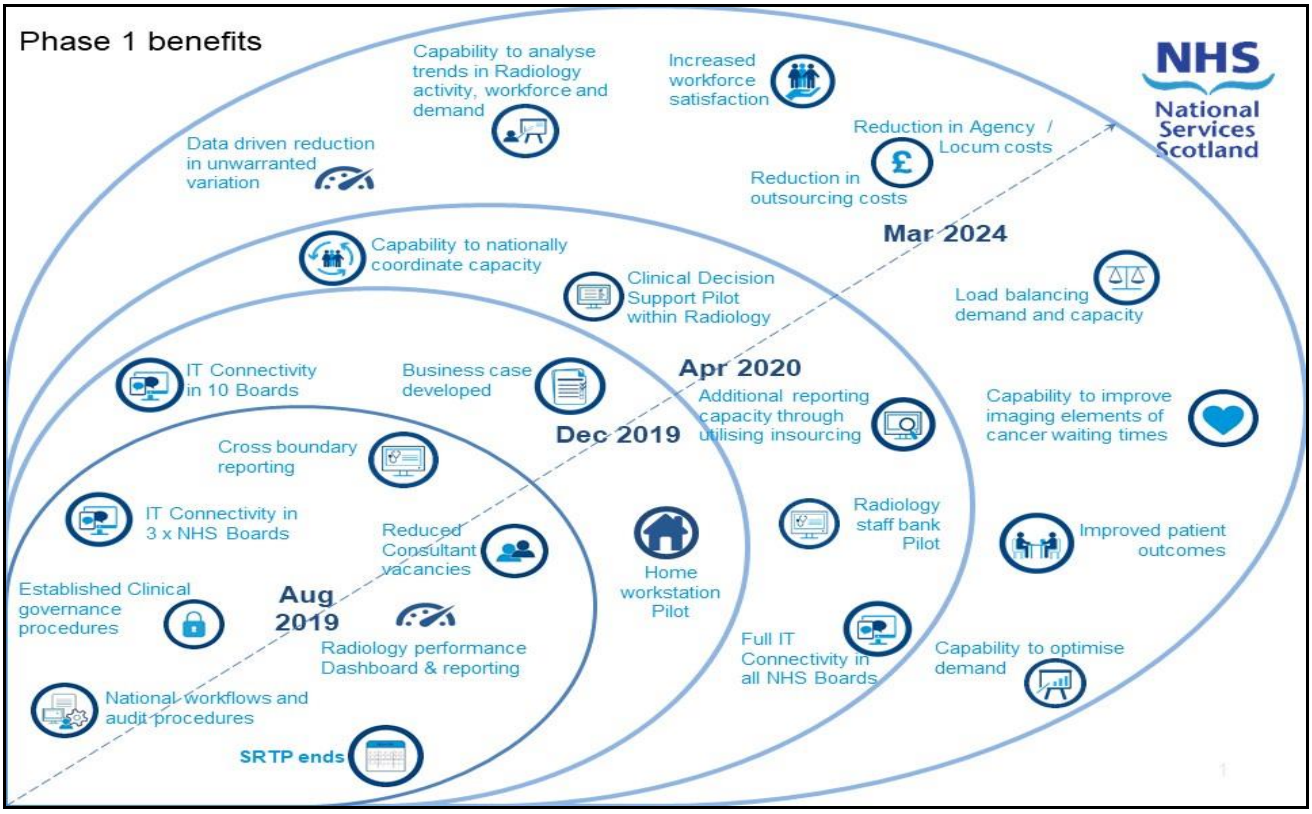
Appendix 8. Benefits from SRTP Phase 1 Business Case

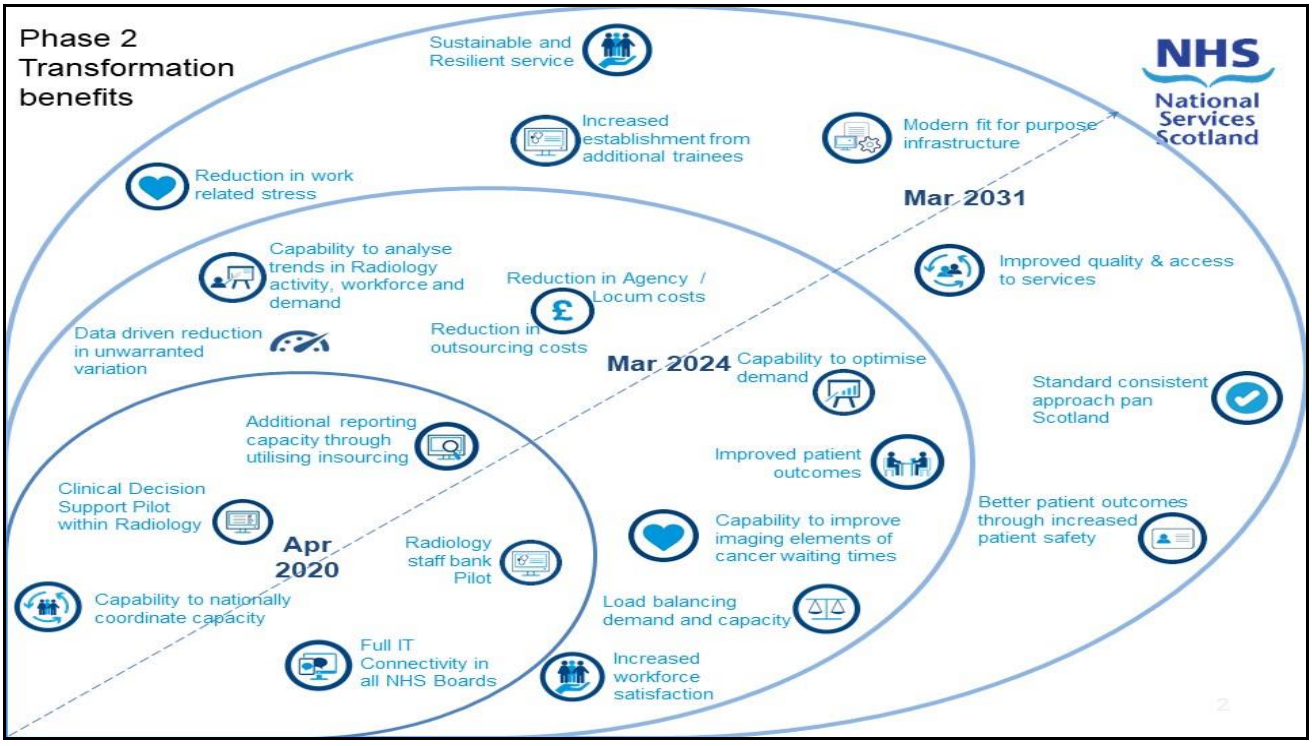
As a reminder, the following benefits (Table 1) were defined in the first SRTP business case.

Table 16: Benefits Realisation Matrix, Section F, p56 of 2017 SRTP business case

Benefit	Anticipated Measure	Anticipated Timescale
Net Financial Benefit	£1.5m per annum	2018/19 onwards
Reduction in overall costs of image reporting including outsourcing costs	£4.5m per annum	2020/21 onwards
Increased productivity due to improved IT	1% productivity gain £0.9m per annum	2018/19 onwards
Improved strategic planning	Demand and capacity planning via NRIIP	2018/19 onwards
Optimisation of workforce	Increased Reporting Capacity	2018/19 onwards
Service sustainability	Patient Access Targets	2018/19 onwards
Service improvement	Via NRIIP	2018/19 onwards

Appendix 9. BENEFITS ROADMAP





Appendix 10. Assumptions

Area	Source of data	Forecast assumption
Assumptions for financial modelling		
Outsourcing spend	NSS Procurement Outsourcing costs 2018	Assumed if no increase in demand, outsourcing costs remain flat
Insourcing / Locum spend	Royal College of Radiologists (RCR)- Workforce Census Report 2018	Assumed if no increase in demand, insourcing/locum costs remain flat
Clinical / Medical spend	15% uplift applied to 2015/16 Boards data *CFN members were asked to provide 2018/19 data, 3 of the 6 boards returned increases between 12-17%. These 3 boards represent 47% of NHS Scotland in terms of volume and spend	GEM assumed these costs would not be impacted by the project
Growth in demand -Outsourcing -Insourcing / locums -Substantive staff	Average annual increase based on historical trends 2012-2018 from Cost Book	Assumption made that 50% of annual increase could be completed by additional staff and resulting 50% of exams will be split between outsourcing and insourcing/locums. Assumption that consultants can complete 4 CTs or 4 MRIs or 20 plain films per hour Assumed a consultant radiologist works **40 hrs/week for 42 weeks** (i.e. annual leave, sick leave, study leave excluded). Assumed growth increases by the same number of exams each year, i.e. Y0 = x, Y1 = 2x, Y2 = Y1+x, Y3 = Y2+x, etc
Equipment - non capital	15% uplift applied to 2015/16 Boards data	Same costs factored in across all options

	*re CFN member returns described above	
Gross Pay - Substantive	4% uplift applied to 2015/16 Boards data	From 19/20 assumed 1% pay uplift YOY to account for inflation
Gross Pay - non substantive	47% reduction applied to 2015/16 Boards data 4 CFN Board members submitted updated non pay data for 2018/19, 47% reduction is the average of the 4 Boards. These 4 Boards represent 60% of NHS Scotland in terms of volume and spend	From 19/20 assumed 1% pay uplift YOY to account for inflation
Implementation Costs	Developed by the SRTP team for the business case.	Assumes a programme team for 3 years and BAU continuing for 10 years. NSS day rates 1819 used to calculate costs. No overhead recovery has been applied. 3% increase YOY included for Y2 and Y3
Cost of doing nothing	Calculation	Assumed this is the total cost of annual additional demand plus current spend on outsourcing, insourcing/locums
General assumption – options 1-3 Cost per outsourced exam	NSS Procurement Outsourcing Rates	Average cost taken across all suppliers for each modality (CT/MR/PF). Assumed that cost per exam would remain fixed.
Net saving based on realistic recruitment	Calculation	Assumed that net savings will be the result of all activity done to avoid outsourcing as described below but net recruitment will be newly qualified consultants - retirees
Annual savings CT– cost of outsourced exam v SNRRS Bank	Calculation: outsourced cost of CT minus derived cost of CT through the SNRRS Bank	Assumed in-sourcing hourly rate through new SNRRS Bank as the new Consultant Bank Rate plus on costs Assumed productivity rate for CT same as above. Used this to determine effective cost per CT through new SNRRS Bank.

Amount of reporting time new staff will report for each week		Assumed new staff will report for 80% of time on the basis that the reporting work will be spread across the department
Option 1 – Do minimum **Capacity** CTs from SNRRS Bank Pilot	Calculation	Assumed that for the SNRRS pilot, 30 consultants will sign up and each work on average 4hrs/week over 42 weeks. As above, assumed 4 CTs can be completed per hour
Consultants hired for additional CT demand		Assumed 2 x consultants hired to work on demand increase for CTs
Savings **CT savings**	Calculation – difference between outsourcing cost and effect cost of the SNRRS Bank, insourcing/locum and hiring additional staff	Assumed that as CTs are the most expensive exam to outsource that these will be the priority to in-source through the SNRRS Bank Assumed that savings are a sum of these calculations
MR and PF savings	Calculation – difference between outsourcing cost and hiring new staff to meet the demand	Assumed that the number of new staff hired will align with the newly qualified Radiologists (CCT) – Retirees This has been named realistic recruitment
Option 2 and Option 3 – assumptions same for both **Capacity** CTs from SNRRS Bank (extended from pilot)	Calculation from boards bespoke data capture for Business Case 1	Assumed that 50% of radiologists working less than 11PAs /week will increased to 11PAs/ week over a 42 week year and this additional work will be done for the SNRRS Bank.
Capacity from Retirees	Data based on figures from Scottish Government regarding retiring radiologists	Assumption that 50% of retirees will choose to work on average 2 PAs/week over 42 weeks. Assumed a retiree will work for 2 years on the bank.
Capacity from Radiographers	Calculation	Assumed that reporting

		radiographers can report 20% of all Plain Film demand at a rate of 17 per hour Assumed that time freed up from radiologists reporting Plain Films will be used for CTs
Consultants hired for additional CT demand	As option 1	
Savings CT savings MR and PF savings	As option 1	

Appendix 11. Implementation Team

Detailed programme team structure for each option:

Option 0

No associated implementation team

Option 1

				Year 1	Year 2	Year 3
	Project	Role	Staff grade	WTE	WTE	WTE
SRTP Phase 2 Implementation Programme Team	SNRRS Year 1 Pilot Support & Development	Workflow Manager	7	3.0	1.0	1.0
		Workflow Administrators	5	1.0	1.0	1.0
		Project Manager	7	1.0	0.0	0.0
		Project Support Officer	5	0.5	0.0	0.0
Business As Usual Phase 2	SNRRS	Medical Director / Clinical Lead	Consultan	0.4	0.4	0.4
		Workflow Manager	7	-	2.0	2.0
		Workflow Administrators	5	-	1.0	1.0
	Data collection and analysis	Analytics & Intelligence	Various	Various	Various	Various
		Data Management	Various	Various	Various	Various
		Digital and Security	Various	Various	Various	Various
	IT	Contract and Service Management	Various	0.4	0.4	0.4
		IT Project Change	Various	Various		

Option 2

				Year 1	Year 2	Year 3
	Project	Role	Staff grade	WTE	WTE	WTE
SRTP Phase 2 Implementation Programme Team	Programme Support Team	Medical Director / Clinical Lead	Consultan	0.4	0.4	0.4
		Programme Director	8c	1.0	1.0	1.0
		Programme Manager	8a	1.0	1.0	1.0
		Project Support Officer	5	2.0	2.0	2.0
	SNRRS Year 1 Pilot Support & Development	Workflow Manager	7	3.0	1.0	1.0
		Workflow Administrators	5	1.0	1.0	1.0
		Project Manager	7	1.0	-	-
	Workforce Planning	HR / Workforce Lead	7	1.0	1.0	0.0
		Project Manager	7	0.5	0.5	0.5
	Clinical Decision Support	Clinical Lead	Consultan	0.1	0.2	0.2
		Project Manager	7	0.5	1.0	1.0
	Advanced Practice	Clinical Lead	Consultan	0.2	0.2	0.2
		Project Manager	7	1.0	1.0	1.0
		Radiographer Lead	8b	0.6	0.6	0.6
		Sonographer Lead	7	0.2	0.2	0.2
		Radiographer	7	0.2	0.2	0.2
	Artificial Intelligence	Project Manager	7	0.5	0.5	0.5
		Clinical Lead	Consultan	0.1	0.2	0.2
	NSS PHI / BI Team	Analytical & Intelligence	Various	Various	Various	Various
		Data Management	Various	Various	Various	Various
		Digital and Security	Various	Various	Various	Various
Business As Usual Phase 2	BAU Leadership and Managment	Medical Director / Clinical Lead	Consultan	0.2	0.2	0.2
		Exec Lead	Exec	-	-	0.4
	SNRRS	Workflow Manager	7	-	2.0	2.0
		Workflow Administrators	5	-	1.0	1.0
		Service Manager support to SNRRS	8b	0.4	0.4	0.4
	Data collection and analysis	Analytics & Intelligence	Various	Various	Various	Various
		Data Management	Various	Various	Various	Various
		Digital and Security	Various	Various	Various	Various
	IT	Contract and Service Management	Various	0.4	0.4	0.4
		IT Project Change	Various	Various	-	-

OPTION 3

				Year 1	Year 2	Year 3
	Project	**Role**	**Staff grade**	**WTE**	**WTE**	**WTE**
SRTP Phase 2 Implementation Programme Team	**Strategic Development**	Change Management / OD	7	0.5	0.5	0.5
		Clinical Leadership Fellow	Registrar	0.5	0.5	0.5
		Health Economist	8a	0.5	0.5	0.5
		Business Case Development	7	0.5	0.5	0.5
		Consultation / Events Management /	5	1.0	1.0	1.0
	Programme Support Team	Medical Director / Clinical Lead	Consultan	0.4	0.4	0.4
		National Exec Lead	Exec E	0.4	0.4	0.4
		Programme Manager	8b	1.0	1.0	1.0
		Project Manager	7	-	1.0	1.0
		Analyst	6	1.5	1.5	1.5
		Project Support Officer	5	2.0	2.0	2.0
	SNRRS Year 1 Pilot Support & Development	Workflow Manager	7	3.0	1.0	1.0
		Workflow Administrators	5	1.0	1.0	1.0
		Project Manager	7	1.0	-	-
		Project Support Officer	5	1.0	1.0	1.0
	Workforce Planning	HR / Workforce Lead	7	1.0	1.0	0.0
		Project Manager	7	0.5	0.5	0.5
	Clinical Decision Support	Clinical Lead	Consultan	0.2	0.2	0.2
		Project Manager	7	0.5	1.0	1.0
	Advanced Practice	Clinical Lead	Consultan	0.2	0.2	0.2
		Project Manager	7	1.0	1.0	1.0
		Radiographer Lead	8b	0.6	0.6	0.6
		Sonographer Lead	7	0.2	0.2	0.2
		Radiographer	7	0.2	0.2	0.2
	Artificial Intelligence	Clinical Lead	Consultan	0.2	0.2	0.2
		Project Manager	7	0.5	0.5	0.5
	NSS PHI / BI Team	Analytical & Intelligence	Various	-	1.5	1.5
		Data Management	Various	-	0.8	0.8
		Digital and Security	Various	-	0.2	0.2
Business As Usual Phase 2	**BAU Leadership and Managment**	Medical Director / Clinical Lead	Consultan	0.6	0.6	0.6
		Regional Clinical Lead	Consultan	1.5	1.5	1.5
		National Exec Lead	Exec E	0.6	0.6	0.6
		Regional Exec Lead	Exec D	3.0	3.0	3.0
		Service Planning Lead	8a	1.0	1.0	1.0
		Recruitment Lead	7	1.0	1.0	1.0
		Radiologist Training & Co-ordination	Consultan	0.5	0.5	0.5
		Radiographer Training & Co-ordinatio	8b	0.5	0.5	0.5
		Digital Innovation Lead (Clinical Fello	Registrar	0.4	0.4	0.4
	SNRRS	Workflow Manager	7	-	2.0	2.0
		Workflow Administrators	5	-	1.0	1.0
		Service Manager support to SNRRS	8b	-	0.4	0.4
	Data collection and analysis	Analytics & Intelligence	Various	Various	Various	Various
		Data Management	Various	Various	Various	Various
		Digital and Security	Various	Various	Various	Various
	IT	Contract and Service Management	Various	0.4	0.4	0.4
		IT Project Change	Various	Various	-	-

Appendix 12. Non-Monetary Benefits criteria and weighting

The criteria are listed below, along with a weighting assigned as to their relative importance as defined by the clinical and service need.

- Sustainable and resilient service – improved efficiencies (Weighting: 30%)
  - Increased resilience of radiology service at a local level (e.g. ability to deal with local capacity shortfalls)
  - A resilient and flexible radiology service that can respond to challenges around capacity and demand via a collegiate approach
  - Support for clinical services in acute and primary care
  - Support emergency and unscheduled care
  - Support remote and rural NHS Boards
  - Supports improved workflow and increased productivity
  - Maximisation of role utilisation and flexibility
  - Ability to create reporting work lists and allocate reporting across Health Board boundaries
  - Ability to operationally manage and strategically plan services utilising NHS datamarts;
  - Ability to model future services, utilising NSS data marts

- Improved quality and access to services (Weighting: 30%)
  - Maintain local image acquisition and therefore local patient access
  - Retain Radiologists at local level
  - Reduce the clinical risks associated with outsourcing, locum and agency staff
  - Allow improved expert Radiology input to Multi-Disciplinary Team meetings leading to improved diagnosis, staging and treatment plans for patients including cancer patients
  - Allow more effective use of the expert skills of the radiology workforce
  - Support cross-boundary image reporting
  - Allow cross-boundary specialist opinion
  - Improve patient experience by expediting diagnosis and treatment

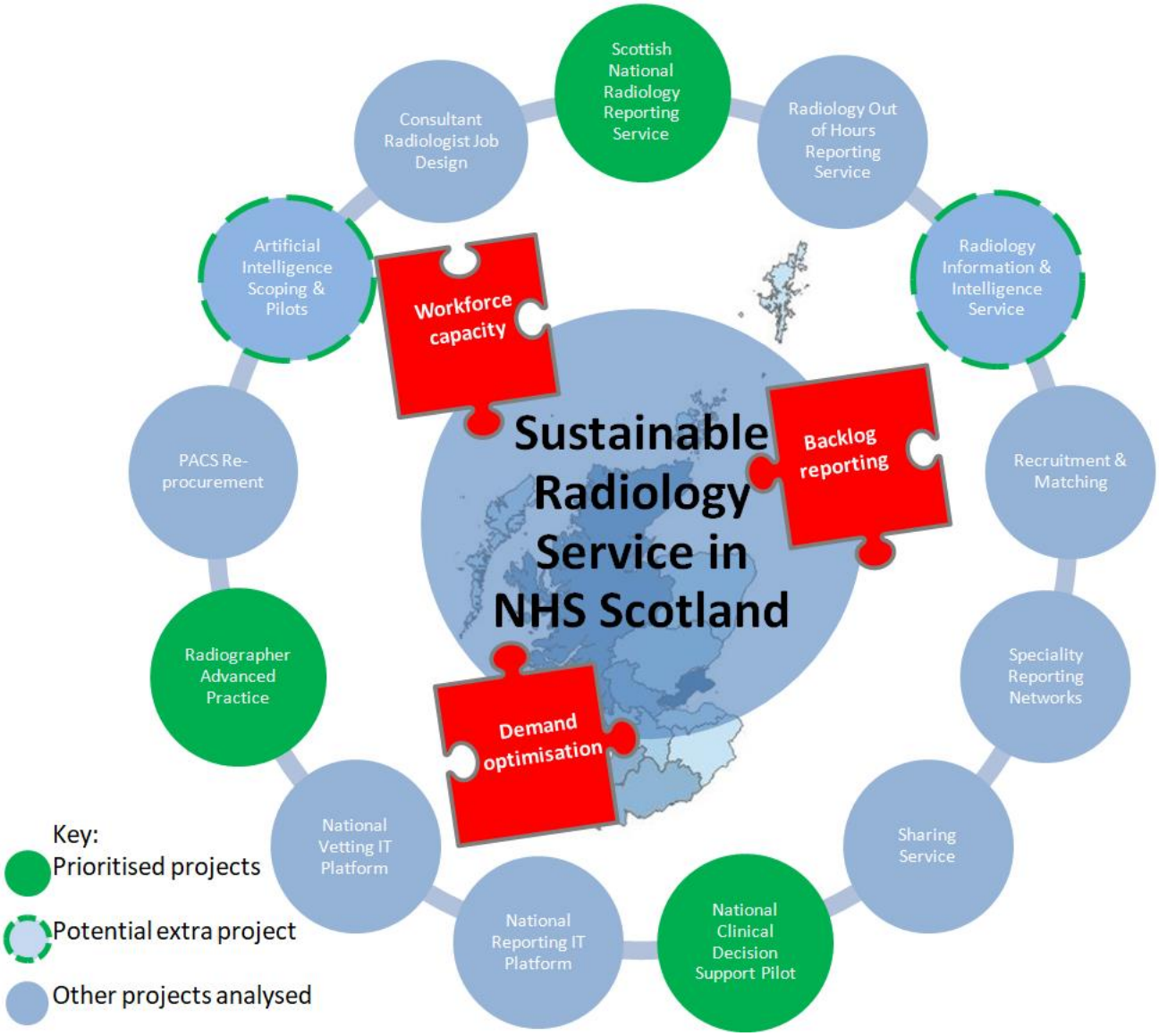
- Standardised consistent approach pan Scotland (Weighting: 18%)
  - Reduce unwarranted variation in demand for radiology services
  - Reduce unwarranted variation in radiology practice.

- Improved wellbeing of staff (Weighting 10**%)**
  - Recruitment and retention of staff

- Increased job satisfaction; and
- Reduction in work-related stress.

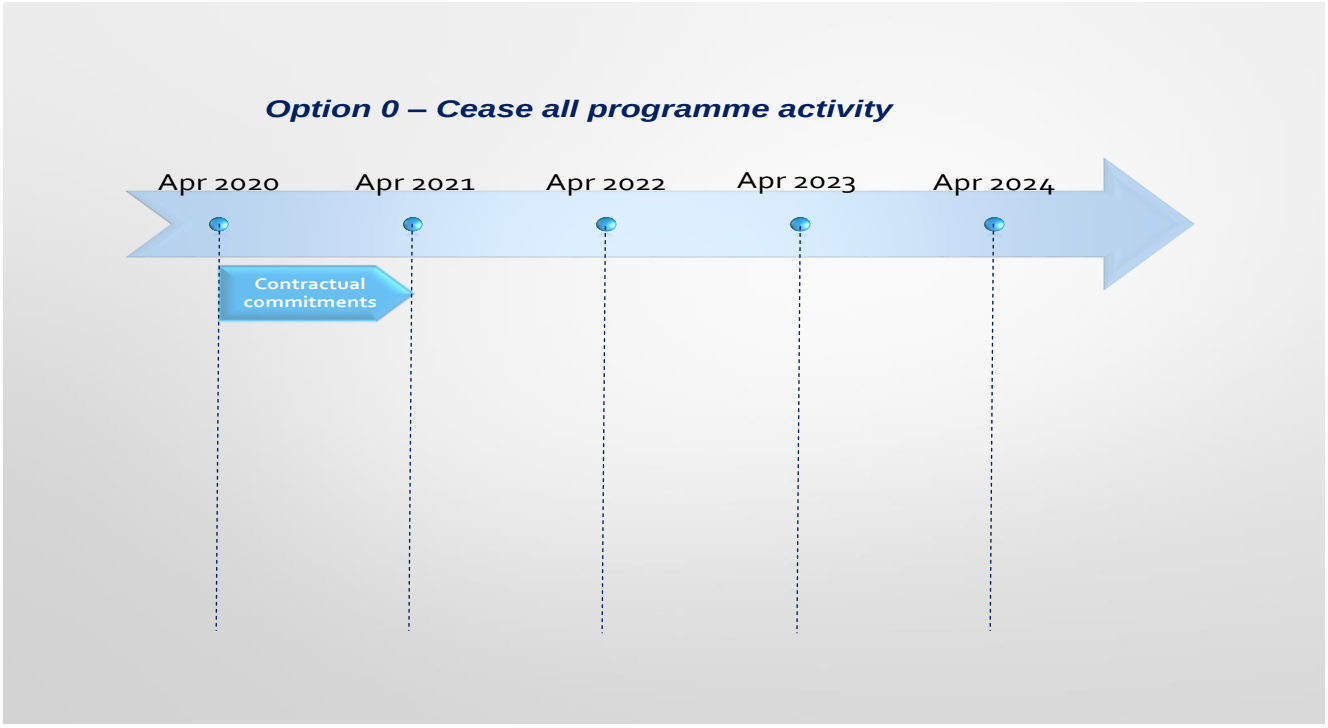
- Modern fit for purpose infrastructure (Weighting: 12%)
  - Supports requirements of current clinical services;
  - Meets the anticipated needs of future clinical services;
  - Supports linkage to current NSS data marts; and
  - Delivers future flexibility of data analysis according to anticipated service needs.

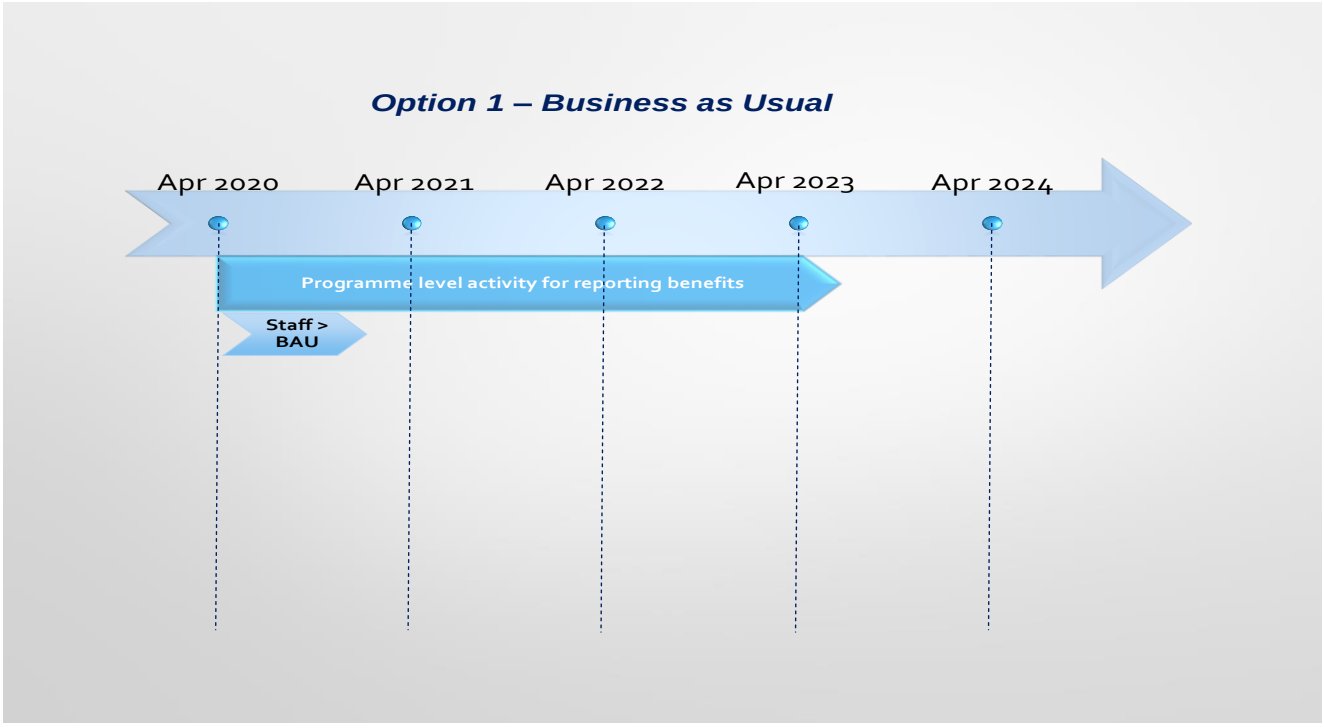
Appendix 13. Future Project Options



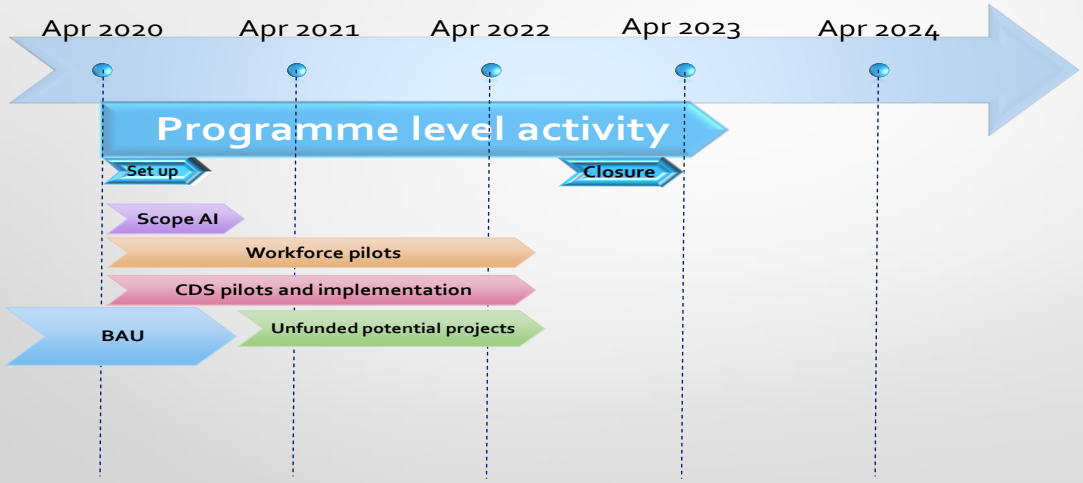
Options Summary – SRTP Business Case Phase 2												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Implementation Costs												
Option 0		£ 376,793	£ 384,329	£ 392,015	£ 127,793	£ -	£ -	£ -	£ -	£ -	£ -	**£ 1,280,930**
Option 1 (programme ends after 3 years and only IT/NRIIP/SNRRS costs)		£ 1,038,797	£ 1,006,016	£ 981,278	£ 838,012	£ 838,012	£ 838,012	£ 838,012	£ 838,012	£ 852,997	£ 852,997	**£ 8,922,144**
Option 2 (programme ends after 3 years and only IT/NRIIP/SNRRS costs)		£ 1,670,381	£ 1,849,473	£ 1,837,705	£ 864,012	£ 864,012	£ 864,012	£ 864,012	£ 864,012	£ 864,012	£ 864,012	**£ 11,405,642**
Option 3 (programme ends after 3 years and only IT/NRIIP/SNRRS costs)		£ 2,787,946	£ 3,006,128	£ 2,955,516	£ 1,810,005	£ 1,810,005	£ 1,810,005	£ 1,810,005	£ 1,810,005	£ 1,810,005	£ 1,810,005	**£ 21,419,627**
Option 0 Do nothing												
Growth in Demand												
CT	£713,772	£1,427,544	£2,141,316	£2,855,088	£3,568,860	£4,282,632	£4,996,403	£5,710,175	£6,423,947	£7,137,719	£7,851,491	**£46,395,175**
MR	£354,149	£708,297	£1,062,446	£1,416,595	£1,770,744	£2,124,892	£2,479,041	£2,833,190	£3,187,339	£3,541,487	£3,895,636	**£23,019,668**
PF	£138,988	£277,976	£416,964	£555,951	£694,939	£833,927	£972,915	£1,111,903	£1,250,891	£1,389,879	£1,528,867	**£9,034,211**
Annual additional demand	£1,206,909	£2,413,817	£3,620,726	£4,827,634	£6,034,543	£7,241,451	£8,448,360	£9,655,268	£10,862,177	£12,069,085	£13,275,994	**£78,449,054**
Current outsourcing/insourcing spend	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	£11,594,046	**£115,940,460**
Total cost of doing nothing	£12,800,954	£14,007,863	£15,214,772	£16,421,680	£17,628,589	£18,835,497	£20,042,406	£21,249,314	£22,456,223	£23,663,131	£24,870,040	**£194,389,514**
Annual increase in cost of doing nothing		9%	9%	8%	7%	7%	6%	6%	6%	5%	5%	
Cumulative increase in cost of doing nothing		9%	19%	28%	38%	47%	57%	66%	75%	85%	94%	
Option 1												
Net saving assuming recruiting to all posts required		£1,846,582	£1,932,934	£2,015,601	£2,100,725	£2,185,848	£2,269,129	£2,352,410	£2,435,691	£2,518,971	£2,602,252	**£22,260,143**
Net saving based on realistic recruitment		£1,322,553	£692,484	£901,255	£468,884	£1,238,409	£1,228,068	£974,891	£1,209,935	£1,041,683	£1,035,281	**£10,113,443**
Contribution to additional demand		55%	19%	19%	8%	17%	15%	10%	11%	9%	8%	
Contribution to total do nothing demand		9%	5%	5%	3%	7%	6%	5%	5%	4%	4%	
Option 1 - net impact		£283,756	-£313,532	-£80,023	-£369,128	£400,397	£390,057	£136,879	£371,923	£188,686	£182,284	**£1,191,299**
Option 1 - cumulative impact		£283,756	-£29,776	-£109,799	-£478,927	-£78,529	£311,527	£448,406	£820,330	£1,009,015	£1,191,299	
Option 2												
Net saving assuming recruiting to all posts required		£ 1,693,209	£ 1,784,218	£ 1,874,587	£ 2,006,600	£ 2,173,836	£ 2,235,972	£ 2,298,107	£ 2,360,243	£ 2,422,378	£ 2,484,514	**£ 21,333,663**
Net saving based on realistic recruitment		£ 1,349,813	£ 780,050	£ 1,185,524	£ 710,467	£ 2,212,732	£ 2,099,310	£ 1,601,782	£ 1,918,192	£ 1,598,773	£ 1,542,655	**£ 14,999,298**
Contribution to additional demand		56%	22%	25%	12%	31%	25%	17%	18%	13%	12%	
Contribution to total do nothing demand		10%	5%	7%	4%	12%	10%	8%	9%	7%	6%	
Option 2 - net impact		-£320,568	-£1,069,423	-£652,181	-£153,545	£1,348,720	£1,235,298	£737,771	£1,054,180	£734,762	£678,643	**£3,593,657**
Option 2 - cumulative impact		-£320,568	-£1,389,991	-£2,042,172	-£2,195,717	-£846,997	£388,301	£1,126,072	£2,180,252	£2,915,013	£3,593,657	
Option 3												
Net saving assuming recruiting to all posts required		£ 1,697,509	£ 1,812,262	£ 2,049,565	£ 2,111,701	£ 2,173,836	£ 2,235,972	£ 2,298,107	£ 2,360,243	£ 2,422,378	£ 2,484,514	**£ 21,646,085**
Net saving based on realistic recruitment		£ 1,472,690	£ 984,912	£ 1,906,412	£ 907,506	£ 2,212,732	£ 2,099,310	£ 1,601,782	£ 1,918,192	£ 1,598,773	£ 1,542,655	**£ 16,244,965**
Contribution to additional demand		61%	27%	39%	15%	31%	25%	17%	18%	13%	12%	
Contribution to total do nothing demand		11%	6%	12%	5%	12%	10%	8%	9%	7%	6%	
Option 3 - net impact		-£1,315,256	-£2,021,216	-£1,049,104	-£902,499	£402,727	£289,305	-£208,223	£108,187	-£211,232	-£267,350	**-£5,174,662**
Option 3 - cumulative impact		-£1,315,256	-£3,336,472	-£4,385,575	-£5,288,075	-£4,885,348	-£4,596,043	-£4,804,266	-£4,696,079	-£4,907,311	-£5,174,662	

Appendix 15. High level timeline (per option)

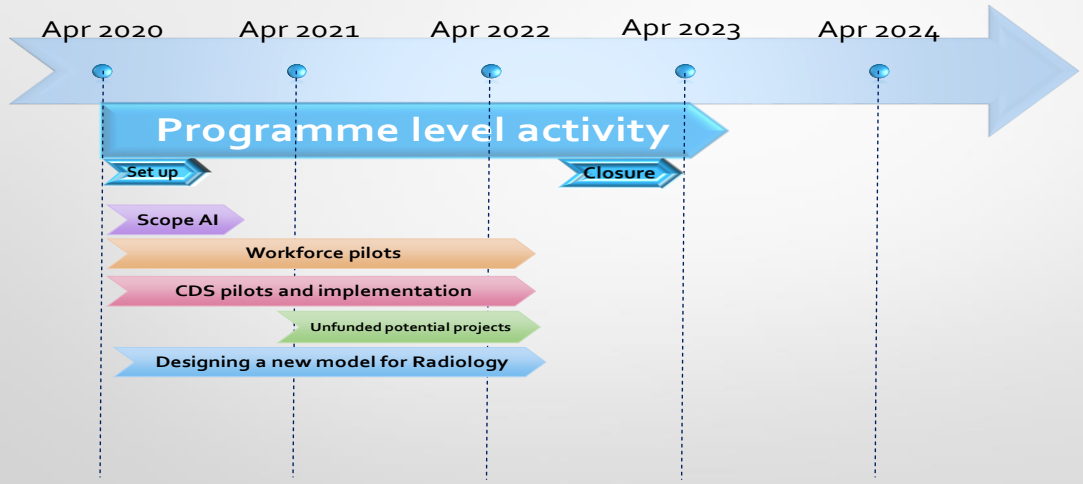




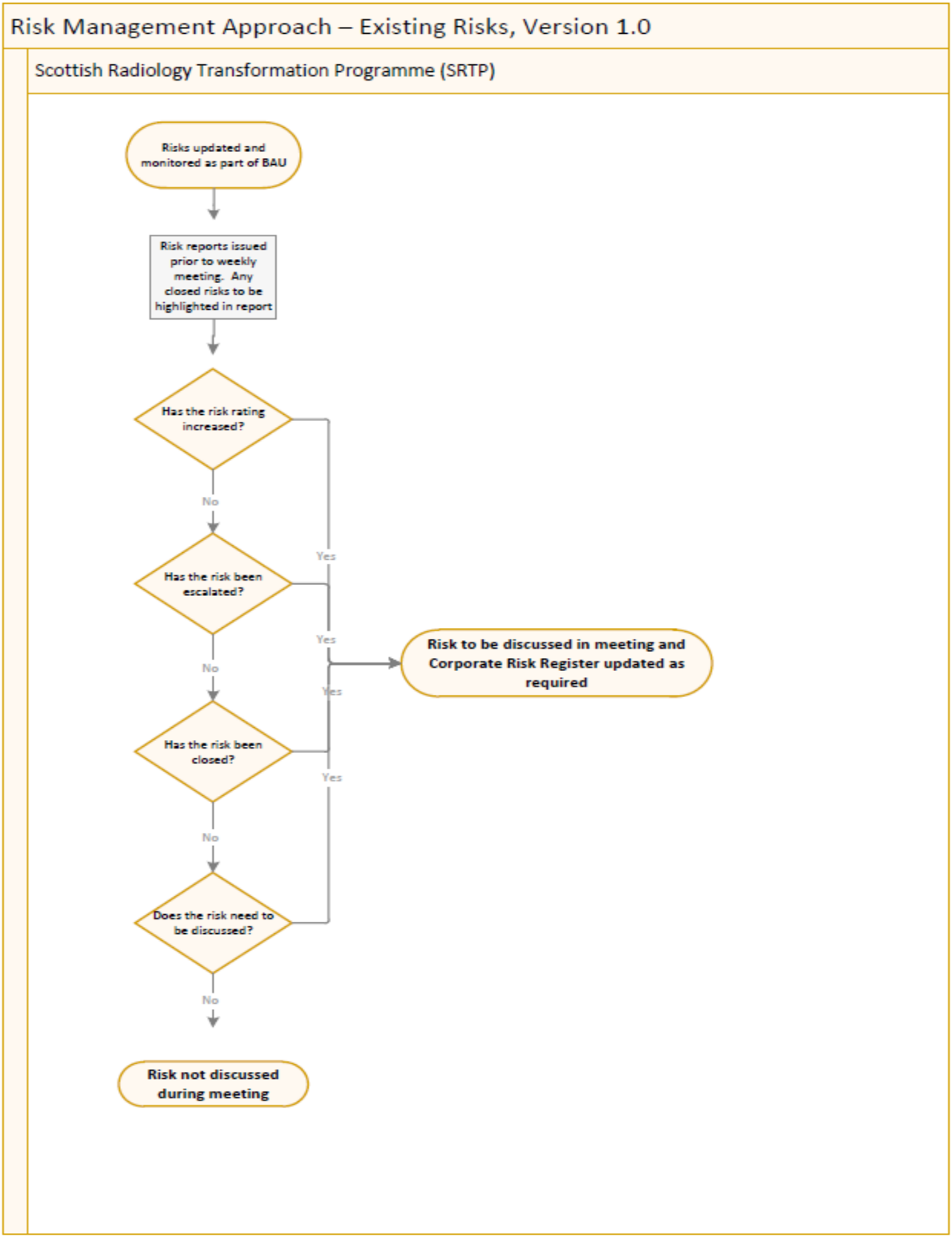
Option 2 – BAU and a new Radiology Programme

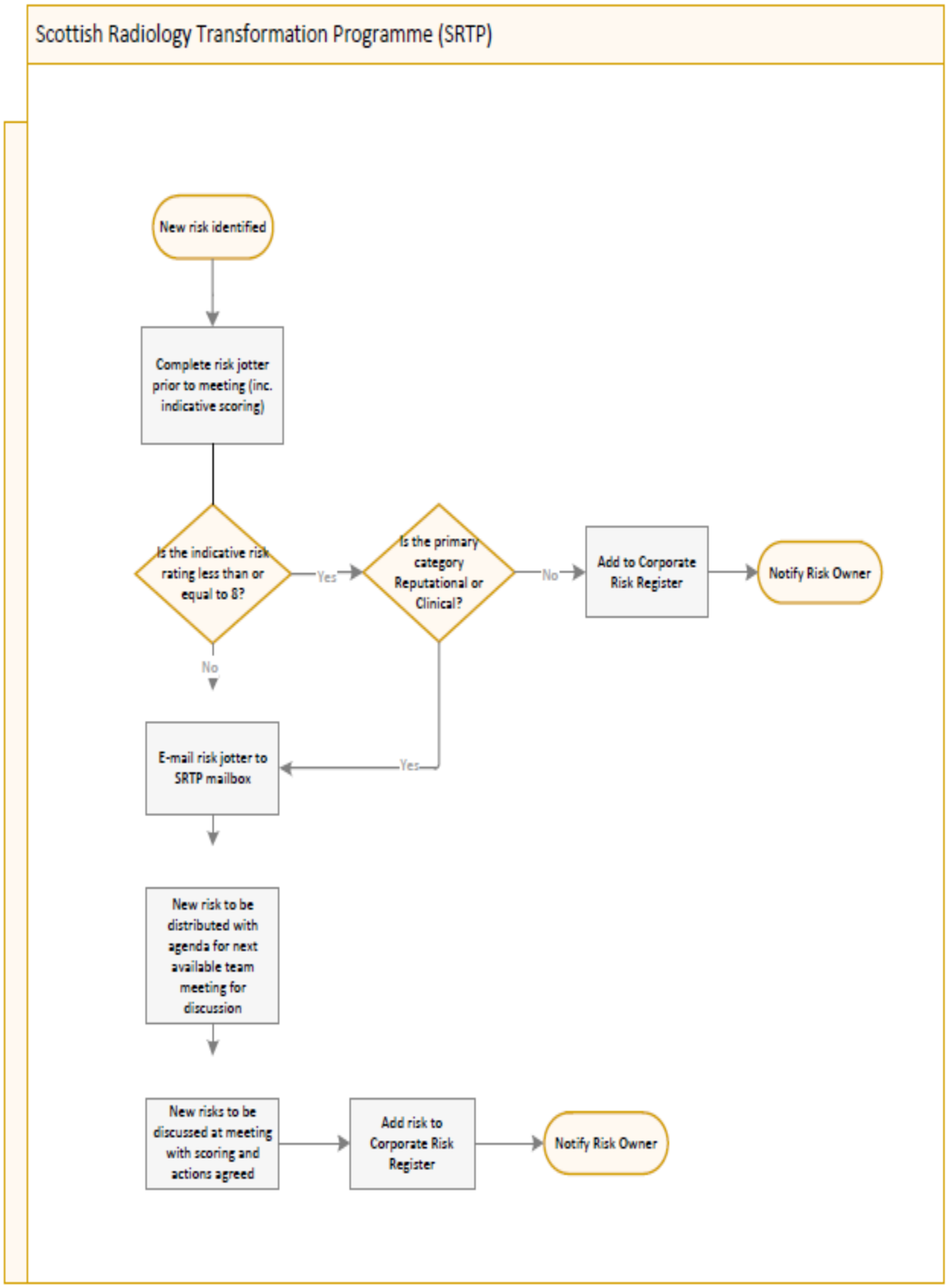


Option 3 – BAU, a new Radiology Programme and Designing the Future

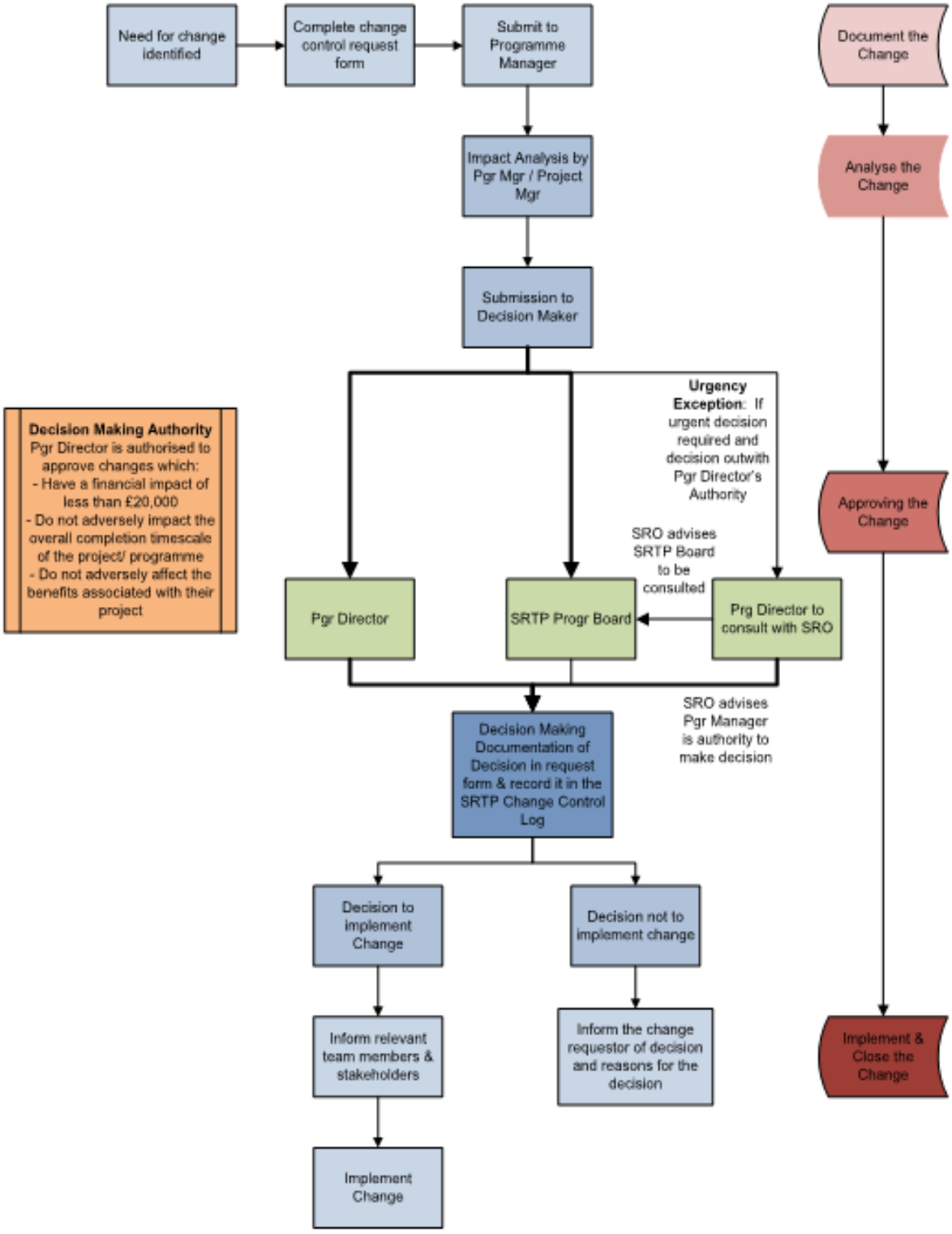


Appendix 16. Risk Management Approach




Scottish Radiology Transformation Programme (SRTP)
New risk identified
Complete risk jotter prior to meeting (inc. indicative scoring)
Is the indicative risk rating less than or equal to 8?
Yes
Is the primary category Reputational or Clinical?
No
Add to Corporate Risk Register
Notify Risk Owner
No
E-mail risk jotter to SRTP mailbox
Yes
New risk to be distributed with agenda for next available team meeting for discussion
New risks to be discussed at meeting with scoring and actions agreed
Add risk to Corporate Risk Register
Notify Risk Owner

Appendix 17. Change Management



Appendix 18. Glossary & Terminology

Glossary	
BaU	Business as Usual Completed project delivery that has been handed over to a operational team needing an open ended revenue budget and governance arrangements
BI	Business Intelligence
CLO	NSS Central Legal Office
Cost Book	Scottish Health Services Costs
GEM	Generic Economic Model
GMC	General Medical Council
ISD	NSS Information and Statistics Division
MRI	Magnetic Resonance Imaging
NPC	Net Present Cost
NPV	Net Present Value
NRAC	National Resource Allocation Model
NRIIP	National Radiology Information and Intelligence Project
NSS	National Services Scotland
PgMS	Programme Management Services Within NSS Strategy, Performance and Service Transformation
PHI	NSS Public Health and Intelligence
RCR	Royal College of Radiologists
SHTG	Scottish Health Technologies Group
SNRRS	Scottish National Radiology Reporting System
SRTP	Scottish Radiology Transformation Programme

Terminology used	
2017 SRTP business case	NHS Scotland Shared Services National Radiology Programme business case (approved by CEs 8/8/17)
SRTP Phase 1 programme	The programme as delivered Aug 2017 - Sep2019
SRTP Phase 2 programme	The potential programme as detailed in this business case for Apr 2020 – March 2023
RCR workforce census 2018	Clinical radiology UK workforce census report 2018

Appendix 19. Business Case Development Discussion & Control

19.1 Key Information

Title	Scottish Radiology Transformation Programme (SRTP) Phase 2
Date Published / Issued	27/11/2019
Date Effective From	13/12/2019
Version / Issue Number	V2.0
Document Type	Business Case
Document Status	Final Version for distribution
Author	Hamish McRitchie SRTP (Medical Director), Jim Cannon (Programme Director SRTP Phase 1)/, Jill Patte (PgMS Programme Portfolio Manager), Jennifer Robertson (SRTP Project Manager) and Hazel Stewart (Project Manager)
Owner	Jill Patte (PgMS Programme Portfolio Manager)
Contact	NSS.S.R.T.P@NHS.net
File Location	\\freddy\projects\Shared Service Portfolio\Health\Radiology\02 Implementation Phase\Projects\Long Term Vision\papers\BusCase

19.2 Revision History

Version	Date	Summary of Changes	Name	Changes Marked
v0.1 - v0.29	Apr-18/ Nov-19	Initial Drafts	Jill Patte, SRTP Team	X
V0.30	Nov-19	Comments incorporated from CFN Network	Jill Patte, SRTP Team	X
V0.30	Nov-19	Comments incorporated SRTP Programme Board	Jill Patte, SRTP Team	X
V1.1	Nov-19	Comments incorporated SRTP Corporate Finance Network	Jill Patte, SRTP Team	X
V2.0	Dec-19	Comments incorporated from CEs	Jill Patte, SRTP Team	X

19.3 Approvals

This document requires the following signed approvals:

Version	Date	Name	Role	Signature
V1.0-1.1	13/11/19	Jill Patte	Project Portfolio Manager	X
V1.0-1.1	13/11/19	Hamish McRitchie	Medical Director	X
V1.0	21/11/2019	Corporate Finance Network Group		X
V1.1	05/12/2019	Directors of Finance Group		X
V1.1	10/12/2019	Chief Executives Group		X
V2.0	13/12/2019	Jill Patte	Project Portfolio Manager	X

19.4 Distribution

This document has been distributed to:

Version	Date of Issue	Name	Role / Area
V0.26	15/07/2019	Carolyn Low	Director of Finance and Business Services
V0.30	22/10/2019	SRTP Programme Board	Sent for comment and feedback
V0.30	22/10/2019	Corporate Finance Network Group	Sent for comment and feedback
V1.0	14/11/2019	Corporate Finance Network Group	Sent for comment and feedback
V1.1	26/11/2019	Directors of Finance Group	Sent for comment and approval
V1.1	26/11/2019	Chief Executives Group	Sent for comment and final approval
V2.0	13/12/2019	To all networks and uploaded on website	Sent for information