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Science and Innovation Audits

Wave 1: Lessons learned report

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Lessons learned report

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1 Introduction

This report presents an overview of the main lessons that emerged from completing the first wave (Wave 1) of five Science and Innovation Audits (SIAs), focusing in particular on the work of the national contractor (Technopolis). It also includes selected feedback from the Wave 1 SIAs, gathered through the closing workshop held at 1VS Conference Centre on the 7th November and the Wave 2 launch event, December 9th 2016.

The report is organised in five sections, as follows:

- Section 2: The SIA process
- Section 3: Analytical framework and SIA report
- Section 4: Data provision
- Section 5: Engagement with consortia
- Section 6: Quality assurance

For each section, we provide a brief summary, followed by our preliminary assessment of lessons learned. Finally, Section 7 provides some suggestions in terms of recommendations for Wave 2 (and Wave 3) of the SIAs.

2 SIA process

2.1 The process

The Wave 1 SIA process was organised in three phases. Figure 1 provides an overview. The boxes in light blue represent the actions that were the responsibility of Technopolis, while the boxes in white and red represent the actions that were the responsibility of the individual SIA consortia.

In summary, the three main phases were:

- **Phase 1: An inception phase** from March to April 2016. In addition, to the inception meetings with each consortium and BIS, this phase was dedicated to collating existing relevant data to inform the individual SIA's analyses. As part of this process, Technopolis contacted the following custodians of the different data sources: IPO, HEFCE, RCUK, Design Council, UKTI, BEIS, NCUB and the Smart Specialisation Hub. Building on the conversations with data holders and previous work carried out by the UK High-Level Landscape Mapping Group[1] we defined an initial list of datasets. As part of this task, we assessed all the different data sources for their periodicity, reliability, and feasibility to cut across geographical and thematic domains. The outcomes of this phase were presented to BEIS and the SIA consortia in an Inception Report (Deliverable 1). The Inception Report also contained our analytical framework and suggested a common structure for the individual SIA reports (further discussed in Section 3 of this document)
- **Phase 2: Analytical support.** At the end of May, Technopolis delivered the relevant datasets and initial data analysis to each of the five SIA consortia. After delivering the core data, Technopolis began to provide its 'analytical support' function. This function is further discussed in Section 5

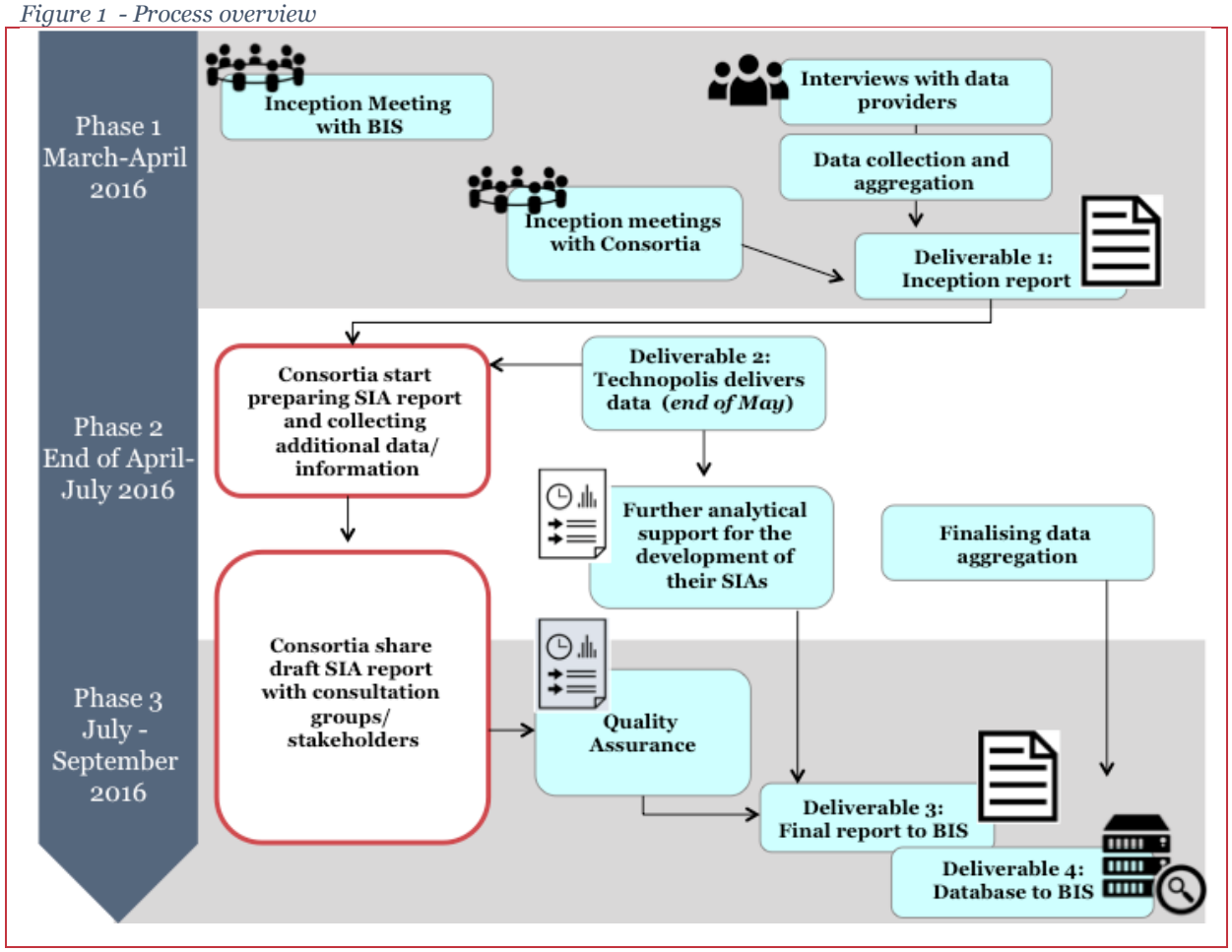
  After the final inception report was submitted Technopolis attended a workshop with the consortia on May 24th as an early opportunity to discuss the main challenges and potential ways forward. This workshop included a presentation from BEIS and Technopolis on the SIA process, a presentation from the Smart Specialisation Hub (on their offer), a short presentation from each

[1] http://www.rcuk.ac.uk/research/landscape/

Consortia (on their hypothesis and governance structure for the SIA), and group discussions among representatives of the five consortia.

- **Phase 3: Consolidation stage.** Finally, the consolidation stage started in July with the drafting of the reports by the consortia**.** The reports were shared with Technopolis as drafts at various points in time. Technopolis provided advice in terms of the adequacy of information and presentation. We also provided feedback where we thought that additional evidence was necessary and advice on how to strengthen the arguments or cases presented (see Section 6). This stage will finalise with the deliverable of this report as well as the final database containing all the data and indicators collected throughout the SIA process

Figure 1 - Process overview



2.2 The role of the national contractor and SIA consortia

The national contractor (Technopolis) was commissioned to support the SIA process:

- To provide an analytical framework and report structure for the SIA consortia to work within
- To compile and partially analyse existing national datasets, which will help consortia in the preparation of their individual Audits
- To provide ad hoc analytical support and advice to consortia, carrying out mini desk studies, further analyses of national data sets or collating information (including data) that do no exist in national data sources and that may provide further insight into local strengths
- To provide support to the consortia in their Quality Assurance of the Audits

The SIA consortia were set up:

- To run local consultations and develop additional data and insights to provide a more qualitative elaboration of the regional picture provided by analysis of national data sets
- To prepare their individual SIA reports and summaries, using the guidelines set up by BIS (Technopolis)
- To oversee the implementation of the SIA conclusions and recommendations, beyond the term of the SIA process itself

3 Analytical framework and SIA report

3.1 SIA structure and framework

In April 2016, Technopolis circulated an SIA Guide, based on our Inception Report, which amongst other things explained the common analytical framework and the links between the proposed evidence base and the structure for each SIA report. We also provided the following instructions:

- Each SIA consortium must produce a report with a similar structure, beginning with an introduction to the partnership and its geography, followed by a presentation of the area's science and innovation strengths and concluding with a list of strategic opportunities
- Additionally, each report was to comprise: an Executive Summary (c.5 pages); an accessible main report (c. 40 pages) written for public consumption; and a series of more detailed appendices, of value to local policy teams and analysts assembling business cases, etc.

We explained that this common structure would help to facilitate subsequent decision-making across government and among other stakeholders too.

We suggested each SIA produce a main report of eight chapters (as shown in Table 1). For each chapter we made a series of recommendations on possible data sources and other evidence. More specifically, for each chapter we provided:

- The questions that should guide the completion of each section (e.g. excellence in research)
- A set of proposed indicators, based on our analysis of existing data, that would provide evidence on the strengths of the region for each section
- Suggestions for possible additional evidence and information types (qualitative and quantitative) that could help to strengthen a case and more clearly demonstrate a place's national and international comparative advantage. We made suggestions based on the principles of robustness, replicability and comparability

Table 1 - The SIA report template

Chapter heading	Brief description
Introduction to the SIA area	Describe the audit area and the composition of the partnership and its synergy (i.e. how the partners and locations are 'more than the sum of the parts')
Regional science and innovation assets	Profile the main drivers of innovation in the SIA area, including people and skills, research expenditure and access to finance Profile the main public and private science and innovation assets in the area, including institutions, facilities, government laboratories or private research and technology centres. Present an overview of the stock and flow of human capital and talent available in the region
Excellence in science and research	Profile the region's principal strengths in terms of research excellence, presenting current and emerging fields

Chapter heading	Brief description
Innovation strengths and growth points	Focusing on the areas of strength identified in previous sections, provides an overview of regional economic capacity, including an overview of the region's key clusters. Identifies thematic or sectorial areas where investments are concentrated, and where there is a concentration of high-growth businesses in the region. Describes the business environment (ease of doing business and their chances of survival) and notes relevant trends
National and international engagement	Present an overview of the region's connectedness, locally, nationally and internationally. Describes notable alliances, including best examples of coordinating structures, and showcases local capacity to work collaboratively across the science and innovation landscape
Related developments in science and technology internationally	Outline the anticipated development in the national and international markets that align with the areas of strength identified by each of the Audits
Developments in national and international markets	Outline the anticipated developments in national and international markets that align with identified areas of specialisation Provide a tentative sizing of current international markets and/or customer groups relating to them
Conclusions: Regional strengths and opportunities	Detail opportunities that build on the strengths identified and/or address specific gaps in the identified areas of strength, and that are judged to be ambitious and of (international) strategic importance to the region in the medium to long term

For each chapter, we also provided an indication of the intensity of participation expected from Technopolis and the individual SIA consortia in each section of the report in terms of the provision of data and information (see Table 2).

Table 2 - Intensity of contributions

Sections	Technopolis	Consortia
Introduction to the region and SIA process	✓✓	✓✓✓
Regional science and innovation assets	✓✓	✓✓✓
Excellence in science and research	✓✓✓	✓✓
Innovation strengths	✓✓✓	✓✓✓
Established industrial capacity and growth points	✓✓	✓✓✓
National and international engagement	✓	✓✓✓
Developments in science and technology internationally	✓	✓✓✓
Developments in national and international markets	✓	✓✓✓
Regional strengths	✓	✓✓✓
Future opportunities	✓	✓✓✓

3.2 Basic principles of the SIA concept

The SIA concept enshrines several basic principles designed to support stronger, placed-based innovation, as described below:

Hypothesis driven

- The SIAs are hypothesis driven, and will develop and test the ideas set out in the Expressions of Interest (EOIs). As such, the SIAs should focus on developing their specific hypotheses, rather than ranging across all areas of science and innovation activities within the region. It is targeted rather than exhaustive

- Exploring individual hypotheses should involve testing and connecting different elements in the innovation ecosystem e.g. research excellence, university business interaction and a critical mass of innovative internationally competitive firms. For example, an interest in precision medicine may involve consideration of research capabilities in fields such as systems biology or centres of excellence in personalised medicine and industrial capacity in pharmacology or medical devices
- The individual hypotheses may be modified or even 'falsified' as a result of the SIA process, with individual consortia possibly focusing on a sub-set of their initial ideas where those are revealed to be especially promising

Forward looking

- The SIAs should be forward looking, linking analysis of current strengths in science and innovation with anticipated developments in new applications and markets internationally in the medium to long term
- The SIAs should focus on strategic opportunities where the area in question has the wherewithal to take advantage of such global developments, in support of its international competitiveness
- The SIA process is not an exercise to prove which area is the 'best' in the UK; it is an opportunity to systematically review particular local strengths where there is the capacity and future potential for the region in question to be globally competitive

Innovation driven

- The SIAs should focus on those opportunities where there is a strong link between research excellence and the potential for strategic innovation locally
- Innovation is taken to mean new or significantly improved processes, products or services, including business models
- Innovation occurs widely in both the public and private sectors, and both are of interest within the SIA process. There is an expectation, however, that the greatest opportunities for future growth are likely to be in the private sector

3.3 An assessment of the Wave 1 SIA reports

3.3.1 Our assessment

The paragraphs below summarise our assessment of the SIA reports, judged against these principles.

- **The basic concept**: the five consortia all embraced the idea of the SIA process, and the notion of locally specific, international comparative advantage
- **The partnerships**: there were substantial benefits in terms of network creation and partnership building locally. This kind of benefit is hard won and should help to ensure follow-up action and even secondary strategy-setting initiatives outside the SIA process
- **The instructions**: The SIA report template and instructions were helpful in enabling the SIA partnerships to get on with their work quickly and to prepare content-rich reports. The structure was adhered to pretty closely by all five. All partnerships did well in observing the tight timetable too
- **Presentation of data**: The SIA reports did not make as much use of data as expected originally, either those data that were centrally provided or otherwise. The somewhat granular nature of the core data set was one part of the problem. The lessons-learned workshop revealed that the tight timetable and limited resources available to most SIAs meant the authors were not always able to present evidence in a manner that would allow comparison with national or international norms. Trend data were not widely used
- **Content**. In terms of content, the SIA reports tended to focus most heavily on their scientific assets and capabilities and did a less good job of presenting local industrial and innovation capabilities. This perhaps reflects the fact that the HE sector was the driver of each of the five SIAs

in Wave 1, with businesses mostly involved as consultees rather than being part of the core team or governance structure. Edinburgh was the exception, or at least their central focus was on the digital economy and the digital transformation of other elements of the city region's economic base (public and private)

Most of the SIA reports tended to omit any kind of prospective analysis and the question of their region's potential for capturing specific / quantifiable shares of future global markets (what that might deliver in terms of additional output / employment in the next 10-15 years, locally). There were almost no instances where the authors considered the opportunities or threats posed by international partners or competitors

- **Legibility and credibility**: The conclusions were not always easy to link back to the preceding analyses. This is in part an issue of structure, as noted above, however, there was also a sense that the word 'audit,' within the title Science and Innovation Audit, may have led to overly comprehensive presentations of SIA capacity. We had expected a less fulsome treatment, with authors focusing on that sub-set of instances where the SIA partnership in question has a demonstrable overlap between its world class science and innovation and evident future growth opportunities globally
  - The 6-page summary reports made good use of graphical design and visualisation tools, and were as a result very much more readable than the full reports
- **Connections, local to national**: the SIA reports tended to treat wider national capabilities and strategies only very lightly, and rarely explain precisely why a substantial additional initiative in one region (rather than UK wide) is a good idea. There are for example numerous suggestions for new centres that might otherwise have been expected to be put forward as proposals by the Catapults or other national technology programmes, and yet no mention is made of how the pieces would fit together, avoiding unnecessary duplication and producing valuable synergies
- **Surprises:** None of the hypotheses appears to have been discounted as a result of the SIA process, and nor has there been much evident reshaping. It seems that the ideas set out in the EOIs informed the construction of the partnerships and the working groups, and as a result the original suggestions all made the grade and are part of the conclusions. We had expected the review to rule out at least some hypotheses. While there is no requirement to be the best in the world at something in order to capitalise on global developments related to that particular arena, there is probably a need to more robustly test the sufficiency of local capacity
- **Conclusions and next steps:** The conclusions are not particularly exciting, with some of the better presentations linking back to proposals that had been under consideration prior to the running of the SIA process and in one or two cases these have already been submitted and approved for financial support through other regional development initiatives. The desire to avoid causing the process to produce a series of shopping lists has arguably led the partnerships to present rather general proposals for next steps / future actions, which will need quite a lot of further development. Most of the reports say very little about next steps

Feedback from the lessons learned presentations made by the Wave 1 SIAs to the Wave 2 SIAs at the Wave 2 launch workshop:

- Given the scope of the work, the 6-month timetable was thought to be the minimum one could work with
- The SIA process is resource intensive, and does place a heavy burden on the SIAs' core management teams. The level of resourcing varied quite widely across the five partnerships, but the discussions among consortia suggest a rough estimate for the cost to each partnership might fall in the range of £250K-£500K. The estimated cost comprised contributions-in-kind largely, priced using people's salaries, and might be two or three times higher using full economic costing principles or the equivalent consultancy rates

3.3.2 Lessons learned and recommendations

Based on our assessment of the SIA process and reports, we identified four key lessons and recommendations

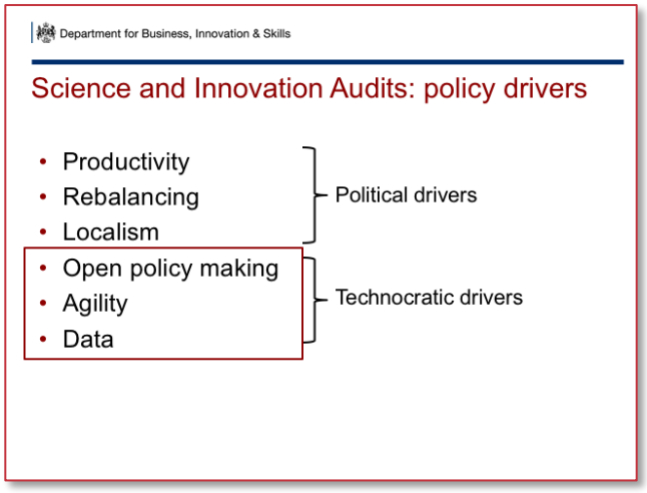
- **Regarding the use of data and evidence.** We recommend that Wave 2 consortia should be required to present a minimum set of (standard) metrics in each chapter, to ensure a more complete evidence base and greater insight about local performance relative to national or international benchmarks
- **Regarding partnerships.** We recommend stronger and earlier business engagement in Wave 2, to ensure there is greater attention paid to local innovation strengths and business capacity
- **Regarding the legibility of the report.** We recommend making clearer the need to produce both a short, sharp summary report that makes full use of graphical design and visualisation techniques as well as a more substantive evidentiary report. We also recommend the core chapters of the main report should be organised around the individual hypotheses that have come through the process. This thematic approach would make the reports easier to read and should allow arguments to lead to conclusions in a much clearer fashion
- **Regarding the hypotheses**. We recommend the SIA partnerships take a more discriminatory process regarding the testing of the hypotheses set out in their respective EOIs

4 Data provision

This section reflects on the more technical side of the data provision as there were important lessons learned from that aspect of the national contractor's support.

The objective of the data provision task was to build a data resource that could be used for the Wave 1 SIA exercise, and which could be passed on, re-analysed and improved for Waves 2 and 3 and possibly provide the basis for a new national information resource beyond Wave 3. This approach to open and reusable data respects the policy drivers, which underpin the whole exercise (see Figure 2).

Figure 2 – SIA policy drivers



4.1 Accessing and linking national datasets

As a first step, Technopolis contacted key data holders around Government including amongst others the IPO, HEFCE, RCUK and Innovate UK in order to understand the latest developments within the UK data landscape of science and innovation. We also built on previous work carried out by the High Level Landscape Mapping Group in the report "The UK Knowledge and Research Landscape: A report

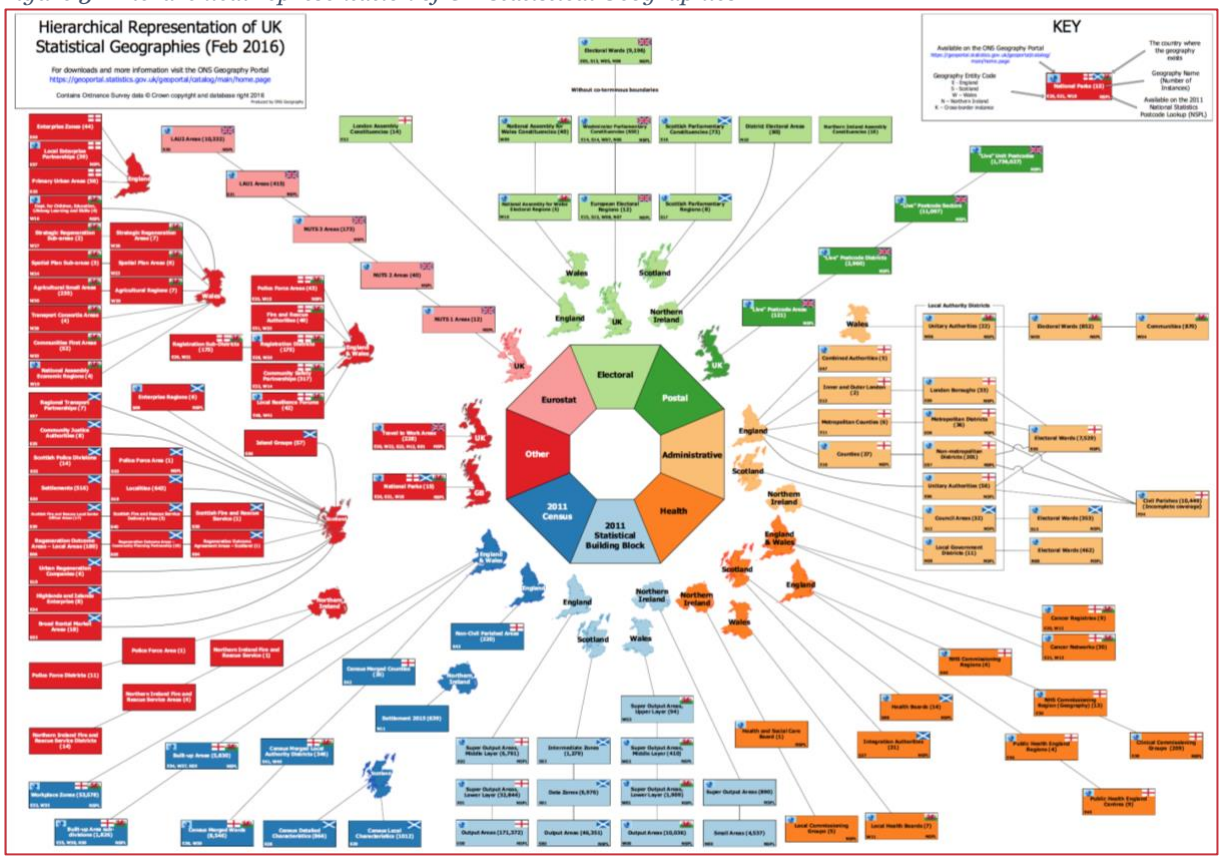
on available resources" from February 2016. This was combined with additional desk research in order to map relevant sources of information. Each data source was characterised according to the type of data, list of variables and indicators, periodicity, and relevance to the Audits.

The SIA process is a 'place-based' exercise, but one that invites partnerships to come forward with new and variable geometries. The SIA geographies comprised a multiplicity of territorial constructions that do not align neatly or consistently with the existing boundaries outlined by the official definitions of local authorities, regions and home countries (as defined in the NUTS1 classification, e.g. North West England, Scotland) or LEPs. As such, each SIA area is defined bottom-up by each SIA consortium or partnership. The territorial composition is central to the vision and flavour of each SIA report and after discussion with BEIS and the individual SIA consortia we referred to the SIA territories as 'areas' or 'regional networks.'

These 'regional networks' are fluid, in the sense that certain territories might be 'claimed' by more than one SIA consortium. Even though this poses a challenge when analysing or interpreting different national datasets (e.g. economic output), it does not undermine the validity of the SIA process. Different 'regional networks' can, for example, have different relationships and use differently any given research facility or laboratory.

The core data were provided centrally for each SIA consortium, and there was a substantial additional cost to re-analyse every data set in order to present those statistics in line with the new geographies and topics of interest. In practical terms, we invited each SIA consortium to define its territorial extent using post codes, local authority areas and LEPs. While this limits the utility of the resulting data for re-use by third parties (we will need to re-compile all of these data for use with different geographical combinations that arise in the subsequent SIA Waves), it does provide local partners with a new and otherwise unavailable window on to their region's attributes and performance. In order to arrive at a consistent and replicable approach for linking available information for any potential SIA area across the UK, we turned to the ONS hierarchical representation of UK statistical geographies (Figure 3).

Figure 3 - Hierarchical representation of UK Statistical Geographies



Source: ONS (2016)

The ideal situation with regard to data sources is to arrive at one or several datasets allowing for:

- Analysis at the relevant level of geographic disaggregation
- Analysis at the relevant level of thematic disaggregation
- A comparison with the UK average (to gauge national advantages of specific consortia)
- A comparison with an international average (to gauge international standing)

In practice, with this being an aggregation and linking of different sources, some of these requirements could be satisfied by some of the data sources, but not all of them could be satisfied all the time.

We devised a rule-based methodology for dealing with different types of SIAs, so that we could deconstruct them as a combination of standard ONS geographies:

1. We scanned the shortlisted Expressions Interest EoI for each SIA, identifying areas defined explicitly or through the geographical remit of the organisations involved in the consortia
2. We defined an SIA area as a combination of standard ONS geographies:
   - For areas in England:
     - LAUs (Local Authority areas Level 1) or LEP (Local Enterprise Partnerships)
   - For areas in Wales:
     - LAU (Local Authority areas Level 1) or NUTS3 (European Statistical Classification Level 3)
   - For areas in Scotland and Northern Ireland:
     - NUTS3 (European Statistical Classification Level 3)

3. We developed a list of 'in scope' areas for each of the shortlisted SIAs and circulated them to the consortia for amendments and validation

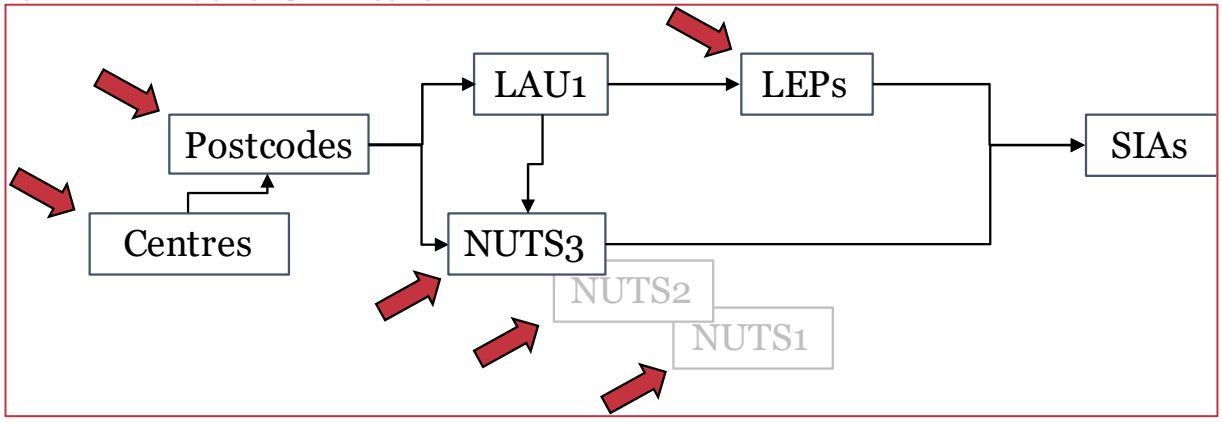
Wave 1 of the SIA Exercise had all potential types of geographical cases, plus a combined SIA:

- England SIAs: Midlands Engine; Manchester and East Cheshire; and Sheffield and Lancaster
- Other home countries: Edinburgh and the Lothians
- SIA area across UK home countries: South West England & South East Wales

One of the five SIAs comprised two discontinuous geographical areas (Sheffield and Lancaster), while another was focused on a single theme (Edinburgh and the digital economy). The Wave 2 applications revealed further configurations, with for example, the offshore renewables SIA encompassing multiple local clusters (in discontinuous areas) throughout Scotland and England. There were also many instances where SIAs overlapped, Wave 1 to Wave 2 and Wave 2 to Wave 2. The complex and overlapping geometries make it harder to produce and explain the core data (economic or innovation related) on the one hand and emphasise the importance of more thematic data on the other. The latter is not readily available however, and often requires primary research, which can be costly, particularly where comparative national and international data are sought. Data science techniques are helping to square the circle, however, the emphasis of the SIAs on specific strategic opportunities will place a premium on bespoke analyses for the foreseeable future.

Each dataset has different levels of aggregation, ranging from NUTS1 areas, to Local Enterprise Partnership (LEP) areas, down to postcode-level data. One of the main steps is to devise a methodology to reconcile the data that we have collected at different levels of aggregation to SIA-level, so that relevant information can be extracted (Figure 4)

Figure 4 - Levels of geographical aggregation



Source: Technopolis (2016)

Getting data at the right level of aggregation requires an understanding of the indicator sources and some manual fine-tuning. The objective is to query each data source to obtain the best possible resolution available, while avoiding double counting. For example, if we have data only at LEP level and these LEPs overlap, we provide data points for the different LEPs in the SIA are but we don't add them up. If we have data at LAU or NUTS3 area, we know that these do not overlap, so we can aggregate the results (if it makes sense). If we have discrete information, such as companies, projects, participations, etc. we link the information at postcode level and provide aggregates at the LAU and SIA level. In the case that we have data at Centre-level (e.g. REF, HEB-CI), we jump through an enhanced version of Digital Science's GRID Database, to link centres to their location.

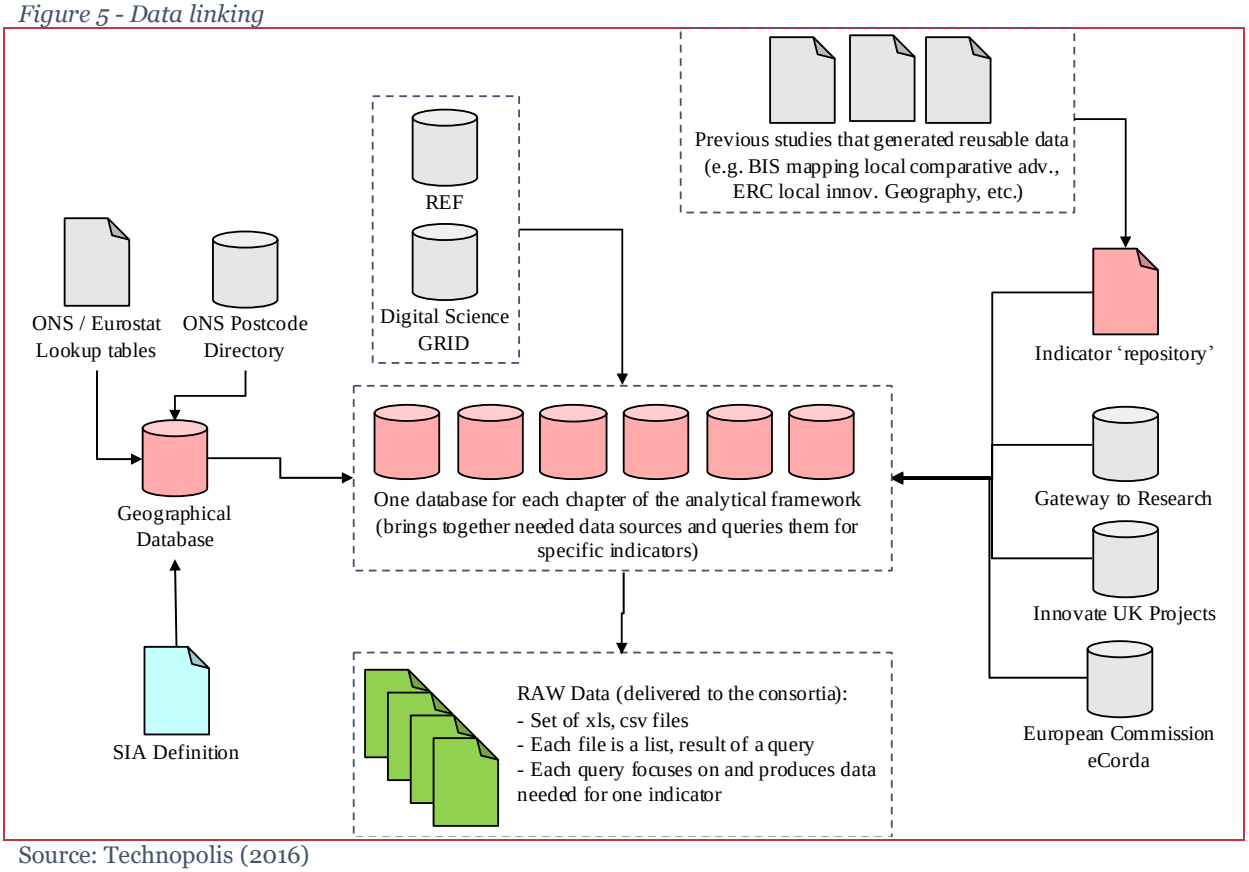
The final dataset was built as a collection of 'loosely coupled' MS Access database files. This is a useful construction at this pilot stage, as it allows Technopolis, BEIS and the SIA consortia to play with the data and query definitions using any desktop computer. However, going forward, it is possible and

good practice that these are exported to an open format such as CSV and SQL files, such that they can be shared more widely.

- Geographical information: A database file with geographical information contains the SIA definitions, through a link to an excel file that can be updated easily and each SIA is given a unique SIA identifier, since SIA areas have no equivalent ONS unique ID. We also import ONS and Eurostat lookup tables for several geographical classifications, as well as the latest snapshot of UK ONS postcodes (containing ~2 million items). The output of this database is a set of queries that produce lookup lists that allow us to 'translate' from the SIA Identifier, to a list of LEPs, LAU1s, NUTS3, and Postcodes in each SIA area
- An 'indicator repository': We have dumped all the information that we have re-used from previous studies into a table that we call 'indicator repository'. We then have coded each data point to its corresponding ONS geography ID. This is a process that has been done through a combination of fuzzy matching and manual coding. This large table is imported any time a query needs an indicator from a previous study
- Other databases: One-off or continuously updated data sources which are comprised of multiple tables and are more complex (such as the Gateway to Research and the Results of the REF), live each in their own database files. As long as we have unique identifiers at the right geographical level, we can produce adequate links through queries, which produce indicators at relevant levels of geographical aggregation. We carry out those queries in a separate database files, where we bring together all the data sources needed for each chapter of the methodological framework

All these data sources come together under specific database files for each of the sections in our analytical framework. In them, the queries for each indicator were assembled, and the results exported to a series of raw data files that were shared with the consortia, so that they could do their own further analysis and visualisation (Figure 5).

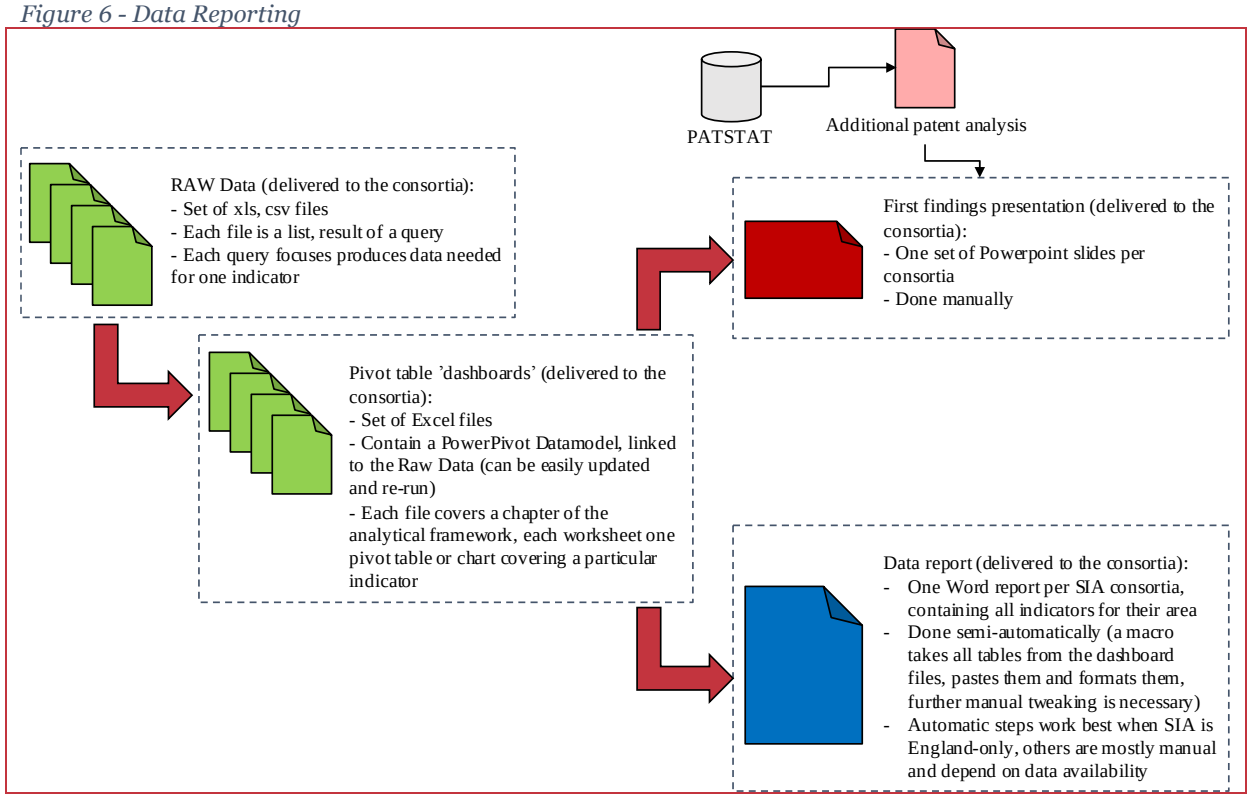
Figure 5 - Data linking



Source: Technopolis (2016)

The raw datasets provided by Technopolis were accompanied by a set of reporting deliverables, comprised of data reports and PowerPoint presentations with comprehensive explanatory text of the main highlights (Figure 6). This was well received by some consortia but appears to have possibly overwhelmed others. For Wave 2, we will sit with the partnerships to explain what they have at their disposal and how to go about making best use of these materials. In addition to strengthening our engagement, we may suggest a shorter list of key indicators.

Figure 6 - Data Reporting



Source: Technopolis (2016)

The bottom-up nature of the SIA exercise also meant the definition of priority themes or topics was particular to the consortium in question, and was not necessarily consistent with other SIA's scoping of broadly analogous fields or indeed existing national classifications. As an example, the Wave 1 SIAs comprised multiple definitions of the digital economy, which did not align neatly with definitions used by ONS or the research councils for example.

Since many of the core datasets either had no thematic classification of relevance to the SIAs or they used a set of categories that were a poor fit, we opted for providing all the data to consortia and to highlight those thematic areas where there was more concentration of activity in each of the indicators. We also, together with BEIS, mapped all the thematic 'aspirations' of consortia into a broad set of domains, in order to figure out possible patterns and whether we could 'go up a level' in providing relevant data by topic (Figure 7). We managed to achieve this for most data sources consisting of entity-based records (a project, a participant, etc.) but not for the broad indicators. In these cases, requesting both a geographical and thematic disaggregation very quickly turned into a disclosiveness problem. We had these types of issues with Community Innovation Survey (CIS and UKIS) data and when requesting occupation data to National Records Scotland, for example.

For many STI data sets, we were also repeatedly faced with questions relating to the 'headquarters' effect, where corporate headquarters in London for example register activity that is occurring elsewhere in the country (e.g. patents, R&D tax credits, etc.). This is common to many current official

datasets, and cannot be mitigated easily, which is why local knowledge is needed to comment upon or adjust such data.

We also found that these various data challenges are not always well understood, and that the SIA partnerships often need careful explanation as to the limitations of the existing datasets, to minimise the risk that useful evidence is not used at all or is used without the appropriate supporting explanation and caveats. We recognised there is a need for greater care around the provision and briefing about the utility and use of available data, and will place more emphasis on this kind of capability building in Wave 2.

Figure 7 - Different examples of thematic priorities of consortia

SIA_ID	Broad Domain	Sector (as mentioned in the EoI)
SIA0001	Energy	Energy
SIA0001	Health	Health innovation
SIA0001	Advanced Manufacturing	Advanced Materials
SIA0001	Digital	Digital
SIA0001	Bio-economy	Industrial biotechnology

SIA_ID	Broad Domain	Sector (as mentioned in the EoI)
SIA0003	Energy	New Energy Systems
SIA0003	Health	Health innovation
SIA0003	Advanced Manufacturing	Aerospace and Advanced Engineering
SIA0003	Advanced Manufacturing	Next generation microelectronics
SIA0003	Digital	Digital Living Innovation Platform
SIA0003	Bio-economy	Environment and Sustainability
SIA0003	Other	Resilience

Source: Technopolis (2016)

4.2 Lessons learned from the data provision and recommendations

- There is a wide availability of public sector datasets focusing on different aspects of the science and innovation landscape in the UK. From patents, to research and innovation projects to the results of the national assessment of universities (REF), there is an open dataset that can be re-used and analysed in different contexts. Data holders consulted as part of the exercise have been generally welcoming to the idea of us reusing their data for the SIA exercise, and some have volunteered and contributed with additional cleaning and generating lookup tables to make our work easier. On the other hand, some other data holders have expressed doubts at the complexity of what we were aiming to do and reservations about the caveats of their own data holdings and the extent to which the data could be misused or taken out of context. These are all legitimate concerns, since this is the first time that the SIA exercise is run, we took a more 'explorative' approach to working with the data, and the caveats of different datasets are often not openly documented.
- Data custodians are increasingly not only providing access to part of their data holdings in open formats, but are also developing single-source analysis dashboards and web based tools to allow users make sense of the data. For example, HEFCE's maps on Higher Education and Local Growth[2], Innovate UK Innovation Maps[3], UKTI and OLS Life Sciences Company Maps[4], etc. Sometimes, these services are labelled as pilots or BETA services, or are experimental in nature. This area is a very fast-moving target, with many data holders currently improving on their internal Business Intelligence systems and aiming to provide more structured information and analysis, both to their stakeholders and to the public. It is therefore difficult to keep track of all

[2] http://www.hefce.ac.uk/analysis/maps/

[3] https://innovateuk.blog.gov.uk/tag/innovation-map/

[4] https://www.lifesciences.ukti.gov.uk/map/

these initiatives since no single point of access exists and new services are emerging or being discontinued all the time

- Data underpinning previous one-off studies is only available in selected cases. This type of data is also useful, especially when indicators have been constructed through access to the original statistical microdata, and present geographical or thematic aggregations not openly available anywhere else. These studies and analysis papers, of which there is an increasing number at LEP-level, have provided many of the indicators that are necessary to populate our analytical framework. On the other hand, these sources seldom cover all the UK Home Countries (contributing to an uneven data availability in SIAs covering non-England territory), quickly become out-dated without the possibility of updating (unless the same type of study is re-commissioned), and require complex and sometimes manual ETL[5] processes and addition of unique identifiers before they can be linked to others. Examples of these are the study "Mapping local comparative advantages in innovation" commissioned by BEIS in 2015[6]
- The study team attempted to access the statistical microdata for several of the indicators where the availability or level of aggregation was not entirely satisfactory, with varying degrees of success. Data on student populations and HEB-CI survey results was obtained for several consortia and the costs and procedures involved probably mean that this microdata can be bought and accessed for all consortia in Wave 2, resulting in improved and more up to date information for the indicators that build on these sources. Other key indicators, including those relating to R&D tax credits, FDI and the UK Innovation Survey (UKIS / CIS), present difficulties of access and re-use due to disclosiveness, which imply that a full analysis of this is only feasible by people with access to the micro-data facilities and the resources to run this analysis. Elsewhere we discovered that universities have very much better access to certain key data sources than would be the case for any consultancy, and specifically the Higher Education Statistics Agency's (HESA) Higher Education Information Database for Institutions (HEIDI Plus), which is a web-based management information service that provides access to very much more detailed and analysable statistics about UK higher education than is available publically. Each of the lead HEIs in the Wave 1 SIAs also had access (charged service) to Elsevier's SciVal service, which provides a level of analytical functionality that goes far beyond earlier scientometric databases (e.g. Scopus or Patstat). We concluded that there will be various indicators, where local analysts will be able to take our preliminary analyses using the core data set and develop those into a much more detailed benchmarking and trends analysis. Subject to any IP or technical restrictions, we would be pleased to be provided with these more comprehensive data in order to run those supplementary analyses on behalf of the SIAs (as part of our ad hoc support)
- In addition to information on the actual dimensions of the analytical framework, access to "infrastructure-type" datasets is crucial. Data coded at geographical level needs a common framework for classification and representation of the different areas. As a result, we have built heavily on data and unique identifiers provided by the ONS, as a way to identify and link different statistical geographies and layers, and by Digital Science's GRID database, to link universities, centres and other research assets to specific geographies. The documentation from the ONS with regards to the hierarchical representation of UK geographies has been critical in order to understand how SIA areas can be deconstructed into a set of smaller statistical geographies. These "infrastructure-type" datasets are the 'spine' that allows us to connect all the other different data sources together, in order to bring together all the information available about a specific place. For entity-based datasets (i.e. those that contain information at the level of specific centre, project participant, etc.) we have gone down to postcode-level matching in order to relate these to geography. We have also improved on some of these databases, for example prior to using GRID we updated its UK NUTS classification to the latest version and used latitude and longitude

[5] Extraction, transform and load (ETL): any operations to be done to data before it is in a format where it can be readily queried and linked using relational database techniques

[6] https://www.gov.uk/government/publications/local-enterprise-partnerships-evidence-on-local-innovation-strengths

coordinates to assign approximate postcodes for centres through reverse geocoding, allowing us to use the dataset for postcode level matching of centres to the SIA geographies

- Access and re-use of public sector data benefits tremendously from synergies generated by the ability to also re-use code and analysis algorithms written by other organisations. NESTA, as part of their Arloesiadur data pilot project[7] are open sourcing code[8] that can be used to retrieve Gateway for Research (GtR) data through APIs. Technopolis used some of these routines to access Research Subject and Research Topic tags for each project in the GtR database, and this has allowed topic level analysis of this data for the consortia. Additionally, this has triggered an internal conversation on how to improve our code documentation and sharing processes so that we are also able to give back to the community
- Our data provision task for the SIAs was an ambitious one, inasmuch as it is one of the first exercises that we are aware of where multiple sources from different custodians are accessed and linked together and pulled within a common analytical framework, using custom geographical constructs. We have taken a more explorative approach during this first wave, focusing more on the possibilities than on achieving absolute accuracy, and testing different types of indicators and data sources to try to understand what is most useful for consortia in this type of exercise. Others, notably the Smart Specialisation Hub, have taken a more focused approach working with a very much smaller set of well-understood STI metrics. This approach is motivated in part by the presumed limitations in capacity and capability on the user side (i.e. within many of the 38 LEPs). It will be important that we continue to share our experiences going forward so that we can all improve in our understanding of what data is more relevant and interesting
- We were given a great deal of support by numerous data providers, which was critical to our ability to produce the volume of material we did in a 6-week window

Our main recommendation for Wave 2 (and 3) is for the national contractor to focus down on a smaller, but still ambitious core data set, and to explore various further opportunities for accessing and recompiling public data sets. This is critical to ensure the core data are up to date and have the right territorial configuration and the best practicable thematic structure. We have assumed BEIS is not in a position to commission an update of key material and studies such like “Mapping local comparative advantages in innovation”.

5 Engagement with consortia and (additional) analytical support

5.1 Engagement

Our engagement with the consortia started during the Inception Phase. The interactions between the consortia and Technopolis happened directly with the core team of three which includes the Project Director (Paul Simmonds), Project Manager (Cristina Rosemberg), and Deputy Project Manager (Xavier Potau).

We took presented the SIA process to the steering groups of each SIA partnership and additionally attended several early meetings with three of the SIAs, by invitation, and then maintained regular contact with each SIA coordinator via email and telephone. During Phase 3 of the process we suggested additional face-to-face meetings with consortia, to help develop their analyses and reporting, however as a result of the pressure on the partnership’s own timetable, this offer was not taken up.

5.2 Additional analytical support

The original budget allocated around 100 staff days for ad hoc analytical support for up to 10 SIA consortia, and the study team gave each consortium a preliminary working budget of 10 staff days to

[7] http://www.nesta.org.uk/blog/arloesiadur-data-pilot-1-mapping-research-networks-open-data

[8] https://github.com/nestauk/gtr

inform their planning. This allocation was indicative, and was expected to be used to varying degrees by different SIAs depending upon the size of the region in scope and the level of internal resource available. To help SIAs with their planning, we suggested the following potential exercises:

- Providing further data analysis to support indicator building (from the set of indicators and data available and described at length in Sections 6 and in Appendix B)
- Providing further analytical support to identify / review any additional external studies or online resources, which may add depth / robustness to a specific hypothesis or SIA report
- Carrying out mini-desk studies, to research a particular topic, through a combination of online research and targeted (telephone) interviews with experts. In this case the analysts would conduct interviews (by phone or Skype) with consortia stakeholders or other experts knowledgeable about the local area. The structure of the interviews will be kept open, as their focus will depend on the needs of the consortia and of each SIA. For reference, it takes 0.5 consultant-days to set up an interview, conduct the interviews (and any necessary follow-ups) and write-up the interview notes

On several occasions we provided further examples as to how we could help the consortia to produce further content for their respective assessments. As an example, we prepared a case study on 'Oncology', following a suggestion made to the Manchester and East Cheshire SIA partnership, as part of our feedback on the first draft of their final report. This 'taster' is presented in Appendix A.

Where we produced specific outputs – new tables, briefing papers – we shared the material with all five SIAs, and not just the commissioning group. We hope this openness would be strengthen the work in general and we also saw these deliverables as a marketing platform of sorts, helping consortia to understand what others were doing and where we might be able to provide additional support to them.

In the end, this sharing of materials produced only mild interest from other consortia and few related 'commissions.' Again, the consortia had fixed on their own trajectories and with the tight timetable it was not practicable for most of them to be quite so reflexive or open to new material.

Ultimately, we delivered about 60 staff days of ad hoc support. Table 3 provides an overview of the support providing to consortia during this phase. In several cases, the SIA partners commissioned another contractor to provide more extensive and specific technical support, and made less use of the national contractor as a result.

Table 3 - Description of analytical support

Consortia	Description
All	• Thematic analysis of Gateway for Research projects in the SIA area • Patent analysis using PATSTAT data
Edinburgh and Lothians	• Requested custom data to Scottish Statistics Agency (they were not able to provide due to disclosive nature) • Requested data at institution level for HEB-CI survey • Comparison of GVA metrics of SIA area, constituent areas and international comparators
South West England & South East Wales	• 2nd pass at the data report, looking at indicators for Wales manually and better integrating some of the results to arrive at estimates at SIA-level (where possible)
Sheffield and Lancaster	• Re-run the data report also considering a set of 'secondary geographies'
Midlands Engine	• Re-run the data from Gateway to Research to include also Innovate UK projects (instead of having the two of them in different queries)

Consortia	Description
Manchester and East Cheshire	• Greater Manchester and East Cheshire commissioned a short exercise to examine supply chain relationships and innovation within the consortium area, focusing on the five areas/sectors of interest for the SIA • The exercise was based on desk research and telephone interviews with companies based in the region (primes and their supply chain) in the areas of ICT and digital, Energy, Health innovation, Industrial biotech, and Advanced materials • To reach suitable firms to consult, Technopolis coordinated with: New Economy Manchester, Midas (Greater Manchester's inward investment agency), the Cheshire and Warrington LEP, Cheshire East Borough Council, and the Skills and Growth Company East Cheshire • We conducted a total of five interviews, with four companies and one research and technology organisation. The study resulted in a short briefing note based around four key research questions: – The nature of inter-company relationships in Greater Manchester-East Cheshire – Relationships with science and technology organisations in the region – Important investments and developments – Policy recommendations / requests

5.3 Lessons learned from engaging with the SIA consortia

The following lessons have emerged regarding engagement with the consortia and analytical support:

- We expended double the number of days on data collation / linking / packaging than had been expected, and around half the number of days on ad hoc technical assistance from SIA partnerships. The former was a function of the number of data sets we compiled and the intrinsic difficulty in re-basing those data to work with the variable SIA geographies
- Demand for technical support from the national contractor was reduced in part by the decision of the partnerships to mobilise local consultants (existing contractors, typically), which were able to play a very much fuller support role than was being offered by the national contractor
- There was also uncertainty about the kind of work Technopolis could carry out, and where it would fit into a fast moving and often distributed process. The individual SIA project managers tended to outsource the content generation to a series of thematic working groups. For Wave 2, we would hope to be able to do a lot more. We circulated several good examples of the types of work / outputs we can do (as a taster) and critically we have committed to work directly with the subsidiary groups, rather than indirectly relying on the coordinator / lead author to spot the connection between the need for help and the support on offer
- There was a timing issue too for Wave 1, whereby we were busy preparing the templates / instructions / data at the same time as the SIA partnerships were setting up their working groups, and we were as a result 'late' in getting material to the SIAs and this produced a good deal of frustration. We did not do enough to manage this unavoidable situation, and next time through, we will place greater emphasis on engagement across the piece, to ensure the SIAs understand our respective roles and the kinds of data we will provide and the kinds of technical support they can draw on. Getting closer to their development process will also hopefully help to inject a little more discipline into their use of evidence and the assessment and identification of priorities

Our main recommendation is to work more closely with the consortia from the outset and organise more face-to-face meetings, especially when the data is delivered. We will also attend the early meetings of the Wave 2 thematic working groups, to help ensure the SIA process is fully understood across the consortia and to allow us to get closer to the action, and thereby offer direct advice and suggest additional activities we can take on through our ad hoc support.

6 Quality assurance

6.1 The quality assurance process

In terms of the QA process, we followed a dual approach. The first line of attack was around the robust, transparent and replicable nature of our own process and data. This worked well, albeit we are not yet in a position to hand over a consolidated database to BEIS so others might simply re-run the exercise. This will be part of our final deliverables, due at the end of Wave 2.

Subsequently, we worked with each of the SIA coordinators to QA their reports. This began with checking for compliance with the template, but when we understood people were using the right headings but not linking things up or making persuasive arguments, we quickly switched to a more qualitative approach. We gave bespoke feedback on the early drafts for all of the reports, underlining the need to focus on priority areas and to develop arguments that combined local strengths with global opportunities and set current assets against future economic impact locally. We also asked for more and better data to support those arguments.

In the main, this high-level, directional advice was received with good humour, but in most cases, did not result in major changes in content or style. It was clear that the timetable and distributed authorship was making it hard to redirect the process. We provided further feedback on subsequent drafts, on one or two further occasions for each of the five SIAs, even outlining an executive summary in one case. We also provided more detailed annotated comments to illustrate how we thought the reports could be strengthened. Ultimately, this produced some minor improvements, but most of the higher-level suggestions went unused.

We took the view that our QA was a matter of giving advice on improvements, rather than suggesting authors must change their presentations or indeed anything more hawkish (e.g. this is not compliant or of a sufficient standard, so we will not allow you to submit it to BEIS). These are the SIA partnerships' reports rather than ours, and they will be used locally as well as by BEIS. There is a need to retain their good will; no matter the gaps or inconsistencies, they have all worked hugely hard and produced lots of fascinating detail about their local capabilities.

6.2 Lessons learned from the QA process

Our own internal QA process worked well, and will be run in much the same way for Wave 2, however, it will be documented more formally, as part of the Wave 2 consolidation report, so that the approach can more easily be replicated by BEIS or third parties for Wave 3 and beyond.

It was helpful to provide feedback to authors at two different levels: high-level comments about the completeness and coherence of reports and the kinds of further work that would help to make for a more persuasive presentation; and more specific feedback on drafting, use of data, argumentation, etc.

Looking at a very early draft of the SIA Reports was helpful in confirming the authors had understood the instructions as regards the basic structure and principal elements of the individual chapters. It also revealed an issue about the balance of material presented, between science and innovation on the one hand, and between current capabilities and future opportunities on the other. We were able to give feedback to the authors immediately, which gave time for some adjustments to be made in assembling evidence and developing the narrative and conclusions. We were also able to write back to other authors reasonably quickly with our high level feedback before giving more detailed comments on specific arguments or use of evidence.

Authors said they found this top line advice instructive, however, it was not always easy to address our various points within the time available and with the resources at their disposal. On a positive note, the specific feedback provided on for example, missing references or poor drafting of text, was almost always acted upon.

The lesson for Wave 2 from this experience is that we need to give the high-level feedback early enough in the process to allow the authors and their working groups sufficient time to fix gaps or imbalances. They need to be made aware of this ahead of time too; for the first Wave, we were not in a position to say exactly how the QA process would work. We can do so for Wave 2. It will also be helpful to follow-up with authors immediately to check the feedback is clear and will be looked at, and then again a week or so later to check the extent to which they feel confident their researchers / writers are able to act on the advice. This second check was left undone in Wave 1.

This will also allow us to more carefully check the extent to which we as the national contractor may be able to help with the gap filling, either through our own ad hoc desk research or through more interaction with the respective working groups.

7 Lessons learned workshop

BEIS hosted a closing workshop for the Wave 1 SIA consortia, which was held at the 1VS Conference Centre in London on 7th November 2016. The core teams of each of the five SIA consortia attended the event, along with several other key partners including the team from the Smart Specialisation Hub and Professor Stephen Roper, Director of the Enterprise Research Centre (ERC) at the University of Warwick. The event was intended to allow the SIA partnerships to provide their feedback on the Wave 1 experience, and delegates were given a very simple agenda with just five discussion Topics. The following bullet points capture the main issues arising. They resonate with the lessons captured elsewhere in this report, and have weighed particularly heavily in our final conclusions and recommendations:

- SIA process and communications with BEIS
  - The discussion groups all reported that the partnerships had been clear about the purpose of the SIA process, and fully appreciated the ambition to connect an analysis of local science and innovation capabilities with future market opportunities in a global context.
  - There were surprises about the amount of work involved and the extent to which that would largely fall to the individual SIA partnerships to resource
  - All SIA consortia had found the timetable challenging, given the extent of the work that was required and the fact that the partnerships were often new
  - Greater interaction with BEIS – and with the other SIA consortia – may have made things easier or clearer
- Balance of science, innovation and market opportunity
  - The groups agreed that most of the SIA consortia had found it easier to document current regional capabilities and harder to describe future global opportunities
  - The reports made a better job of presenting the areas' scientific capabilities, and had found it harder to detail local innovation capacity. This is largely a function of data availability, however, several commentators acknowledged that stronger industry involvement in the SIA process would help
  - Business engagement can be a challenge, especially among smaller businesses, where there is a particular pressure on resources. Involving key firms in the core team should reassure business people more generally of the relevance and value of the exercise
  - There was a suggestion that a reworked report structure would help to strike a better balance between current capabilities and future market opportunities, possibly beginning with a view of future opportunities. There was also a view that taking a more thematic approach would have made writing – and reading – easier
- Future opportunities, comparisons with other regions, position in global market

  - Pressure of time and data limitations had made it harder for the SIA consortia to consistently compare their capabilities with those in other UK regions
  - The SIA consortia said they would have welcomed more support with this aspect of their work, and recommended this is looked at again for Wave 2, in order to enhance that aspect of the individual SIA reports
- Analytical support by the national contractor
  - The SIA consortia acknowledged that they had been provided with substantial amounts of data by Technopolis, however, the data and instructions arrived several weeks after the consortia had begun their work and the volume of data was a little overwhelming and meant it was used to a lesser degree
  - The rather granular nature of much of the data was also problematic, inasmuch as it often didn't provide a window on to the specific topic of interest
  - The SIA consortia had mixed views as regards the value of the additional analytical support, with a general recommendation that the contractor should work more closely with the individual teams in future waves in order to more easily identify helpful analytical support
  - Most of the consortia chose to commission additional external support, to ensure they had the necessary analytical capacity at their immediate disposal
- Keeping momentum going
  - The discussion groups all confirmed that the SIA process had been an important building block for the local partnership and that the SIA reports really mark the beginning of the SIA journey rather than the end. The partnerships will live on in most cases, with action plans being developed, and further collaboration on strategy development and project definition. In several cases, further analysis will be undertaken

8 Conclusions and recommendations

8.1 Conclusions

Wave 1 of the SIA has successfully concluded with the production of 5 SIA reports and executive summaries. A substantial amount of information and local intelligence has been brought together as part of the process and we trust that the executive summaries (which are intended to convey the SIA main arguments in terms of the interplay between science assets and innovation capabilities as well as investment propositions emerging from that analysis) will produce some valuable information and conclusions. It is also clear that this is the end of the beginning, and that the individual SIA partnerships are each planning to continue to operate as a regional forum and coordination mechanism to press for implementation – and is some cases further development – of their respective report's conclusions and recommendations.

As originally intended, this pilot has served to identify lessons and recommendations for the Wave 2 and 3 of the SIA process, which are presented in the sub-section below.

8.2 Recommendations

8.2.1 Regarding the SIA report and process

Based on our assessment of the SIA process and report, we identified four key lessons and recommendations

- **Regarding the use of data and evidence.** We recommend that Wave 2 consortia should be required to present a minimum set of (standard) metrics in each chapter, to ensure reports present a more complete evidence base and to ensure the data are presented in a manner that shows local performance relative to national or international benchmarks

- **Regarding partnerships.** We recommend stronger and earlier business engagement in Wave 2, to ensure there is greater attention paid to local innovation strengths and business capacity within the process overall, and within the final SIA reports
- **Regarding the legibility of the report.** We recommend making clearer the need to produce both a short, sharp summary report that makes full use of graphical design and visualisation techniques as well as a more substantive evidentiary report. We also recommend the core chapters of the main report should be organised around the individual hypotheses that have come through the process. This thematic approach would make the reports easier to read and should allow arguments to lead to conclusions in a much clearer fashion.
- **Regarding the hypotheses**. We recommend the SIA partnerships take a more discriminatory process regarding the testing of the hypotheses set out in their respective EOIs

8.2.2 Regarding data provision

We concluded that we should provide the Wave 2 SIA partnerships with a slightly narrower set of core data, in an attempt to reduce the risk of consortia being overwhelmed by material. We also concluded that we would immediately follow up deliver of the core data with a bilateral discussion, to explain the contents of the database and how it might be used and re-used. We will also prepare a first analysis of the core data for each SIA, using the briefing paper to help the partnerships to further understand the utility of the national data sets.

A number of indicators in the Wave 1 core data set were derived from a BIS-commissioned study, "Mapping local comparative advantages in innovation," and were already somewhat out of date in 2016. We agreed to explore ways in which those individual data sets could be directly accessed by the study team, in order to ensure the Wave 2 Consortia have access to the latest statistics practicable.

8.2.3 Regarding engagement with the consortia

Our main recommendation is to work more closely with the consortia from the outset, to ensure the partnerships fully understand the overall SIA process, both within the steering committees and within the working groups. We will pay particular attention to these interactions in the delivery of the core data set and briefing paper, but crucially, we will participate more closely in the individual SIA exercises, attending key meetings of their steering groups and also participating in the early meetings of the thematic working groups. We have also agreed to continue to work closely with the Smart Specialisation Hub, to ensure the SIA and Smart Specialisation processes remain well articulated.

Appendix A : A case study on 'oncology'

A.1 Science and innovation assets

A.1.1 Health innovation and oncology

Manchester and East Cheshire have an historical and strong capability in cancer research, with several worldclass cancer research institutes and larger numbers of researchers working on related topics.

The big research centres include

- The Christie NHS FT's cancer centre
- The Manchester Cancer Research Centre (MCRC) - a partnership between the UoM, and Cancer Research UK which will house an additional 150 scientists and a further 100 clinical trials
- UoM Institute of Cancer Science
- The Cancer Research UK Manchester Institute - one of only three such major centres nationally. The site has helped lead work on the first human trials of the EGFR inhibitor, Iressa, as well as anastrozole (both AstraZeneca).
- MCRC is also the base for the **Cancer Imaging Centre** (joint project with the University of Cambridge) which serves as focal point for research in areas such as optical microscopy, magnetic resonance imaging, ultrasound, and Positron Emission Tomography
- Additionally, the **Proton Beam Therapy Facility** currently under construction (one of only two such facilities in the UK) will link to local research expertise in nuclear. Helping clinicians learn about how tumours feed and grow, how cancer cells signal to one another, the environment surrounding tumours and molecular and genetic signatures
- Plans are underway to establish a **National Centre for Cancer Biomarkers** which will link across to the new **Medicines Discovery Catapult** in Alderley Park, and stratify high-risk groups using genomic, environmental and imaging biomarkers to modify future cancer risk – acting as a global hub that will direct individual treatment plans

A.2 Science and innovation talent

A.2.1 Health innovation and oncology

The SIA report shows the great strength of UoM in medical and health-related research, complementing the overview of major assets

The presentation would be strengthened if it were possible to estimate the numbers of public and private sector researchers involved with medical research (and oncology)

And how many postgraduates – medical sciences – graduate each year and are available to work with local research centres or technology businesses

A.3 Innovation strengths – health innovation

A.3.1 Regional businesses

The SIA report would benefit from an overview of the healthcare companies in the region that benefit from the area's research strengths already and may be well placed to exploit those assets in pursuing the anticipated expansion in global sales of cancer-related diagnostics and treatments.

The SIA report mentions various companies at different points, including

- Astrazeneca in Cheshire

- Sanofi in Cheshire
- Bristol-Myers Squibb and Novartis in the Liverpool and Wirral area

Significant or innovative firms in GM/ EC involved in personalised medicine including medi-tech, e-health, devices and consumables are eLucid mHealth Ltd, ISOSEC, Phagenesis, and Brooks Life Science Systems. The major firms in the Analytics and Diagnostics sector in GM include Intertek, Kratos Analytical, LGC, Hologic, Thermo Fisher Scientific (Cheshire), Life Technologies (Cheshire), Waters (Cheshire) and Qiagen.

A.3.2 International competitors

PMLive publish a top 20 list of global pharma companies by oncology sales. The table presents the list ranked by revenue for 2014, the latest year available at the time of writing. It also shows growth in global oncology revenues from 2013, and each company's ranking in the same list for each of the three preceding years. The table and figures have been compiled from GlobalData's pharmaceutical revenue figures, which are based on sales of prescription medicines, including generic drugs. The list includes a further 14 companies, which had appeared in the top 25 in one or more of the three preceding years.

Table 4 - Top 20 Pharma Companies by Global Oncology Sales for 2014

	Company	2014 ($m)	Growth 2014 (%)	Rank 2013	Rank 2012	Rank 2011
1	Roche	25151	2	1	1	1
2	Novartis	10264	8	3	3	3
3	Celgene	7485	18	4	4	4
4	Johnson & Johnson	3991	19	5	5	6
5	Bristol-Myers Squibb	3530	20	9	11	12
6	Lilly	3394	4	6	9	8
7	Takeda	3265	3	10	8	10
8	AstraZeneca	2937	-5	7	6	5
9	Merck & Co.	2696	-11	8	7	9
10	Amgen	2057	39	2	2	2
11	Pfizer	2022	2	11	12	11
12	Astellas	1913	27	14	20	21
13	Bayer	1483	14	13	19	16
14	Otsuka	1419	22	20	16	18
15	Sanofi	1237	-5	15	10	7
16	Merck KGaA	1161	2	16	14	14
17	Eisai	1127	1	18	17	19
18	AbbVie	778	-1	21	21	20
19	Pharmacyclics	510	3543	-	-	-
20	Incyte	407	54	-	-	-
-	Biogen Idec	1138**	17**	17	15	17
-	Dendreon	325**	24**	-	25	24

	Company	2014 ($m)	Growth 2014 (%)	Rank 2013	Rank 2012	Rank 2011
-	GlaxoSmithKline	1377*	12*	12	13	13
-	Gilead Sciences	352*	1*	24	-	-
-	Ipsen	701*	2*	23	22	22
-	Kyowa Hakko Kirin	1014*	2*	19	18	15
-	Onyx	350**	23**	-	24	23
-	PDL BioPharma	292*	17*	25	-	-
-	Teva	709*	17*	22	23	25

Technopolis computation based on GlobalData's pharmaceutical revenue figures, http://www.pmlive.com/top_pharma_list/oncology_revenues
Notes:
* = 2013
** = 2012

The figures relate to the companies' global activities and not their UK operations, however, the table does confirm the presence of several world-leading oncology companies in the Manchester and Cheshire region.

AZ has seen a decline in its global oncology sales each year since 2011, and has fallen from world number 5 and US$3.7 billion in 2011 to world number 8, with global oncology sales of US$2.9 billion for the FY 2014. A quick review of AZ's position suggests in the North West also suggests the company may no longer represent a major opportunity for regional growth. AZ closed its Alderley Park R&D unit in 2013, with a loss of 700 jobs, and a laboratory in Brixham, Devon, alongside the building of a new £330m global headquarters for the firm in Cambridge. It has however committed to open a new manufacturing site in Macclesfield in Cheshire to manufacture Zoladex – a prostrate cancer treatment – which is scheduled to open in 2016, and will create 300 jobs. However, the company's UK-based oncology R&D will be undertaken at its Cambridge site primarily, albeit it remains hugely engaged with oncology research, with over 50 oncology therapies are in various stages of trials (https://www.astrazeneca.com/our-science/pipeline.html).

A.4 Developments internationally

Health innovation and oncology

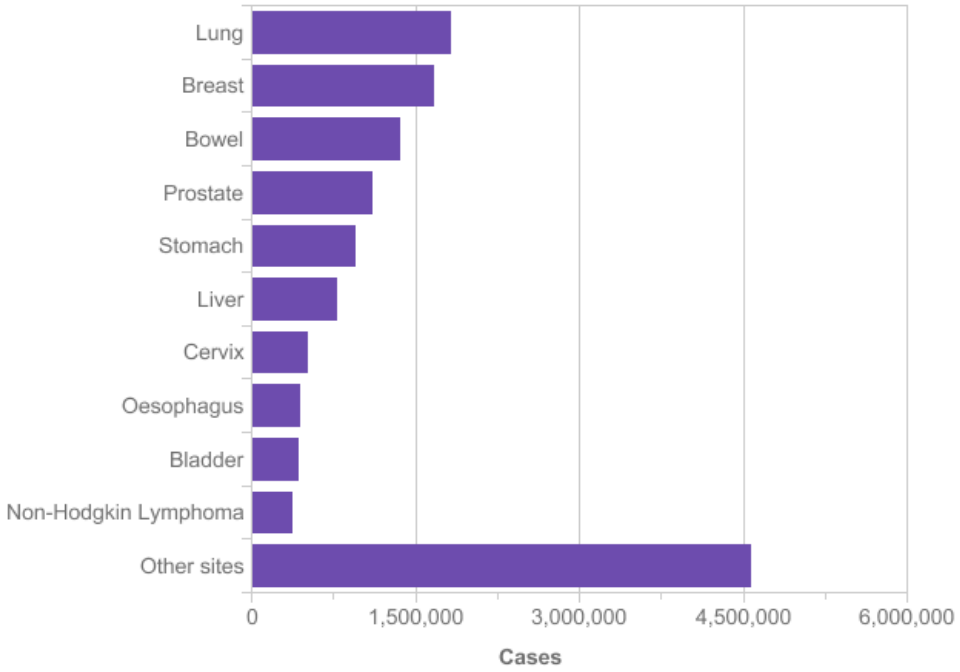
- The incidence of cancer has been increasing, with changing lifestyles and ageing populations. Particularly so in emerging and middle income economies
- At the same time as the world has become better at screening, diagnosing and treating
- Advances in oncology research are yielding new determinants and a greater understanding of the diseases progression
- Cancer diagnostics are moving forward quickly too, including next generation sequencing to allow comprehensive genomic profiling (multi-gene diagnostics) and data analytics
- An IMS Access Point report (special edition on oncology, Volume 6, Issue 12, May 2016) suggests there are 100+ molecules in development (Phase III development) and that around 70% are targeted. The most common projects relate to lung, breast and gastric cancer. Around one third of the oncology drugs launching in the next five years are expected to have biomarkers, many of which will be newly discovered genes or specific mutations. IMS estimates suggest that 30% of all drugs sold will be cancer drugs by 2020 (IMS oncology report 2016)

Cancer Research UK publishes a World Cancer Factsheet, which presents statistics from the International Agency for Research on Cancer (IARC). The latest available Factsheet (January 2014) states that there were around 14.1 million new cases arising in 2012. There were around 8.2 million

cancer-related deaths in the same year. The IARC statistics estimate that 32.5 million people had been diagnosed within the five years previously were alive at the end of 2012.

Lung, female breast, colorectal and stomach cancers accounted for more than 40% of all cases diagnosed worldwide. In men, lung cancer was the most common cancer (16.7% of all new cases in men). Breast cancer was by far the most common cancer diagnosed in women (25.2% of all new cases in women).

Figure 8 - The 10 Most Commonly Diagnosed Cancers: 2012 Estimates



Source: prepared by Cancer Research UK, from IARC statistics

If recent trends in major cancers are seen globally in the future, the burden of cancer will increase to 23.6 million new cases each year by 2030. This represents an increase of 68% compared with 2012, with substantial growth in incidence rates among medium income countries. One also sees markedly different incidence rates by type of cancer across the world, which suggests there will be very different regional markets.

A.5 Developments in the wider funding landscape

Public and charity research funders have developed close synergies and have refined their strategies and focuses accordingly. For example, the Wellcome Trust does not fund cancer research anymore. MRC is also increasingly concentrating on targeted funding to tackle emerging health challenges such as antimicrobial resistance and dementia. Alliances with the NHS and NIHR as well as the biomedical/pharmaceutical industries are also becoming more focussed and stronger. For example, MRC's stratified medicine programme.

In oncology, CRUK remains the main research funder. Their ambition is to accelerate progress in cancer research and see three-quarters of people surviving the disease within the next 20 years. They have a four-fold strategy: prevention, earlier diagnosis, develop new treatments and optimise treatments for each patient. There is room for more public-private R&D collaborations in these areas as follows:

- Prevention: Vaccines, drugs

- Diagnosis: imaging technology, diagnostic tests, biomarker discovery
- Treatment: drug discovery, combination therapies, immunotherapy, technology to deliver precise radiotherapy or perform surgery less invasively
- Optimisation: personalized/stratified/precision medicine

These research areas also leave room for smaller biomedical companies and contract research organisations to provide services to larger companies like AstraZeneca on a supplier or outsourced basis. This might include biopharmaceutical or medical device development, biologic assay development, commercialisation, preclinical research, clinical research, clinical trials management and pharmacovigilance.

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