Department for
Business, Energy
& Industrial Strategy

South West England and South East Wales Science and Innovation Audit

Annex N: Business Cases

A Science and Innovation Audit Report sponsored by
the Department for Business, Energy and Industrial Strategy

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Annex N: Business Cases

Our planned investments cover a timeline of projects currently in the bidding process, those that are under development and opportunities emerging from our audit that are the new opportunities. The following projects have a 2-page project profile in this Annex:

New proposals at Outline Business Case stage:

- High Value Engineering Design & Systems Integration Capabilities (Bristol)
- Digital Innovation Hub (Bristol)
- Digital Innovation Specialist Centre: Institute for Environmental Risk (Exeter)

Projects under development:

- National Composites Materials Centre (Bristol)
- Oceansgate Marine Industries Production Campus (Plymouth)
- Compound Semiconductor Cluster (Cardiff)
- Institute for Sustainable Technology Innovation (Wiltshire)
- Berkeley Science and Technology Park (Gloucestershire)

Bids in progress:

- Institute for Advanced Automotive Propulsion Systems (GD3 & RPIF) (Bristol)

New proposals at Outline Business Case stage

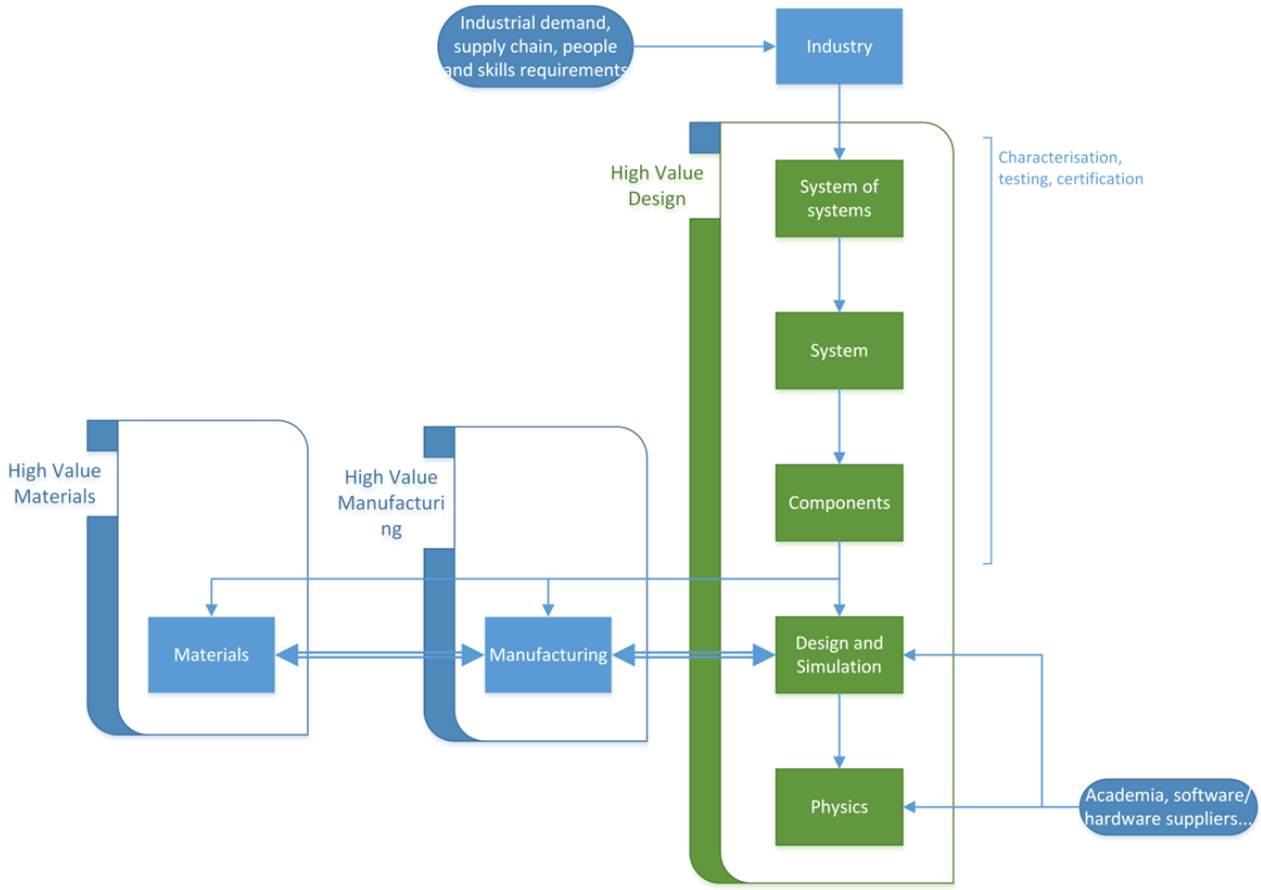
Project Title: Securing excellence in High Value Design (HVD)
Current Status: The Challenge: The UK aerospace sector is the 2nd largest in the world, with proven experience in the design and manufacture of complex major components and systems. However, a number of factors have contributed to a situation where the UK aircraft design capability has suffered decline for a number of years and this now threatens the future of the UK Aerospace Industry. Notably, the extended period between new aircraft development programmes, combined with retirement of experienced Engineers, is leading to a growing “capability gap”. **The Solution:** Continued success depends on retaining excellence in design in the face of growing international competition. “High Value Design” is the intellectually-intensive activity associated with architectural definition and integration of a complex product, its major components and systems. Engineers and designers involved in the conceptual / architectural design phase have the greatest influence on overall product specification and thus the subsequent selection and optimisation of technologies and systems. Other industrial sectors face similar challenges, and opportunities for cross-sectorial support and benefits have been identified. Urgent action is needed to ensure future competitiveness of HVD in the UK, and to demonstrate this to the global market. Investment in improving the “design productivity” of UK-based engineering teams is essential. Proposals include the formation of a “High Value Design Institute” (HVDI), dedicated to

delivering the next generation of engineering design capability in the region as part of a national HVD capability initiative. This project is at a formative stage but has support from some of the UK's largest aerospace companies. A number of OEM's and first tier suppliers have independently identified the need for urgent action to support the UK's vital HVD capability. This was confirmed when aerospace stakeholders met to discuss the SIA. The UK Aerospace strategy has identified this as an area of importance. The Aerospace Technology Institute[1] is currently carrying out a strategic review of the topic.
Partners: Currently: Airbus, Rolls-Royce, Leonardo Helicopters, GKN, Dowty Propellers, together with West of England Aerospace Forum, regional universities and the National Composites Centre. It will ultimately form part of a national programme and links to other organisations, other sectors across the UK and beyond are being established.
Strategic Case: The market for civil aircraft over the next 20 years is forecast to be worth over $5tn. New market opportunities for low earth orbit vehicles and unmanned air vehicles continue to emerge. We must be positioned to maximise the exploitation of this growing sector. Strength in HVD will have the greatest influence on productivity and competitiveness acting as critical backbone to stimulate growth in the UK's aerospace industry. The extended period between new aircraft development programmes, combined with retirement of experienced Engineers, is leading to a growing "capability gap". Developing Engineers can no longer gather experience in delivering all-new products as manufacturers focus on derivatives to existing products. Overseas investment in HVD capability is increasing in response to recognition of the need for action, threatening to improve local competitiveness to the detriment of the UK. Without immediate action, there is a real danger that vital HVD capabilities will be lost making it difficult, if not impossible, for the UK to bid for future high value design and manufacturing opportunities. With appropriate support, the UK aerospace industry has the opportunity to take a global leadership position on the "digitalisation" agenda (the design process and digital services). This proposal seeks to address some of the fundamental challenge articulated in the Aerospace Growth Partnership's Means of Ascent, Industrial Strategy for UK Aerospace 2016 which states that 'HVD is essential to high value manufacturing'. Current indications are that a HVDI would be an effective means to co-ordinate a programme of capability development and demonstration. Such an environment would give the "next generation" chance to learn from experienced practitioners, but also allow them the opportunity to explore innovative ideas that can form the basis for future products and services relevant to evolving market demands. The UK must also proudly demonstrate its proven capability if it is to influence the investment and procurement decisions of international stakeholders. Our audit areas is well positioned to host elements of such an Institute as it is home to significant capabilities within leading aerospace OEM's and supply chain companies, leading universities, HPC capabilities and the National Composites Centre (part of HVMC).
Economic Case: The case for investing in HVD is robust. c128,000 people are employed within UK aerospace, with 154,000 jobs in associated businesses. Within aerospace itself,

[1] Technology Strategy & Portfolio Update (July 2016) http://www.ati.org.uk/strategy/publications/

at least 26,000 people are engaged in design and Engineering-related activity. Aerospace generates over £31bn pa T/O, with £27bn exports pa. BIS figures (Growth is our business - Professional and business services strategy (2113)) showed Engineering Consultancy (a key provider and user of HVD-related activities) accounted for 14% of GVA delivered by the Professional and Business Services sector. Without developing and retaining vital capability, there is a danger the UK's competitive strength in advanced engineering design will be eroded with the consequential loss of high quality jobs, GVA and tax revenues. Many of the companies in aerospace are transnational with headquarters / shareholders globally. Excellence in HVD capability and productivity is essential if the UK is to retain competitiveness and the accountability for the design (and thus manufacture) of complex systems and products in the face of growing competition from overseas providers. Similar issues are faced by other sectors including automotive, nuclear and renewables. It therefore follows that the benefits of investing in the UK's HVD capability would be felt across many sectors other than just aerospace, benefiting the wider UK economy.
Commercial Case: The project is at a conceptual phase and relevant stakeholders are engaged in defining it. Means of addressing the challenges facing those engaged in HVD are being developed. There is a need to bring people together and develop innovative solutions to complex challenges. Whilst there could be a need for new premises, the aim will be to make use of existing infrastructure where possible.
Financial Case: Work is underway to define the financial model associated with this project. These studies are drawing in experience from similar initiatives to ensure that best practice is adopted and that any solution is financially robust.
Management Case: Whilst many businesses have significant order books, many engaged in HVD are facing a reduced workload while future market drivers evolve. Consensus amongst our aerospace community of the need to develop this into a firm proposal which could be undertaken within 3 months if this business case is accepted by BEIS.

Figure N1: The importance of High Value Design in retaining System of Systems capability within the UK



Project Title: Digital Innovation Hub
Current Status: An Outline Business Case, based on the Five Case model, has been developed for the **Digital Innovation Hub** (DIH) addressing the research, innovation and skills needs of the region's world leading digital companies.
Partners: University of Bristol is the lead organisation. Partners include Bristol City Council, a range of private sector partners such as Oracle, Nokia, IBM, BAE, Airbus, Axa, and other public and third sector partners such as GCHQ and Bristol Health Partners.
Strategic Case: University of Bristol is proposing a major new facility within Bristol city centre, radically different from a conventional university. Rather than re-implement the traditional organisational structure and operational practices of a UK research intensive university, it will be an innovative new style of higher education facility, designed from the ground up to be suited to the needs of the 21st Century. Referred to by the working title Digital Innovation Hub, it will be a major generator of the skilled graduates, underpinning technologies and innovative applications needed for the modern knowledge economy of digital goods and services. Initially, it will house researchers with world class specialisms in core technologies such as data analytics, cybersecurity, communications and networks and in applications areas including digital

health, smart cities, transport & autonomous systems and creative digital technologies. Over the life of the facility these will change to remain at the leading edge of digital innovation.

Staff and students of the University will be co-located with, and working alongside, partners from a variety of relevant industries ranging in size from start-ups, through SMEs, to major multinationals, on an annual cycle that rejects the traditional notion of an "academic year". The activities of the students, staff, and industry partners will be focused on challenge-based research and education, co-created, co-developed and co-delivered by the University and its corporate collaborators, developing graduates with sought-after skills in technology research and development in a commercial context, in innovation, and in entrepreneurship. The intended location of DIH places it at the core of the Bristol & Bath technology cluster and it will have strong and supporting links with specialist digital centres regionally (such as the Institute for Environmental Risk proposed elsewhere in the Science and Innovation Audit and regional incubators for digital start-ups), nationally including the Digital, Transport, Energy Systems and Future Cities Catapults and internationally.

Policy supports the development of the Digital Innovation Hub at a national, local and university level. Four principal objectives for development of research, innovation and the digital economy have been identified from a review of UK policy documents: *growing the digital economy*; *providing skills for the digital economy*; *maintaining world class research*; and *enabling collaborative research*. These are supplemented by local support for the digital economy, innovation, inward investment, and collaboration between industry, the public sector and academia. The University of Bristol Strategy (2016) has clear recognition of, and desire to build upon a close relationship to the wider city, particularly with reference to the 'city as a testbed' for digital innovation, and also sets out to explore the development of a new campus.

Economic Case: The Economic Case demonstrates that the Digital Innovation Hub represents good value for money, generating approximately £153m in present-value GVA benefits through additional employment in the local economy. This monetised benefit represents only the impacts of direct employment in the building itself, plus the knock-on income effects of these jobs and student expenditure within the economy. This is expected to be a relatively small benefit in comparison to the wider economic impacts of the project, that will extend to the national economy as a result of:

- Research itself
- Research becoming innovation
- Talent generation (employees)
- Talent generation (entrepreneurs)
- Collaborative research and networks (inc. SMES)
- Inward investment and retention
- New business creation & scale up
- Cluster impact

The above benefits have been assessed qualitatively and mapped to the set of market and systems failures that lead to their under provision in the absence of public support. Although challenging to measure quantitatively, current evidence suggests their scale is significant, contributing both to the success of the local economy and in maintaining UK competitiveness by driving productivity and economic growth.

The Economic Case has discounted alternative options, such as the "Do nothing" option, an option to develop a new building at the current Clifton Campus and another option for a site outside the city centre, on the basis that they do not meet the strategic objectives of

the University, city or wider economy. The preferred option taken forward to appraisal is the **DIH** at the Temple Quarter Enterprise Zone (TQEZ). The location in the Enterprise Zone, adjacent to a major transport hub and in the centre of the Bristol and Bath digital cluster has many benefits. This is compared against a low cost "Do Minimum" alternative of extending the existing Merchant Venturers Building, which in comparison delivers just over £2m in GVA benefit and very little in terms of wider economic benefits, representing only a marginal increase in the scale of activity, with little prospect for in-house collaboration with industry.

Commercial Case: A range of procurement options are still being considered for a building for the DIH activity, the most likely being that the University will design and build a new building that it would own, maintain and operate. To this end, available land has been identified in the TQEZ, and an acquisition strategy is being developed. Procurement will be compliant with OJEU processes. The contribution of the private sector will be crucial, and early engagement has been positive.

Financial Case: An outline project budget has been developed based on the best available assumptions at this stage, which for the medium scenario (18,000m^2) is an estimated £107m. Finance will need to be secured, and a possible breakdown is set out:

Source of Finance	Capital/Recurrent	£m
University of Bristol	Capital	**17**
Business and private sector	Capital + Recurrent	**40**
West of England LEP LGF	Capital	**15**
UKRPIF	Capital	**20**
UK Government	Capital	**15**
TOTAL funding required		**107**

Note: This table represents a possible breakdown of costs, based on University of Bristol experience and early discussions with stakeholders / funders.

Management Case: An initial timeline has been developed, targeting a completion date of summer 2021. The University has a range of experience in major capital project delivery, including the National Composite Centre. Ongoing management of the DIH building and programmes will fall within existing established faculty structures.
Major risks have been identified at this early stage and mitigation measures outlined. The approach the University and partners take to active risk management will specify the roles and specific responsibilities in managing risk, as well as how risks are identified, assessed, addressed and escalated through the projects governance framework.

Project Title: Institute for Environmental Risk & Innovation (IERI)

Current Status:
Concept Development – further detail and business case in development.

Partners:
Jointly led by Met Office and University of Exeter. Partners from across public, private and academic sectors – in particular the re/insurance, disaster risk reduction, disaster risk financing sectors and infrastructure sectors. It is expected that the Institute would have

global impact, and involve international governments and UN agencies.

Strategic Case:

We propose an Institute of Environmental Risk & Innovation to drive the development of services that will enable society to become more resilient to Environmental Risk. We estimate that a £60m public investment could deliver a 5-year return of over £500m, with public sector leverage having potential to more than double this.

Society's exposure to extreme weather and climate events threatens to derail the sustainability of economic development and social welfare across the globe, and to threaten the securities on which we rely for our health and wellbeing. Extreme events and severe weather conditions are becoming more frequent, with costs of adapting to these conditions expected to rise to $70-100bn globally by 2030. In the UK the impacts of such events have been brought into sharp focus winter 2013-14 flooding, with estimates putting the insurance costs at £500m and the damage to the UK economy at £630m. The 2015 flooding in North West England again emphasised how exposed and potentially unprepared we are. Delivery of greater economic and societal resilience to environmental risk requires translation of huge, complex and diverse sets of knowledge and information, into actionable intelligence that can be ingested quickly and implemented with confidence. There is now an urgent need, and indeed critical opportunity in the context of international developments such as the Sendai Framework for Disaster Risk Reduction, the Sustainable Development Goals and the United Nations Climate Resilience Initiative, to deliver step changes in modelling, communicating and responding to risk to address future environmental hazards in the context of our changing climate and vulnerability.

Traditional approaches to modelling risk have relied primarily on isolation of each major component of the system, and utilised empirical/statistical techniques based on observed hazards. But the world is changing and past observations are no longer a reliable measure of future risks, especially in the context of environmental change. In recent years, efforts have been made to integrate adjacent components; however, a step change is now required to deliver a more interdisciplinary and innovative approach. Importantly, a new approach will need to combine scientifically intensive techniques with innovative communication methods and new business models. Scientific innovation will be required, for example, to integrate key feedback loops into models, ensure formal propagation of uncertainty down the whole information chain, and incorporate new approaches to modelling socio-economic impact. Innovation in the technical infrastructure, communication of outputs, and associated business models will also be required – for example, innovation in data streaming across the Cloud will be integral to the success of IERI; increased digital connectivity will be required in engaging communities globally; and business models and services will need to drive data transparency and enable rapid communication and action from the synthesis of complex information.

Addressing these challenges requires a critical mass of knowledge, infrastructure and resources that cannot be readily accessed by entrepreneurs, innovators and SMEs; this is evidenced by the dominance of three global companies - RMS, AIR Worldwide and CoreLogic - within the commercial catastrophe modelling market. An Institute for Environmental Risk & Innovation would catalyse the development of a new generation of integrated risk models that are global in reach and open to all through delivery of a directed, interdisciplinary research programme and targeted innovation and translation

programme. The planned, co-located, “Environmental Futures & Big Data Impact Lab” would facilitate the development of both physical and virtual communities focussed on generating commercial and socio-economic growth from associated innovation activities. Through close partnership, shared staffing and common objectives the Institute for Environmental Risk & Innovation and the Environmental Future & Big Data Impact Lab would support the existing catastrophe modelling community, whilst addressing the issues associated with critical mass and enabling growth of a complementary industry focussed on communicating environmental risk and possible responses to a wider audience. This in turn would enable the world, and UK in particular, to be better prepared and more resilient to environmental hazards through a range of research, policy, business and societal responses that are formally costed and evaluated. Ultimately, development of an Institute for Environmental Risk & Innovation, in partnership with the private sector, offers opportunity for the UK to further cement its position as a nation that is seeking to address the global challenges associated with climate change. In addition, IERI will require the continued development of essential technical infrastructure such as high speed, high capacity wireless networks, high performance computing for complex simulations, advanced data storage and manipulation capabilities, and an associated skills and knowledge economy. These developments, alongside the entrepreneurship and innovation facilities afforded by the Impact Lab, will be used as leverage in driving growth in other environmentally related sectors and in achieving a common vision for a smarter city.
Economic Case: Detailed options are in development in line with Green Book guidance; however, it is anticipated that a public investment of £60m could deliver a 5 year return in excess of £250m, with private sector leverage having potential to double this figure.
Commercial Case: Initial components of IERI could be housed immediately in the Met Office collaborative building, with a permanent location and technical infrastructure for being built as part of ongoing development of the Global Environmental Futures Campus at Exeter Science Park. Development of a full Commercial Case is being undertaken as part of detailed scoping, with all strategies expected to comply with public sector procurement guidelines.
Financial Case: Development of a full Financial Case is being undertaken as part of detailed scoping; including identification of up-front investment, ongoing business model, and potential funding sources. Up-front capital investment will be required to cover development of appropriate accommodation and technical infrastructure. Initial revenue investment will be required to cover early stage operations; detailed scoping will aim for a self-sustaining model within 5 years.
Management Case: Strategic Outline Case (SOC) by end of Oct16; with an Outline Business Case (OBC), contingent on SOC, by end Dec16; a Full Business Case (FBC), contingent on SOC & OBC, by end Mar17. Implementation of a seed-corn to IERI could begin Apr17.

Projects under development

Project Title: Composites Excellence Programme – with National Composites Materials Centre

Current Status: Our area is the centre of the UK composites industry. It is home to all of the major aerospace companies whose composites technology & product is world-leading, & a strong maritime supply-chain. It houses the UK's National Composites Centre (NCC), the internationally renowned ACCIS centre (University of Bristol), coupled with academic specialists in composite recycling in Exeter, non-destructive test and metrology at Bath University, and maritime composites at the University of Plymouth. The NCC, ACCIS, & the wider University of Bristol have declared aspirations to develop the capability, with the inclusions of the wider industrial and academic base in the region, into the "Global Go To Place for Composites". The aspirations are currently in formation & different elements are at different stages of development but would include:

- Development of the National Composite Materials Centre (NCMC) for research into future composite materials e.g. fibres, textiles and resins. Proposals are currently with Innovate UK & BEIS, with support from OEMS, Tier 1's & materials manufactures.
- Extension of the already world-class NCC capability in composites for transport vehicles, in particular for aerospace and increasingly for automotive. ATI proposals for advanced, innovative equipment are in process to develop this capability. Further funds will be needed to address some specific automotive and rail technologies
- A Smart Structures capability, drawing on technology from the University of Bristol, University of Cardiff, the Semi-conductors Catapult in Cardiff, and 'Bristol is Open'.
- A multi-materials "Beyond Carbon Fibre Programme". The use of carbon and/or glass fibre alone will not be the solution, ultimate the use of multiple materials will be required. The proposed Global Centre of Excellence in the SW must be able to advice in this area. Work on this has begun & is at an early stage with High Value Manufacturing Catapult funding fuelling early work.
- With a world focused on sustainability, reducing waste & recyclability, a "Composites & Multi-Materials Sustainability Centre" is in early planning, & would form a critical piece of the overall capability. This would build on the University of Exeter's knowledge of recycling & recyclable materials, bio materials, the NCC's waste-free manufacturing plans (the data-driven factory) & through-life knowledge (Uni of Bath).
- A Large Structure Centre. The proposal has been reviewed by BEIS. & is still under consideration for future funding.
- Critical is the extension of knowledge, training & skills for the future work force, potentially through a National College, coupled with higher education provision.
- Cutting across these, there is a need to develop the industrial composites supply-chain. Data shows huge gaps in the supply-chain, and a need for new/transitioned companies.

Partners: The lead organisation will be NCC with the support of the University of Bristol & South-west academic sector. HVMC-CPI will support NCMC to deliver this.

Strategic Case: Composite materials are enabling a paradigm shift in a number of sectors

such as aerospace, defence, automotive & maritime. The UK market is predicted to grow from current £2.3B to £12.5B by 2030 (UKTI), with the majority of the growth coming from transport sectors such as aerospace & automotive. This indicates a significant opportunity to make the UK, led from the SW, great in Composites. Other nations & global companies can see this trend & the race is beginning to secure the future fibre/matrix supply chains & continued product & process activity. With appropriate & timely investment, the UK can win a significant portion of the projected growth in revenue, increase the UK GVA content & better anchor existing product manufacture. In terms of product development the UK is already excellently placed with the NCC which, with associated academic support, is in place to provide the research, development & scale-up expertise & facilities required. Integration of new & other materials (multi-material solutions) & digital & 'smart' (Smart Structures) elements to production & product must be considered to keep the UK & SW at the leading edge globally. Diversity into new sectors such as Oil & Gas, Energy, among others are key opportunities for the region.
Economic Case: The opportunity is to capture additional UK content on future composites products including the value associated with the materials. The UK Composite Strategy 2016 details market growth figures with the current UK product market estimated to be £2.3b, that by 2020 will have grown to £5b & by 2030 the total composite products market value is forecasted at £12.5b. NCC cost modelling studies show that material content of a typical composite product could be 60% to 80% of product value by 2030, most of which will be imported. The opportunity for the UK to complete the supply chain is worth between £7b & £10b whilst also anchoring product production. There is an opportunity for the UK to export the materials to overseas manufacturers, worth a further £2-3b by 2030. The set-up of the NCMC & the SW 'Composite Excellence' programme of R&D in processes & products will enable UK companies to innovate & grow, capturing a significant share of the extensive global markets.
Commercial Case: The "Composite Excellence – with NCMC Programme" envisages a phased 7 year programme of major projects to bring to reality the aspirations outlined above, with public funding to support the infrastructure, equipment, and associated industrial research and developments being put in place, supported by a comprehensive and integrated academic programme. Some of this is directly South-West focused, some to provide national-serving assets and expertise in the region as the 'go to place for composite excellence' for the UK, generating economic benefit and jobs in our area.
Financial Case: The overall costs for the programme are still in definition. The NCMC proposal is for **£114m** over 5 years (2017-2021), to provide open-access facilities to industry. Details are available. Other projects are likely to be of smaller scale, & the funding profiles will differ in relation to project needs.
Management Case: The University of Bristol is the owner of NCC Operations Ltd. Overall management of the programme will be undertaken by the NCC with their support. The proposal is phased & details for the NCMC are available. Major risks include: Lack of Government appetite to support and grow the current composites product sector, and to generate a new foundation materials sector; and Lack of skilled people, and inability to

‘create’ them fast enough to meet industrial demand, and demand in the NCC and associated academic community, to deal with growth.

Project Title: Refurbishment of Dock 4 in Oceansgate Enterprise Zone to create a facility to increase levels of innovation and commercialisation of prototypes

Current Status:

Oceansgate Enterprise Zone is the flagship project in the Plymouth and South West Peninsula City Deal. The aim is to transform an under- utilised part of Devonport Dockyard into a major marine hub of national and international standing. Through City Deal negotiations 7.5ha of the 35ha site will be transferred to Plymouth City Council from the MoD. A consented masterplan estimates that up to 1200 jobs and 25,000m2 will be created. Through the City Deal £25.5m of funding has been raised to invest in infrastructure works and Phase 1 construction so far.

An important strand of Oceansgate is to develop a Marine Technology Centre to enable marine businesses to launch and test prototype devices, including autonomous vehicles, in waters in and around Plymouth Sound and provide research institutes with more accessible facilities to undertake marine research. The Marine Technology Centre is a unique partnership between Plymouth University, Exeter University, Plymouth Marine Laboratory, Sir Alister Hardy Foundation for Ocean Science and Plymouth City Council. The aim of the Marine Technology Centre is to increase levels of innovation and R&D. These onshore and offshore facilities will be the first of their kind in the UK and will link to other marine innovation facilities along the south coast. A crucial part of the Marine Technology Centre offer is access to the water to enable testing to take place. A dock in Oceansgate (Dock 4) has been earmarked for boats and devices to be moored and launched or for devices to be tested within the confines of the dock. However, a programme of works needs to be undertaken before the dock can become operational again. An £2.7m ERDF bid has been submitted to develop the Centre but additional funding is required to refurbish Dock 4.

Partners:

- Plymouth City Council
- Plymouth University
- Exeter University
- Plymouth Marine Laboratory
- Sit Alister Hardy Foundation for Ocean Science

Strategic Case:

The marine sector is one of the largest and most productive sectors in the South West with strong growth prospects. However, there are no commercial marine sites available in region for the sector to grow. Through City Deal negotiations land at Devonport Dockyard has been made available by the MoD to redevelop as a major marine hub. At the same time a gap in innovation assets enabling businesses and research institutes to undertake trials and tests of devices in real life marine environments was a real barrier to

commercialisation and research.

Economic Case:

There are very few marine sites with available docks space in the UK and none in the South West. There are two other docks in Phase 3 but these are considerably larger and will need more investment. They also lend themselves to more competing commercial uses.

Commercial Case:

Phase 3 which includes Dock 4 will be transferred to Plymouth City Council from the MoD in April 2018 on a 299yr lease. The Council is currently inviting expressions of interest from the market to invest in Phase 3 but has earmarked Dock 4 as an innovation asset for prototype testing and research. Surveys of Dock 4 have already been carried out and have generally found the Dock to be in good condition. However, the Docks are over 100 years old and do require some refurbishment and reinstallation of infrastructure such as gates and craneage if its use is to be maximised. Items for investment are listed below:

Minimum requirements are:

- Potential pontoon and mooring infrastructure within the dock would require additional minor investment
- De-silting and cleansing of the dock
- Craneage is likely to be provided by on an site mobile crane and would require additional minor investment.
- Additional dockside surface remediation and health and safety work is also likely to be required.
- Initial estimates for these works are around £300k.

Additional options include;

- To construct a new tidal sill and provide a boat hoist would cost in the region of £1.16m.
- To construct new radial gates around £2.06m.

Financial Case:

Currently there is no project budget assigned to the refurbishment of Dock 4. Plymouth City Council as owner of the site will in the first instance invest up to £8m in infrastructure works such as provision of utilities to enable investment to take place. The Council will then work with partners to seek investment in the Dock as well as private sector investment.

Source of Finance	Capital/Recurrent; Cash/In-kind	£m
DCLG	Capital – cash grant	8.0 secured
Plymouth City Council	Capital – cash grant	5.0 secured
MoD	Loan	1.0 secured
LEP Growth Deal	Capital – cash grant	6.5 awaiting govt approval
LEP	Loan	5.0 secured
ERDF	Revenue/capital grant	2.7 EoI submitted
TOTAL funding for project		28.2

(to date,

Notes: In order to complete Oceansgate Phase 1 to 3 we estimate we require another £17m of public sector investment and £30m of private sector investment.

Management Case:

- Infrastructure works undertaken in Phase 3 - 2017-18
- Detailed survey of Dock 4 conducted - 2017
- Phase 3 transferred to Plymouth City Council – April 2017
- Refurbishment works commence – July 2018
- Refurbishment works complete – May 2019

Project Title: Developing a globally relevant Compound Semiconductor Cluster

Current Status:

Concept Development – further detail and business case in development.

Partners:

There is a diverse, complimentary portfolio of Compound Semiconductor (CS) research in the region's universities (particularly Cardiff, Bristol and Bath) with research areas ranging from CS device physics through to novel component device fabrication, characterisation and system integration in applications such as Optoelectronics, Power electronics, RF communications and Quantum science. In addition, there is a concentration of well-established CS technology suppliers in the region: IQE (Cardiff), Infineon, SPTS (both Newport), Oclaro, II-VI (both Paignton), Plessey (Plymouth) and a wide range of end-users such as Airbus, Bae Systems, General Dynamics, Rolls Royce, Renishaw, Microsemi, Qinetiq, Tata and Sony.

Strategic Case:

The importance of Compound Semiconductor (CS) materials technology cannot be understated. It has underpinned the operation of the internet and enabled emerging megatrends such as Smart Phone and tablet usage, satellite communications/GPS, Direct Broadcast TV, energy efficient solid state lighting, efficient solar power generation, consumer electronics, high capacity communications networks and data storage, advanced healthcare and ground-breaking biotechnology. The demands of next generation electronic technologies are driving the integration and replacement of silicon based electronics with advanced CS materials, creating a truly enormous, once in a generation, market opportunity. Wales and the South West is already home to globally significant activities in the CS technology boom.

In 2015, Cardiff University, IQE Plc and The Welsh Assembly Government aligned their visions for Compound Semiconductor Innovation with the announcement of a collective investment of over £125M in order to seed the ambition to create the world's first Compound Semiconductor Technology Cluster in South Wales. This is embodied in a ~£77M investment in a new Institute for Compound Semiconductor Research at Cardiff University over the next 3 years (including £17.5M from the prestigious UK Research Partnership Investment Fund), and ~£48M for the establishment of a 50:50 Cardiff

University-IQE Joint Venture to drive commercialisation of CS Research and Innovation - the Compound Semiconductor Centre. The vision has been strengthened significantly by a recent vote of confidence from the UK Government by George Osborne's announcement in January 2016 of an intention to create a Catapult Centre focusing on Compound Semiconductor Applications located in South Wales.
The next critical elements of the Cluster focus on energising the industrial supply chain in the South Wales and South West England to leverage the Innovation investment, and upscaling the existing CS manufacturing infrastructure to provide a unique, large scale regional Foundry capability. The scale of the vision requires a long term investment of the order of ~£100M in order to unlock a target economic impact of 4,400 new high skilled manufacturing jobs in the full supply chain.

Economic Case:
The argument for investment in the cluster was underlined by a recent study by Cardiff Business school, which concluded that the GVA per employee in the technology sector including Compound Semiconductors is well above the Welsh average, as are the average earnings in the sector. For example, IQE average gross salaries are an estimated £53,000 across the Welsh operation and close to £40,000 across the whole IQE UK group. Estimated gross value added per employee across the UK group employing an estimated 479 people was over £86,000 in 2013 (greater than twice the Welsh average on both measures). The Compound Semiconductor Cluster will be a catalyst in creating high value jobs in Wales and the South West built on existing expertise and critical mass already in the region, through the involvement of companies listed above. Our model predicts that the cluster would lead to a net increase in GVA of >£378M pa and additional payroll contribution in UK of >£230M pa. In addition, the international nature of the cluster demands that inward investment will be key to measuring global relevance. Our analysis concludes that an inward investment target of £150M is a reasonable target.

Commercial Case:
Commitments to date include:
Institute of Compound Semiconductors: £77M committed to a new Translational Research Facility due to open in 2019 to house 116 CS researchers at Cardiff University's Compound Semiconductor Centre: £24M committed by Welsh Government and WEFO, £24M by IQE to establish the CSC in 2015 (the CSC has 73 staff, August 2016).
CS Applications Catapult: £50M committed by Innovate UK in Jan 2016, along with £50M in R&D funding matched by £50M from industry in 2016-2021, expected 80+ innovation and engineering staff.

Financial Case:
Ongoing investment priorities for the medium term include: £50M capital commitment for build of European Epitaxy Foundry Pilot Line in South Wales under the Cardiff City Deal; £8M for 25% National budget support for UK participants in an £60M ECSEL pilot line project to develop the business model for the European Epitaxy Foundry, with 19 EU partners; and £12-15M operating costs for the cluster companies based in the Region to participate in a large scale Integrated Project of Common European Interest (IPCEI) based on establishing a global customer base and energising the persistence of the cluster.

Management Case:
Establishment of the Compound Semiconductor Company has generated important

momentum and paves the way for successful deployment of the Compound Semiconductor Applications Catapult. A critical step will be for the Catapult to formally adopt the establishment of the Pilot Line as a strategic commercial goal.

	Milestone	Target	Status
M1	Establishment of CSC	2016	Capacity expansion for R+D @ TRL 4+
M2	Development of CS Institute	2016+	Currently increasing research capacity @ TRL1-3
		2018	TRF facility completion@ Cardiff innovation campus
M3	CS Catapult	2016	First CS CRD call July 2016
		2017+	Management team +business plan in place
M4	Pilot Line	2016	Location identified
		2018	Phase 1 Capacity: Operational
M5	First Production	2018-2020	European Foundry Pilot line operational

Project Title: Institute for Sustainable Technology Innovation (ISTI)

Current Status: UoBath proposes to construct a world-leading, sustainable technologies research centre that will develop innovative, sustainable solutions to long-standing societal, economic and developmental issues in the areas of chemical, biological and materials technologies. This centre will be known as the Institute for Sustainable Technologies Innovation, an early-stage applied research and innovation facility that will collaborate with industry, Catapults & universities. It will develop the next generation of disruptive technologies to the appropriate level for Catapults and industry to take to commercialisation. Local Growth Deal and ESIF bids are currently being developed with Swindon & Wiltshire LEP and West of England LEP. A Strategic Outline Case (SOC) is being drafted[2] according to Green Book guidance.

Partners: A joint working group is being formalised (MoU) between the University of Bath and Swindon & Wiltshire LEP. A partnership with the Centre for Process Innovation (CPI) – the process arm of the High Value Manufacturing Catapult – has been established through a MoU. Industrial partners and collaborators of the Centre for Sustainable Chemical Technologies (CSCT), on which ISTI builds, include: AB Agri; Airbus Group; BioSyntha Technology; Bruker; CatSci; Corbion Purac; Croda; Green Biologics; GSK; Johnson Matthey; Kerry; LanzaTech; Mast; NNFCC; Novartis; PhosphonicS; Sasol; Sharp; SPECIFIC; Tetrapak; Unilever; Veolia; Wessex Water. ISTI will also build on partnerships established through leadership of regional, national and international research consortia such as GW4, EPSRC UK Catalysis Hub (Research Complex @ Harwell) and international partners of CSCT: NTU, Singapore; USP, Brazil; OSU, USA; and Monash, Australia.

Strategic Case: A new approach is required for exploring solutions to increasingly

[2] Deloitte MCS Limited, *Strategic Outline Case: Institute for Sustainable Technologies Innovation,* September 2016

important issues of sustainability, which will have innovation and creativity at its core, whilst also providing a vital link between fundamental research and its technical application in industry. ISTI offers a unique value proposition: a creative, innovative approach to collaborative research with industry and Catapults, exploiting its cross-sectoral and multidisciplinary nature. Research will focus on sustainable chemical technologies, in four themes: Renewable Resources; Smart Materials; Sustainable Manufacturing & Design; and Added Value & Transformation. Themes of research will include: polymers & plastics; industrial biotechnology; the circular economy; and critical raw materials. Themes will involve a broad range of High Value Manufacturers, particularly in the sectors of pharmaceuticals, chemical manufacturing, home & personal care and electronics & consumer devices. ISTI will be a creative, collaborative, industry-facing and reactive, facility that builds upon the current capabilities of CSCT, whilst complementing and further enhancing the offering of CPI, HVM Catapult. The Creative Hub at the core of the development will strengthen existing, and catalyse new, collaborative partnerships, thus building a strong, transformative, UK wide research capability at the leading edge of sustainable technologies. Key project objectives for ISTI, to be achieved by 2025, include: to be one of the top three centres for sustainable technologies globally; contributing to ten new sustainable solutions; and delivering growth for the UK economy through collaboration with HVMs, Catapults and SMEs in order to catalyse real disruptive change and sustainability via its technological output.

Economic Case: A long-list of the potential options has been developed and assessed against the project objectives and critical success factors, to determine a short-list of four options, including a 'do nothing' comparator. The economic, social and environmental costs and benefits of the short-listed options have then been analysed, alongside the potential risks and non-monetary benefits, in order to identify a preferred solution. This preferred way forward consists of two physical components:

- A new research building (approximately 5,000m^2; off-campus, industry-facing) – the Institute itself, incorporating a range of laboratories, offices and conference space, providing high-specification facilities for academics, industry partners and Catapults to collaborate, translate and commercialise research and ideas: and
- A Creative Hub and Academic Gateway (on-campus, close to academic critical mass) that will be a customised space comprising activity areas to stimulate a climate of creativity and awareness of the practical potential and relevance of new technology.

There are a range of benefits of ISTI for both the local region and the UK. The impact of the potential public investment in collaborative R&D on GVA return has been estimated as £200m, based on public investment of £30m over five years.[3] Further benefits include:

- Direct and broader job creation, including high-skilled jobs, through development of ISTI, attraction of industry to the region and support for organisations such as SMEs, start-ups, spin-in corporate projects and programmes;
- Enhanced reputation of the UK for innovative research in sustainable technologies;
- Increases in the competiveness of UK industry on a global scale through development of innovative sustainable technologies, having cross-sectoral implications; and

[3] Warwick Economics & Development. *University of Bath Institute for Sustainable Chemical Technologies – Outline and Rationale*, November 2015.

- Environmental and societal benefits due to faster development and implementation of innovative sustainable technologies, e.g. solutions for decarbonisation of UK industry.

Commercial Case: This is under development and will set out the procurement approach to the provision of the new research facilities, options for agreeing a commercial operating structure and contractual arrangements with potential industry partners. Scoping of locations for the Institute is ongoing with Swindon & Wiltshire LEP, and two possible sites have already been identified, as has a potential campus location for the Creative Hub.

Financial Case: Initial cost analysis suggests that over the next five years the **investment required would be c£50m** to cover capital and operational costs. As specifications and requirements are refined, further economic analysis of the potential benefits, and refinement of the costs is required at OBC stage. Potential sources of funding are shown in the table below. Discussions are ongoing to confirm partners and secure commitments.

Source of Finance	Capital/Recurrent; Cash/In-kind	£m
University of Bath	Capital – cash	10
University of Bath	Recurrent – in-kind	2
Swindon & Wiltshire LEP Growth Deal	Capital – cash	20
Additional grants	Capital - cash	10
Businesses – industrial partners	Recurrent – in-kind/cash	4
Research Council, Innovate UK grants	Recurrent – cash	4
TOTAL funding for project		**50**

Management Case: The Creative Hub and Academic Gateway, to be developed on campus, is anticipated to be operational by Sept 2018. Development of ISTI, once a site has been chosen and funding secured, is expected to start in 2018 and be completed by 2020. Prior to development, key milestones will include clarification of governance arrangements, completion of full design and contractual arrangements agreed.

Project Title: Berkeley Science and Technology Park

Current Status:

The Park is on the site of the former Berkeley Nuclear Laboratories, adjacent to the decommissioned Magnox nuclear power station on the banks of the River Severn. The development site is held on a long lease from the NDA by South Gloucestershire and Stroud College. The development partnership includes the College, the University of Gloucestershire and gfirst Local Enterprise Partnership. Thus far the components of this multi-project, multi-phase development programme are:

- SGS College relocation of engineering and construction training into a refurbished building, with a view to skills training for nuclear
- Due diligence completed, contracts in place and building work commenced to create a Computing and Cyber Centre in a refurbished building, operated by the University and offering advanced business support and training facilities for companies and other organisations
- Contracts in place to build a University Technical College, within the SGS Multi

Academy Trust and sponsored by the University of Gloucestershire, specialising in digital technologies and advanced manufacturing

- Continuing presence of Cavendish Nuclear Laboratories and Magnox
- Agreement under Growth Deal 1 to invest £4 million capital in a Renewable Energies Centre in one or more refurbished buildings, with funding scheduled for 2019/20 and subject to due diligence
- ESIF bid (£948k) for low carbon support programme in second-stage approval process
- Bid in train to Innovate UK to develop a business case for a SmartGrid project, The SmartGrid will reduce each occupier's energy costs via the harnessing and storing of both renewable and off-peak mains electricity. It will also enable occupiers and learners as well as Government, academic and industrial stakeholders to understand, train, innovate and evaluate the efficient capture of and/or purchase of electricity, efficient storage and use of the same. It will also take advantage of predictive behavioural and weather modelling, and explore both physical and commercial applications of smart energy to address National Grid harmonics and short falls in National Grid capacity.
- Marketing of the site in train for commercial tenants, including new location of Green Fuels Research

Partners:

- South Gloucestershire and Stroud College
- University of Gloucestershire
- Gfirst LEP
- Business tenants of the Science and Technology Park

Strategic Case:

The original rationale and policy context was about building up the capacity for nuclear rebuild, in a way which (i) supports economic development of Gloucestershire and the wider region through a focus on applied research, business services and innovation support and (ii) capitalises on the site's potential and the area's existing economic assets to develop applied research, innovation and training for the range of renewable energies. The project gives an excellent strategic fit with the Science and Innovation Audit, linking directly to its foci on new energy systems (including nuclear), digital innovation (including cyber) and resilience (including sustainability and renewable energy), as well as the underlying cross-cutting theme of supporting business innovation. The total area of the development site is 111 acres, of which 60 are within the bed of the River Severn

Economic Case:

The development of the Berkeley site as the Gloucestershire Science and Technology Park was one of three top priorities for investment stated in the Gloucestershire Strategic Economic Plan in order to drive high-skill, high-innovation economic growth. It was endorsed by the Government as part of Growth Deal 1. Since then, individual projects have done their own due diligence to demonstrate the robustness of the economic case

Commercial Case:

The site is fully secured and available on a 999 year lease from NDA. It is fully commercially feasible, with masterplanning, facilities management, and marketing in place

Financial Case:

Source of Finance	Capital/Recurrent; Cash/In-kind	£m
University of Gloucestershire	Each of the Growth Deal and ESIF projects led by UOG has match funding	
SGS College	The Growth Deal project led by SGS has match funding	
Growth Deal	Capital –construction/nuclear skills training	5.0
Growth Deal	Capital - cyber and computing	2.0
Growth Deal	Capital - renewable energies	4.0
ESIF low carbon	Recurrent	0.95 ESIF towards project value of 1.9m
Innovate UK SmartGrid	Recurrent/capital	Development of Stage 1 business case towards £4m project

Notes: The "ask" for this project is for timely support to integrate the various component projects in developing the Berkeley site, so that all components can complement and reinforce each other - and specifically early decisions on ESIF, Growth Deal Advanced Renewable Energy, and SmartGrid

Management Case:

Each project component has its own project plan, timeline and milestones:

- The construction and engineering training facility will be operational from AY 2016/17
- The Computing and Cyber facilities will be operational from January 2017
- The UTC is on track to open September 2017
- The funding for the Renewable Energy project is profiled for 2019/20
- Second round submission deadline for the ESIF bid is end September 2016, seeking funding for the period 2017 – 2019
- SmartGrid funding bid for business case preparation in train

Bids in progress

Project Title: Institute for Advanced Automotive Propulsion Systems (IAAPS)

Current Status: Two capital funding bids have been submitted – one to the HEFCE UK Research and Partnership Investment Fund (outcome known Spring 2017) and one to the West of England Local Enterprise Partnership (outcome expected September 2016). Over £60m of industry match funding is secured. A Business Case, following the Green Book 5 Case Model, has been completed.

Partners: Lead organisation: **University of Bath**. Partners: Industry co-investors - Ford,

McLaren, Jaguar Landrover, HiETA Technologies, Hofer Powertrain. Partners: Letters of support (industry) – Horiba-Mira, Airbus, GE Precision Engineering, AshWoods, BP, Shell, CFMS. Partners: Letters of support (Government, NGOs etc) - Automotive Council, Warwick Manufacturers Group, National Composite Centre, Society of Motor Manufacturers and Traders, Mayor of Bristol, University of Bristol, South Glos Council, Bath & North East Somerset Council, West of England LEP, Swindon & Wiltshire LEP.

Strategic Case: IAAPS is a new research and innovation facility for advanced propulsion systems, to deliver future generations of clean and efficient vehicles.

- IAAPS will contribute to a low carbon economy by 2050, developing new low carbon technologies for the automotive sector to help meet ongoing carbon reduction targets. It will establish the UK as a 'Propulsion Nation',a global leader in propulsion systems;
- The proposed facility will support industry with specialist academic, technological and commercial expertise, keeping research expenditure in the UK and expediting the development of new technologies, ensuring the UK leads the way on ultra-low emission vehicles' R&D;
- IAAPS will safeguard existing and create additional research and automotive manufacturing jobs. It will help build a comprehensive talent pipeline to address the current skills gap, via new apprenticeship, undergraduate, Masters and PhD;
- The development of IAAPS will help secure the long-term future of the automotive sector through the growth of the UK share of the value chain. The Institute will help local SMEs break into the market, strengthening the domestic supply chain and assisting in the re-shoring of manufacturing jobs;
- The University of Bath's Powertrain and Vehicle Research Centre (PVRC) has five decades of globally recognised research in the automotive sector. IAAPS will assist the University in delivering upon its strategic intent. The project aligns with the University's overall vision and strategy around delivering research excellence, and will build upon and enhance PVRC's current role.

IAAPS will address the West of England's intention to invest in areas of strength (advanced engineering), which has the greatest potential to create jobs and growth. It will create 1,900 new jobs and safeguard thousands more. The new jobs created will be more productive, leading to higher wages and a more prosperous regional economy. IAAPS will address skills gaps by developing 'skills pathways' from our local education institutions, alongside IAAPS being developed as a centre for world class training and skills development. IAAPS will be built at the Bristol & Bath Science Park, enabling the science and technology vision of the park to be achieved.

Economic Case: A long list of 7 options were assessed against economic, social and environmental costs and benefits, in order to determine the best value for money. Each option was scored against project objectives, as well as critical success factors (e.g. strategic fit and deliverability).

A short list of 3 (as well as the 'do nothing' baseline option) was taken forward and appraised on both a monetary and non-monetary basis. For each of these, the following was undertaken: A cost / benefit analysis to determine best value for money; Sensitivity analysis; Non-monetary benefits analysis, e.g. ability to collaborate and higher quality research; Key risks associated with the delivery of each option. The preferred option was a **new build with both essential & desirable facility requirements.**

Commercial Case: The University of Bath's procurement procedures comply with EU regulations and the Universities traditional procurement route will be appropriate for IAAPS. The University uses an electronic tendering system (Delta eSourcing) and commonly applies the restricted procedure with standard stages, including publication in the Official Journal of the European Union (OJEU), followed by a pre-qualification questionnaire (PQQ), Invitation to Tender (ITT) for shortlisted companies and subsequent tender evaluation, award and contract issue. Headline procurement:

- Architect appointment (PQQ – Oct 2016 / ITT – Feb 2017 / Appoint – April 2017)
- Architect completes building design (by Oct 2017)
- Construction (PQQ – Nov 2017 / ITT – Jan 2018 / Appoint – March 2018)
- Construction phase (April 2018 – Oct 2019).

A site has been identified at the Bristol and Bath Science Park. The outline planning permission and masterplan for the Science Park supports the development of IAAPS.

Financial Case:

Source of Finance	Capital/Recurrent; Cash/In-kind	£m
UK RPIF	Capital - cash	30 (applied)
WoE LEP	Capital - cash	10 (applied)
Industry co-investment	Recurrent - revenue	61.7 (secured)
TOTAL funding for project		101.7

Notes: The balance of capital monies is being sought from a variety of other sources, including the Advanced Propulsion Centre and via the West of England Devolution deal.

Management Case: The actions required for the successful delivery of IAAPS have been considered, including: Governance and commercial structuring – we have worked with specialist consultants to determine how IAAPS should be run and operated. A short list of two options (IAAPS as a department of the University vs IAAPS as a department of the University but operated by a SubCo) are both being considered. A cost benefit analysis on each option is underway. **Key milestones:**

- Completed: Economic impact modelling; Governance and structuring analysis; SME survey and cluster analysis; Development of Business Case
- September 2016: Marketing materials complete; WoE LEP funding announcement
- December 2016: Appoint Oversight Board
- Spring 2017: UK RPIF funding announcement
- April 2017: Appoint architect
- October 2017: Building design complete; Recruit Chief Executive Officer
- February 2018: Planning permission; March 2018: Appoint construction firm
- April 2018 – Oct 2019: Construction phase; Oct 2019: Complete and handover

- **Risk management** – a comprehensive risk assessment has been undertaken identifying any risks associated with funding, State Aid, demand for use of the facility, reputational risks, construction (delivery overrun) and planning. All risks have mitigation actions and the post mitigation RAG rating is green for all identified risks.