Industry recommendations for interventions supporting photonics and microelectronics sector growth in the South West

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Draft 1.1	Priority rough draft release, 2 March 2021,
Draft 1.2	Editorial notes from March 2021 Budget on fit to Levelling Up Fund & Freeports
Release 1.4	Updates from facilitators, TDA and HotSW client review. Inclusion of recommended action for initial levelling-up fund.
Revision 1.5	Minor text corrections

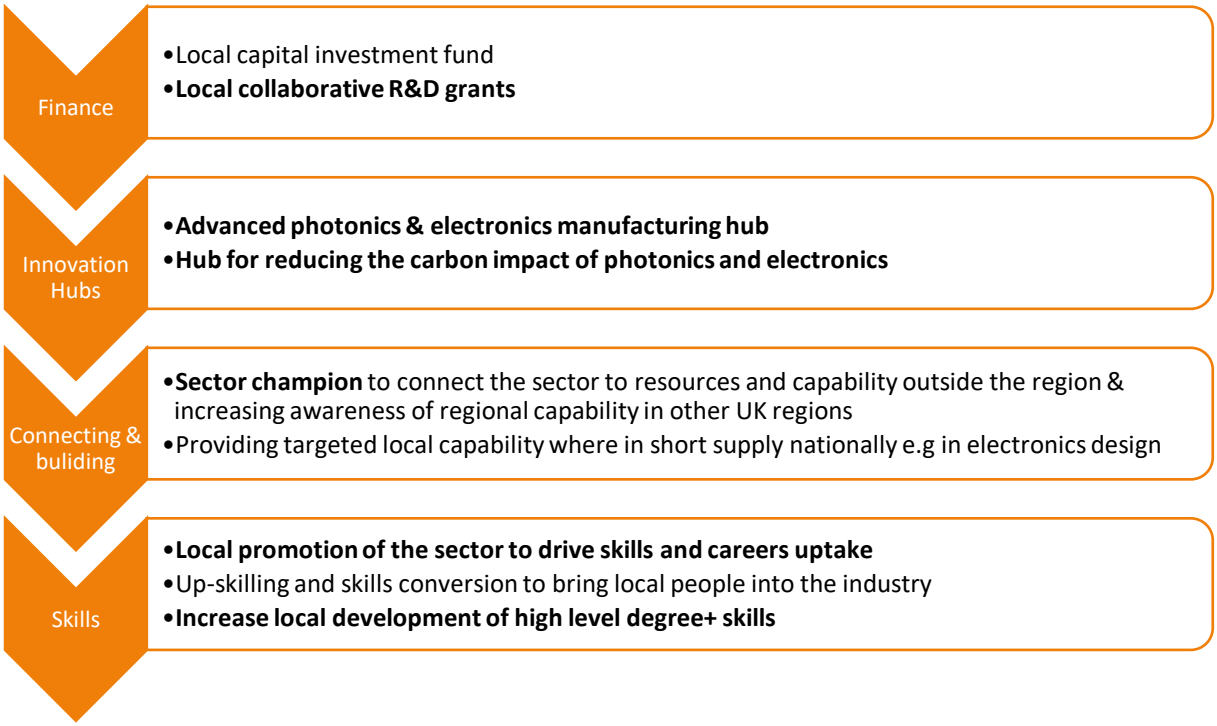
1. Executive Summary

Nine headline concepts for supporting significant growth in the photonics and electronics[1] sector in the Heart of the South West region are identified.

These are grouped into four areas around finance innovation centres, connecting the sector with core capabilities and skills.

The identified concepts were drawn out of a workshop with 35 participants from the photonics and electronics industry across the region, with select invitees from the broader UK innovation eco-system and two participants from potential inward investing companies.

The top highest priority recommended support interventions with greatest breadth of impact and strategy fit are shown in bold, however any and all would provide significant benefits to the local industry.



The concepts range in scale from needing £10m+ of support to <500k, with some that can be initiated almost immediately with near term impact and others that will take longer to deliver and have longer term impact. However, workshop participants did identify a number of areas where leverage of existing facilities and structures can be used to reduce the timescale to begin delivery e.g. launching an innovation hub by leveraging the current EPIC centre.

Almost all the initiatives have the potential to impact broadly across the region and address multiple local and national priorities. Financing and connecting interventions were seen as having the widest pan regional impact with the identified innovation hubs addressing the largest number of local and national priorities.

There are also a number of synergies between the different concepts with the potential to combine several together. For example a single innovation hub could cover both advanced manufacturing and decarbonising of photonics and electronics and provide an extended basis for connecting the region to the wider UK and beyond.

The local photonics and electronics industry has been highly supportive of this initiative and remains ready to help rapidly refine any of the concepts outlined here as more details of new regional funding mechanisms becomes available.

[1] The term electronics rather than micro-electronics is used throughout for brevity and maximum inclusivity.

2. Recommended actions

To grow the photonics and microelectronics cluster, underpinning growth in digital and autonomous systems

The Opportunity: photonics is a £13.5 billion industry in the UK and microelectronics is as least as large again, with both projected to grow by more than 20% between 2020 and 2025. There is a strong and established cluster of 174 companies, employing over 3,000 highly skilled people across the Heart of the South West, contributing over £603 million per year. The cluster boasts a broad range of capabilities across the value chain and is a key cross-cutting technology supporting multiple key UK industries, from telecommunications to transport and aerospace with robust and resilient solutions, with significant opportunity for growth in secure and autonomous systems[2].

Supporting Building Back Better: through the High Potential Opportunity (HPO) in photonics and microelectronics the region will attract inward investment, supporting the development of a world class cluster that places us at the forefront of cutting edge innovation with a focus on 5G, Big Data and autonomous vehicle systems. The region will build on this with skills, local financing and innovation in scalable sustainable process develop significantly expanding the region's innovative capacity and support for local manufacturing[2].

Key Actions: will focus on delivering a Microelectronics and Photonics Innovation Hub delivering regional and national capability in state-of-the art high productivity, low carbon, manufacturing of electronics and photonics systems. The hub will build on the current SW EPIC facility and connect to national innovation centres, focusing on the challenges in combining multiple technologies together to provide robust, resilient, agile solutions with lower carbon footprint. Industry defined high level skills will be developed with leading local universities and colleges. Locally focused collaborative R&D and investment financing will support innovators over growth barriers accelerating time and impact on expanding markets and exports. These actions will enable the cluster to make the most of global opportunities, move higher in the value chain to capture more value in the UK.

[2] Adapted from text developed by the HotSW LEP

3. Introduction

As part of the national focus on 'building back better' from the Covid-19 pandemic, levelling-up regional inequalities, leveraging UK science and innovation strengths and optimisation of the post Brexit economy, central government is expected to increase support for innovative, 'Levelling-Up', regional interventions that support local strengths and regional economic growth.

To be best positioned to take timely advantage of any forthcoming funding developments, the HotSW Local Enterprise Partnership is seeking to identifying concepts for accelerating photonics and electronics growth in the HotSW region with the input of industry.

A brainstorming workshop was convened on 1 March to generate ideas from across the community and seek to differentiate and prioritise them where possible.

Due to Covid-19 travel restrictions the workshop was convened remotely using Zoom with breakout rooms to facilitate discussion and an on-line whiteboard tool, Mural, to capture discussions. As well as local industry from across the south west, key individuals from across the UK innovation eco-system were also invited to participate to both gain understanding of SW regional discussions and to support the broader national fit.

The concepts generates in the workshop, highlights of the discussion and differentiation are outlined below, followed by a brief description of the methodology and participants.

Editorial comments based on broader knowledge of the UK photonics and electronics innovation eco-system are provide in italics. These provide additional information but are not necessarily supported by direct discussion in the workshop.

4. Major ideas and concepts

Nine significant concepts for intervention have been identified that would support significant growth in the local photonics and electronics sectors. These are grouped into four topics areas described in detail in following sections:-

- Financial interventions;
- Innovations centres;
- Skills interventions;
- Connecting and supporting core capability.

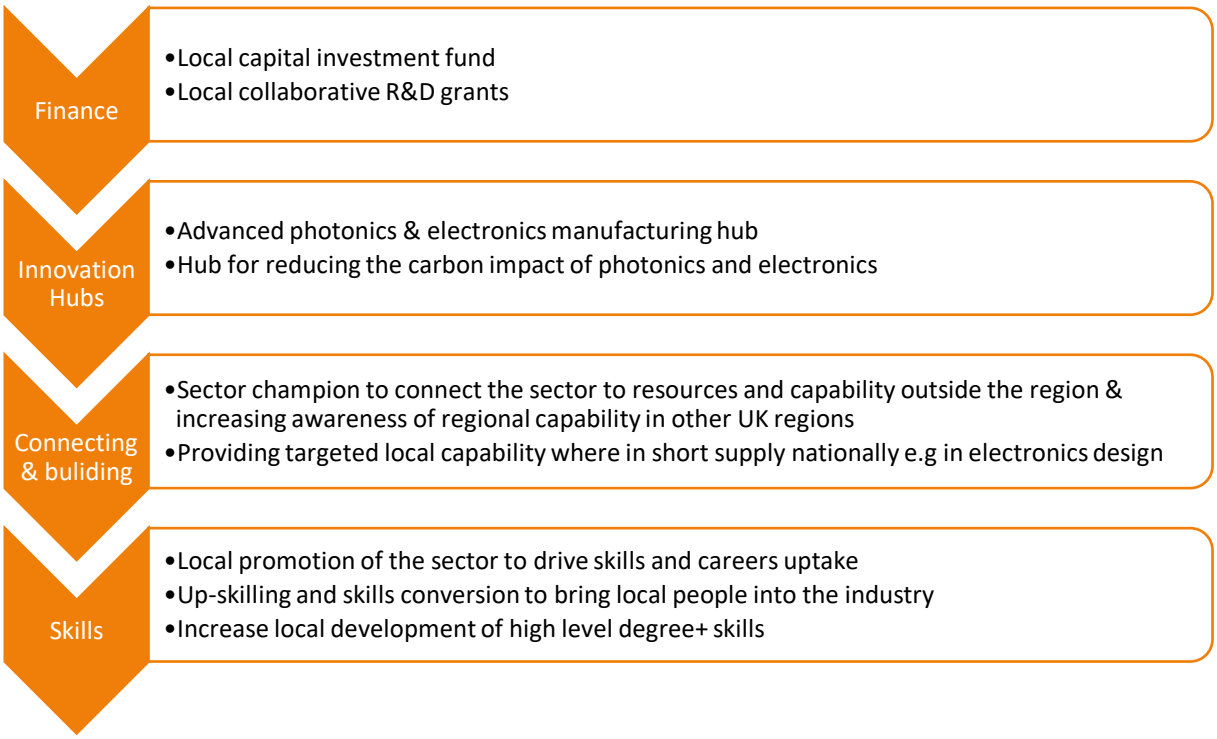


Figure 1 Summary of key concepts for support photonic and electronics growth in the region

4.1. Financial interventions

Three distinct types of financial support were identified during the workshop that would drive significant growth. Whilst take up of any particular intervention will always depend on a company's stage of development, both a regional capital investment fund and local collaborative R&D fund were identified by a wide range of participants as offering distinct value to the sector.

4.1.1. Local venture / investment fund

The difficulty in raising capital funding locally was noted by several participants. A locally focused venture/ capital fund would therefore make a difference to those seeking such investment.

Participants noted that such a fund needs to have a clear remit to support high risk projects in return for equity - and not be a loan or other asset secured funding. Such support would need to accept high potential failure rates in return for potentially high returns from successful ventures. Strong coordination with local universities was seen as important to help support spin-out activity, but such support should not be exclusively available to spin-outs, but also available to independent local entrepreneurs. Seed level funding was identified as the best starting level *(typically <£250k)*.

Wherever possible existing fund structures should be leveraged as participants noted setting up such structures from scratch was a long and expensive process.

Access to capital funding for high-risk high-reward ventures and or scale-up funding with long term returns was recognised by government as problematic under the 2017 Patent Capital Review. National measures continue to be developed including a new infrastructure bank to support 'green investment' in the 2021 budget. The net-zero focus of these latest announcements could be aligned to some of the latest innovations from the sector e.g. in reducing carbon impact of photonics and electronics (see below). An alternative to providing local investment funding would therefore be to provide proactive support to local companies to access these latest and emerging central government initiatives.

4.1.2. Local collaborative R&D grants

Interventions supporting local research and development grants where highlighted in multiple groups- a local 'Innovate UK' style fund for photonics and electronics as it were. This is seen as filing a gap left by some forms of EU funding no longer accessible to the UK, and as a more attractive alternative to Innovate UK funding, where the lack of any focused support for the electronics and photonics sectors leads to very low success rates, even for highly scoring applications, from the open 'SMART' competition process.

Such interventions would also help build local consortia and inter-company collaborations within the region. *Where as other R&D funding sources, (e.g. Horizon Europe & Innovate funding) often effectively encourage partnering outside the region to fit a perceived need for geographical diversity in consortia.*

Local industry also emphasised the need for any local R&D funding to have acceptable terms and conditions – checked with industry in advance and that support capex expenses. Some report wasting significant effort and time on collaborative R&D grant applications only to find the final T&C's unacceptable. Other common frustrations related to Innovate UK grants that only allow minimal depreciation of capex to be expensed, providing a major barrier to capex heavy projects. *The former AMSCI initiative was previously praised for its support of capex heavy manufacturing investments and may provide a useful model*[3]

[3] AMSCI - Advanced Manufacturing Supply Chain Initiative https://www.financebirmingham.com/amsci/

4.2. RTO Innovation Hubs

A number of workshop inputs can be grouped into forms of a research and technology organisation (RTO) innovation hub solving solutions to the extended challenges facing the electronics and photonics industry.

Before identifying the specific foci for such a hub there are many common characteristics in any RTO hub, identifiable from local inputs and parallels with other UK centres, namely:

- A core staff of engineers and innovators able to undertake high technology readiness level R&D projects in collaboration with industry. The expertise of any such hub must be complimentary to, and additional to, that available in local industry. Such engineering expertise enables the hub to add to the local knowledge base and expand industrial capabilities.
- Strong academic / university links are vital for any hub to be able to draw on next generation solutions and access high value facilities and knowledge. Joint academic, positions are often recommended.
- With their own internal expertise RTO hubs are able to, and should fully participate in collaborative R&D projects (e.g. Innovate/ Horizon Europe) with a clear added value proposition to consortia. Such collaboration does not need to be limited to within the region. Indeed a national and pan EU outlook is highly beneficial acting as a conduit for assimilating new knowledge for local dissemination as well as providing additional income.
- RTO hubs must compliment existing national facilities and centres and not duplicate resources available elsewhere.
- Time from inception to being operational needs to be minimised, which implies

The Manufacturing Technology Centre *(MTC) in Coventry, is one of 7 centres that collectively form the High Value Manufacturing Catapult (HVM). The MTC was originally established in 2010 with £40 million support from Advantage West Midlands and East Midlands Development Agency as an independent Research & Technology Organisation to bridge the gap between academia and industry. The MTC now employs over 700 people supporting a wide range of manufacturing industries, including rail, aerospace and automotive. The MTC also now includes an advanced manufacturing training centre and the national centre for additive manufacturing.*

In their own words, the MTC "use our expertise to work hand-in-hand with you, developing manufacturing system solutions to solve your challenges for the short and longer term"

http://www.the-mtc.org

The Fraunhofer Centre for Applied Photonics *(Fraunhofer CAP) in Glasgow is a leading centre for applied laser and optical (photonics) technology research and development.*

In their own words, "Fraunhofer CAP offers professional R&D services to industry as a flexible and practical resource that responds to companies' needs in the development of photonic technologies. Consistent with the Fraunhofer model, training of PhD and EngD students is a fundamental part of our mission"

Fraunhofer CAP was established in 2012 with support of Scottish Enterprise as the first UK Fraunhofer Research Centre and continues to receive regional funding in support of Fraunhofer's funding model of 1/3 industry funding, 1/3 competitively won grant funding (UK and EU) & 1/3 core funding. With ~70 staff and students, Fraunhofer CAP, is part of a global network of 75 Fraunhofer institutes. The head of the centre holds a joint position with the University of Strathclyde supporting strong university links.

https://www.cap.fraunhofer.co.uk/

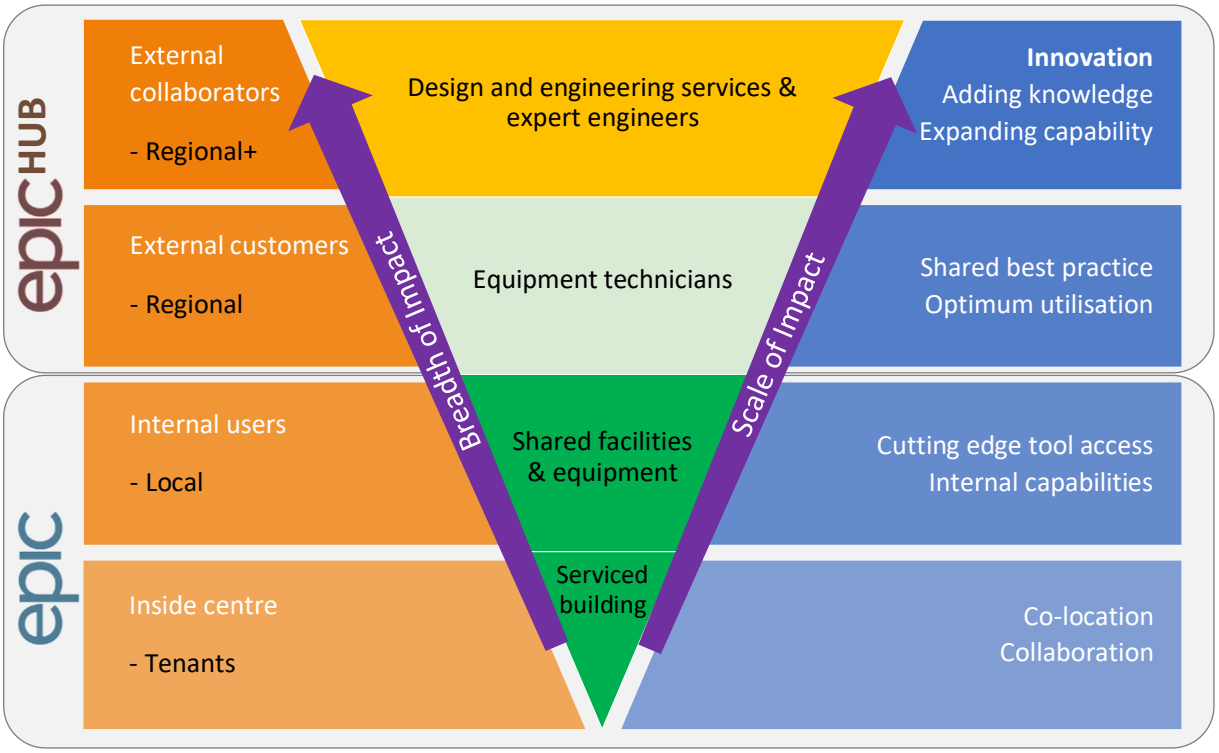


Figure 2 Illustration of how RTO hubs build on innovation centres extending the regional breadth and scale of impact.

leveraging existing physical facilities (avoiding new build) and existing organisational / legal structures. With the exception of the High Value Manufacturing Catapult, (which joined existing centres) the Catapult program has been widely criticised for having excessively long lead-in times.

- A long term, multi-year, commitment to providing substantial core funding from the regional body with commitment to on-going renewal. This is essential to retain the expert staff over the long term (and beyond the timescale of any single project), on-going equipment maintenance and development, training, collaborative bid writing (success rates <15% are not uncommon), industrial engagement and seed project exploration
- Freedom to invest in people and capital equipment as both are essential to deliver additional capability. The core value to regional industry is in the combination of expertise, embedded in people, and cutting edge equipment, which enables the hub to deliver innovative solutions to industrial problems that are beyond any single company's expertise or provision of e.g. equipment alone.
- Understanding of the indirect as well as direct impact of an RTO hub. Whilst projects undertaken with industry provide immediate direct impact to specific partners, the greatest benefit of centres is often in the diffusion of skills developed in the hub to wider local industry. RTOs also provide a vital career path, often between academia and industry, where skills addressing cutting edge challenges are refined in the hub, and then passed into local industry as individuals make their next career move. A high staff turnover is thus a key asset, attracting high level skills into the region and diffusing them on to industry.

Given that there is now significant experience in setting-up, delivering and working with RTO hubs in the UK there is extensive best practice to draw upon. For example, to minimise lead-in time, industry suggested multiple solutions from structuring as a satellite to an existing national centres (e.g. MTC), or as a Fraunhofer centre in

collaboration with local university. Leverage of space in the EPIC centre could provide a rapid near term solution to where to locate such a hub.

Collaboration with Plymouth and Exeter Universities would provide vital academic links across both Engineering and Physics.

There are examples of both regional and central government funded centres. The Fraunhofer Centre for Applied Photonics in Scotland (who attended the workshop), the National Healthcare photonics Centre in Sedgefield and the Compound Semiconductor Centre in South Wales are all supported with regional funding. With Catapults the core funding is from central government[4]. Indeed both regional and central funded models have proven viable, generating significant local jobs and industry growth where a long term commitment is made to core funding.

There is clear differentiation to the remit of the current Torbay EPIC centre which is focused on providing R&D services, as opposed to serviced premises, shared equipment and performance indicators focused on occupancy rates. The current centre does not have its own R&D staff or applied innovation capability. The essential skills to use shared equipment must be supplied by the tenant companies. Whilst providing a strong supporting role, the current facility does not provide additional expertise beyond that in local companies. Without internal technical staff the centre is also limited in the extent that it can work with companies who do not have the skills to use the pooled equipment.

As illustrated in Figure 2, an innovation hub is a natural evolution of the current EPIC centre. Adding technical expertise as well as facilities enables a hub to work, with and deliver solutions for external collaborators in the region (and beyond) vastly increasing the breadth of impact across the regional area. The additional expertise take two forms 1) skilled technicians to use equipment maximising its utilisation & performance systemising processes 2) skilled applied engineers able to develop new processes and solve industrial problems.

The scale of impact is also significantly increased as, with applied engineering, a hub generates new knowledge that is unique to the region. Correctly focused, e.g. on the next generation challenge in automated manufacturing and/or decarbonisation) a hub significantly adds to the capability of local companies and the region

With internal expertise the hub does not depend on the skills in the local companies to use equipment, enabling it to add value to a wider range of clients and be a source of knowledge disseminating out into the region. Innovating at the cutting edge also provides the ultimate showcase of the regions capabilities and assets attracting further investment.

Industry identified several core functions for such a hub which are grouped in two areas described below, with significant potential for cross-over and combined solutions.

4.2.1. Advanced / Automated high value photonics and electronics manufacturing hub

The challenge and demand for advanced manufacturing processes, knowledge and capability is driven by a subtle and critical change in demand profiles across many electronics and photonics applications[5]. Previously markets could be split between high-volume low-margin commodity/ consumer markets e.g. DVD players, and high value niches e.g. communications equipment, instrumentation, industrial control systems etc. Systems for high value applications were/are often assembled by high skilled operators and vulnerable to relocation offshore

[4] Whilst the MTC as part of the High Value Manufacturing (HVM) Catapult now receives its core funding from central government (via Innovate UK) , all the centres within the HVM were originally set-up with regional support.

[5] Electech sector: a roadmap for the UK, https://www.gov.uk/government/publications/electech-sector-a-roadmap-for-the-uk

(cf Nortel Paignton). However, times have changed with a number of new influencing factors now apparent:-.

- Awareness of the security risk and vulnerabilities of distributed supply chains has increased exponentially, exemplified by the UK's Telecom security legislation and telecom diversification strategy.
- Location of origin and security of supply/ design control are now seen as vital to national interests, as exemplified by the new National Security Investment legislation and the core 17 sectors identified for mandatory notification, including many areas of photonics and electronics.
- Labour costs even in 'low-cost' locations have significantly increased reducing the previous advantage of off-shoring
- Volumes in many former niche applications have risen to levels, (and price expectations reduced) to the point manual skilled operator assembly is no longer viable.
- Expectations of reliability and resilience now exceed the levels that can absorb variability inherent in many manual processes.
- High levels of reliability and resilience are now needed and expected in even high volume consumer applications from autonomy, to location and timing, to consumer tech.
- The pace of product iterations has increased to level production needs be close to centre of innovation to facilitate rapid transfer to production. Design for manufacturing is also now critical to smooth production transfer and companies are increasingly looking to leverage new techniques such as 3D printing to shrink not just development time but also time to volume local production.
- In many former niche applications, the minimum volume demanded by the customer has increased to thousands if not millions of units, meaning production must go direct to volume.
- Awareness of the environmental and carbon footprint of manufacturing is increasing and will become a major sources of company differentiation. *(Especially among the younger generations that would be desirable to attract into the industry).*
- Productivity (output per worker) is viewed as a vital performance metric across the broader economy as well as the performance of individual company.
- Many applications now require a combination of two or more micro/integrated electronics, radio frequency (RF), photonics and embedded software technologies.

Not all of these factors are influential in all companies and at all times, but are increasingly present in various combinations, with many mentioned during the workshop, creating demand for a centre that supports the development of advanced automated or semi-automated manufacturing processes that enable higher volume responsive manufacture of photonics and electronics products in the UK.

Variation in the balance of individual company's focus between electronics, RF, photonics and embedded software, was apparent according to the focus of their individual organisation.

As well as supporting greater productivity, such as advancing manufacturing processes are also critical to capturing greater value in the UK by enabling companies to integrate more components and produce systems higher in the supply chain. Manufacturing innovation is also key to responding to volume demand, delivering ever higher performance and robustness and increasing supply chain resilience.

A hub focused of high-volume high-value advanced photonics and electronics manufacturing processes would provide a step change in local capability and knowledge relevant to a broad range of organisations across the region. Such a centre should also have the potential to provide offline (from the company perspective) process development enabling companies to develop more disruptive / new advanced processes without disrupting their existing production, reducing the barriers to

improving and deploying higher productivity solutions. Vitally such **a hub enables companies to focus on what they are good at in designing customer focused solutions, whilst working with the hub to ensure that those solutions are manufacturable, sustainable and locally.**

A cautionary observation was noted, that processes can be very specific to individual product lines and companies. Whilst many are looking to deploy greater automation – individual needs are often unique. Thus any individual project may only have narrow impact, with the broader impact coming from the longer term building of local expertise and its wider dissemination through local industry as individuals circulate back into local companies.

This is challenge faced by all RTO innovation hubs which build capability working on specific industry projects with individually narrow impact, determined by the collaborating companies focus. This will include variation of the technical focus e.g. photonics vs RF vs integrated electronics– all equally valid. The broader impact arises through the accumulated experience, shared learning and application of common principles between projects, continuing technical convergence and dissemination overtime plus the ability to support a wider range of clients with less internal expertise.

Such a hub focused on developing higher productivity locally compatible manufacturing also supports carbon reducing component 'air-miles' and shifting exports to higher value systems. Within the increasing focus on decarbonisation the impact of advance manufacturing on reduced waste, embedded carbon and resource efficiency will become increasingly relevant.

The latter was reflected in additional requests for more environmentally friendly manufacturing spaces within the region. Not readily seen until recently, low/zero carbon manufacturing facilities are likely to become highly desirable especially as manufacturers are increasingly asked by customers to identify the carbon footprint of their products and processes. A pertinent example being Coherent Scotland's new zero-carbon factory in Glasgow. Provision of such space may provide an alternative way of attracting/ retaining high tech manufacturing companies to the region and was highlighted as synergistic with the regions tourist/leisure industry profile.

There are also existing examples of local producers of high value products with high levels of UK content e.g. Queensgate, G&H etc and **strong sector wide interest in increasing the value captured locally**. This will create strong engagement with a hub targeted at addressing manufacturing challenges. However, it was also noted care must also be taken not to duplicate the work of other facilities and work with them to avoid duplication.

An innovation hub can also provide a home for building core capability and offering services in core assets such as electronics and prototype design – see building local core capability, below. With strong focus on next generation manufacturing, the hub would also make a significant contribution toward supporting designing for manufacture in the region.

4.2.2. Hub for low carbon photonics and electronics

A hub for low carbon photonics and electronics would focus on the innovation and maturing of solutions that reduce the carbon / environmental impact of using photonics and electronics. The hub would support local companies to develop more energy efficient solutions and/or more resource efficient photonics and micro-electronic products.

Electronics and digital components and networks are forecast to consume as much as 20% of global electricity by 2030[6]. Use of the sector's products

[6] How to stop data centres from gobbling up the world's electricity, https://www.nature.com/articles/d41586-018-06610-y

will make an increasingly large contribution to global carbon emissions. Innovation in making photonics and electronics products more efficient is therefore key to helping the UK meet its carbon reduction targets, whilst increasing the digital economy. Early intervention led by the SW, would put the region ahead of the curve, making the area a leader in the development of next generation low carbon digital hardware.

This alternative hub would therefore focus on advancing innovation to reduce the environmental impact of using photonics and electronics. Energy efficiency being the clearest target, but reducing material use and increasing compatibility with reuse recycling were also highlighted.

Innovating more efficient approaches without impacting performance was noted as a difficult challenge highly aligned to national and local priorities. The focus adding to local knowledge, and internal company capabilities, by providing expertise in how to engineer at the physics and engineering level for increased efficiency. *Unlike the advanced manufacturing hub, this area is likely to require more fundamental science input, necessitating closer collaboration with academics across domains of physics, engineering and materials science.*

The group emphasised the focus of such a hub should be on innovating fundamentally more efficient/ less impactful photonics and electronics products and solutions. This goes substantially beyond improving understanding of the industry's current environmental impact or making it more efficient in e.g. in design and prototyping, but addresses a much bigger challenge of supporting development of new underpinning technical solutions within the products themselves. *It is not an advice based service, but a technical innovation engineering RTO that is highly technical and sector specific*.

For example a centre such as Exeter Impact Lab, may advocate the use of more digital services, connected devices or leverage of data, that increases use of electronic devices, data traffic and use of datacentres that are in turn all increasing carbon emissions. A Hub for Low Carbon Photonics and Electronics would help ensure the increased digitisation does not lead to its own carbon crisis from ever increasing use of those same digital technologies.

4.2.3. Combined solutions

Highly variable perceptions around decarbonisation and sustainable terminology were evident in in the workshop. Sustainable photonics and electronics appeared at times associated with

- The impact of and improvements relating to photonics production and productivity.
- The efficiency and impact of photonics and electronics on the environment during its use.
- Electronics and photonics for sustainability applications e.g. photovoltaics, batteries, environmental sensing.

These interpretations are all correct in different contexts and illustrate the challenge of developing innovative interventions in these highly topical areas.

The first of these is addressed by Advanced / Automated High Value Photonics and Electronics Manufacturing Hub described above and the second by the Hub for Low Carbon Photonics and Electronics. Combinations of the two are thus clearly possible.

A 'hub for low carbon / decarbonising photonics and electronics' based in the SW could work in both the above areas incorporating both improvements to photonics and electronics manufacturing automation and reduction in the energy consumption of the technology and products themselves, thus providing an umbrella that incorporates all the above concepts and increasing breadth of impact.

The direct development of improved photonics for energy capture e.g. photovoltaics, or electronics for improved batteries was not specifically highlighted as an area the region should focus on- likely due to lack of current capabilities in these

areas. Solutions for environmental sensing is a more complex field due to its diversity.

The region certainly has photonics and electronics expertise that can be applied to e.g. marine sensing challenges. Connectivity between those seeking such solutions and local technology innovators should be fostered, potentially as part of support to and/or in collaboration and the marine cluster in the region.

4.2.4. Centre impact

The workshop did not dwell on the applications and market impacted by such centres, although some were highlighted in discussions and included

- Automotive
- Satellites and space
- Quantum, notably the commercialisation of quantum tech.
- Autonomous systems
- Positioning, Navigation and Timing (PNT)
- Communications (optical and radio frequency)
- Marine and submarine
- Consumer-tech
- Aerospace
- Science
- Life sciences
- Power and energy

The cross-cutting enabling nature of photonics and electronics means that either form of an innovation hub identified or combined versions is likely to impact all of these sectors and more.

4.3. Connecting beyond the region and building core capability

Several members of the photonics and electronics community have called on the region to support greater connectivity to national capability and assets around the UK required for growth. These include

- Semiconductor design, which is interpreted as meaning integrated (silicon) electronics design.
- Electronics and RF circuit design
- Compound semiconductors. This is the key enabling material for many areas of photonics (including integrated photonics), radio-frequency (RF) electronics and power electronics.
- Process development and design for manufacture and automated / volume manufacture of photonics and / or electronics, components and systems.

In some cases there are notable clusters of national expertise SW companies would like to access e.g. the compound semiconductor cluster in South Wales/ Glasgow (see box) or the Manufacturing Technology Centre in Coventry, part of the High Value Manufacturing (HVM) Catapult (which includes an electronics automation group). In other cases, e.g. electronics and RF design, these are seen as core capabilities that are in short supply in the SW region. *Indeed they are found to be in short supply nationally and in principle should be accessible through the CSA and HVM Catapults they remain difficult to access.*

Participants also put forward a need to increase awareness of the SW region capability in electronics and photonics in the rest of the UK and help support new and increased levels of collaboration into the region from other regions.

4.3.1. Interventions to connect in, and connect out

Enhancing connectivity in and out of the region could be achieved by funding **a full time sector champion** tasked to be aware of and facilitate introduction to national capabilities and simultaneously make national assets aware of SW capabilities. A timely example, given the current national focus on telecommunication supply chain diversification, would be fostering greater links with BT's Adastral Park innovation centre.

The same champion/ or cluster lead can also help interconnectivity within the region, collating sector knowledge and helping make connections across Devon and Somerset. They can also work

As background, the UK has no meaningful capability in integrated silicon based microelectronics manufacture. This is undertaken by multi $Bn global foundries e.g. TSMC (Taiwan), but custom circuit design is critical for many photonics and electronics components and systems and can be undertaken locally.

Integrated circuit design should not be confused with bulk electronics circuit design and production, where the SW has leading capability in all elements with several suppliers of printed circuit board and flex circuits including for high resilient applications in aerospace and transport.

More widely the UK also has leading capability in compound semiconductor (CS) production for all applications from the base wafer to integrated devices, which is focused around South Wales, Glasgow and the North East, but also includes Plessey's facility in Plymouth (which used a hybrid silicon CS process). This is supported by the Compound Semiconductor Applications (CSA) Catapult (Newport) and National Epitaxy facility (Sheffield) among many other initiatives.

An additional emerging technology branch is that integrated photonics, often using a combination of all of the above technologies. This seeks to bring the advantages of scale of integrated electronics manufacture to photonics and is increasingly used by photonics companies in the SW region.

with other locally focused champions at the Manufacturing Advisory Services (MAS), Institute of Physics (IOP) and Defence Accelerator (DASA) (representative of the which were engaged with the workshop) and who are keen to know more of the photonics and electronics capability in the region, but have no corresponding regional contact in the sector. They can also work to increase awareness of local capability and potential partnerships with the marine and nuclear sectors plus further extend interactions with the local aerospace sector.

The importance of personal links and networks to facilitate introductions was emphasised. There was no call for new collateral or marketing material, *although such may be required to facilitate engagement*. This perhaps reflects the need for pro-active input and some domain familiarity to successfully reach out and engage specialists, going beyond that achievable traditional via marketing. *Such activity would build on the community engagement undertaken by EPIC and the HPO, adding greater domain knowledge, wider pan regional coverage, greater emphasis on partnership development and much greater UK domestic focus.*

It was notable when seeking pan-regional input for this workshop that there was good knowledge and connectivity from the LEP to expertise in the Torbay region via EPIC and Torbay Hi-Tech Cluster, but low to little knowledge and active interaction with sector companies in the greater Heart of South West region. Any sector champion's remit should therefore extend across the whole region beyond the established Torbay High Tech Cluster.

Others have also found one of the best methods for increasing knowledge of regional capability is through participation in collaborative projects. Catapults are designed seek a one third of their income from competitively won collaborative R&D projects as are Fraunhofer centres and it is also a model pursued by the UK Healthcare manufacturing centre. By not having any internal R&D capability, the current EPIC centre cannot participate in collaboration directly only encourage occupant companies to do so. Supporting an innovation hub in the region (above) would enable direct participation in collaborative R&D projects and in so doing providing a focus for projecting regional capability outward and building new external interactions.

4.3.2. Building core local capability

Connecting to national capability is less effective where there is a shortage of that capability nationally as is the case in electronics and RF design, especially where going further afield for design may reduce the use of local manufacturing capability where this exists in the region e.g. in electronic circuits.

In such a cases there is a case for providing these core short skills within the region accessible to all. Much as the hardware in the EPIC centre is available for resident companies, RF and electronics design service capability could be made available for the sector as a whole across the region.

Care should be taken to discuss this with the manufactures of printed circuit boards and flex circuits in the region to understand the degree of market failure and how such provision would support them as local manufacturers. It should also be verified, if there is a general market shortage of skills, how it may and at what potential premium it would take to secure such services for the region.

4.4. Skills and Training

4.4.1. High level skills supply

The request to support increased availability of electronics and photonics skills in the region is not new. Other UK regions, most notably Scotland have strongly benefited from a 'train local -hire local' approach, where those trained locally at all levels from vocational and apprenticeship to post graduate level become 'sticky' to the region, actively seeking local careers.

However, two key shifts were apparent in emphasis of industry inputs in this area during the workshop.

1. A focus on the need to support the generation (or importation) of higher level skills at degree level and above.
2. A focus on skills in advanced / automated manufacturing.

Both of the above are differentiated from the current, and complimentary, focus of South Devon College (SDC) on vocational skills for the sector. This reflects the success of SDC of addressing the vocational skills need at multiple levels including to high level apprenticeships.

The focus on more advanced manufacturing skills reflects the increasing interest in automated or semi-automated manufacturing rather than assembly by skilled operators noted previously[7].

The need to work closely with local universities (Plymouth, Exeter) and those in nearby regions (e.g. Bath, Bristol, Cardiff[8]) was widely cited with an emphasis not just on course content, but on facilitating greater interactivity with local industry through placement programmes, internships, industry sponsorship and collaborative degrees with industry, such as Engineering Doctorates.

Given the automation interest, interaction should be fostered in areas beyond photonics and electronics technology. For example links with the University of Plymouth/ Exeter Robotics departments enabling more project support and secondments to the local photonics and electronics communities. These will be different and additional to the links with academic departments conducting electronics and photonics research and the relevant academics may not even be aware of potential local partnerships and collaboration opportunities in the sector. As the sector is a customer for automation knowledge, it takes strong focus to overcome initial reaction that e.g. as a photonics company universities engagement teams may assume companies want to talk to their photonics researchers, rather than their automation experts.

Additional beneficial actions would be the support for a Centre for Doctoral training in advance automation e.g. at the University of Plymouth/ Exeter.

The support of a local innovation hub was also seen as a source for generating and support relevant local skills development.

4.4.2. Local industry promotion to generate demand to gain relevant skills

The group also highlighted the need to generate demand from learners for the skills requested by industry. In particular some legacy reluctance to enter electronics and photonics careers is now emerging as a result of negative perceptions and advice given by parents, of what could be termed the 'Nortel generation', to their children.

The focus of many of the highest growth and/or largest election and photonics companies on global customers, with embedded products invisible to the consumer, means students and

[7] Automation skills are often also draw from electronics and photonics, but are a distinct specialism. It should not be assumed that just because a company is producing an electronics or photonics product it has advanced automation skills - the input from the group would indicate otherwise.

[8] Part of the GW4 SW universities alliance of Bath, Bristol, Cardiff and Exeter, potentially providing a basis for collaboration all with excellent photonics and electronics research activity.

schools often remain completely unaware of the strength of the sector locally and its relevance to topical issues that influence their career choices.

A program to promote the sector and its impact on e.g. issues to such as the environment and digital enabler, to the general public and student population should make a material impact on demand for acquiring the skills locally that industry is seeking at all levels.

This activity would also underpin and support he vocational skills programs in development at SDC by supporting and driving demand and can emphasise the multiple pathways to higher levels skills from traditional university degree to higher level apprenticeships.

In post meeting input, participants also noted the potential for collaboration with nuclear, digital and marine sectors on the promotion of career opportunities as all face similar challenges.

When promoting careers at the school level, a general STEM careers approach is often taken, this can be off-putting if too generalised and often uses examples that are not relevant to the local economy. Working with those highlighting STEM opportunities to use specific examples from the local area coupled with a variety of career paths can be most effective enabling maximum relevance to the widest audience. As noted the importance of being relevant to key influencers (e.g. parents and teachers) as well as young people should not be ignored.

4.5. Other concepts

Other concepts and ideas voiced in the meeting, but discussed in less detail or with more niche impact included.

- Aggressively bringing a major industrial player in the sector to the region. *(This being potentially addressed through the HPO program)*
- Centre of excellence in specialist lighting
- Exploitation of marine and submarine applications
- Freeports

Select participants noted interest in the freeport concept understanding its potential benefits for importing duty free, adding value and exporting.

The Plymouth and South Devon Freeport was confirmed in the 2021 Budget following the workshop. Participants noted the importance of working with such already highly developed initiatives as their detailed plans are developed. *There are many photonics and electronics companies within the 28 mile radius understood to be able to benefit from aspects of the Freeport. Engagement of the sector with the detailed Freeport planning that will ensure potential benefits are realised by the local photonics and electronics industry.*

There is some potential fit for an electronics and photonics industry that is heavily export focused. However, others noted extensive leverage of freeports may be at odds with a drive to integrate more locally made content and reduce the 'airmiles' of photonics and electronics components before they are integrated into a higher level system.

5. Differentiation and prioritisation

Approximately nine concepts were identified for differentiation and prioritisation discussion, however time allowed for debate on only 5-6 in any detail:-

- Skills – which discussion spit into up-skilling / CPD and longer term degree + skills development
- Finance intervention in local investment fund and local collaborative R&D grants
- Innovation hubs in advanced photonics and electronics manufacture and decarbonisation of photonics and electronics.

Input was sought from the workshop to differentiate these concept against two sets of axis

- Time to impact and start vs breadth of impact across the region
- Potential funding requirements vs fit to local and national strategies

Those concepts prioritised for discussion were those with the least obvious positioning against these parameters. The other concepts previously highlighted were added to the differentiation figure in post workshop analysis (indicated in paler colour in respective figures)

5.1.1. Time to implement and impact vs. breadth of impact across the region

Discussion around the timeliness of skills revealed additional detail. Demand for high level skills was considered urgent – within the next 2 years from some, indicating a need to import such skills, or links to those already in training at degree+ level, as the generation and completing of higher levels skills programs is considered a longer term process (3 years +).

However, some contributors noted that cross-training and upskilling of existing / new employees can be delivered much faster and achieve similar results. Whilst not definitively articulated as such, this indicates potential demand for coordinate of CPD training between local firms to e.g. provide those automation skills and/or provide basic photonics and electronics knowledge to those coming into the sector from other areas. Development and deployment of such training is seen as a much faster.

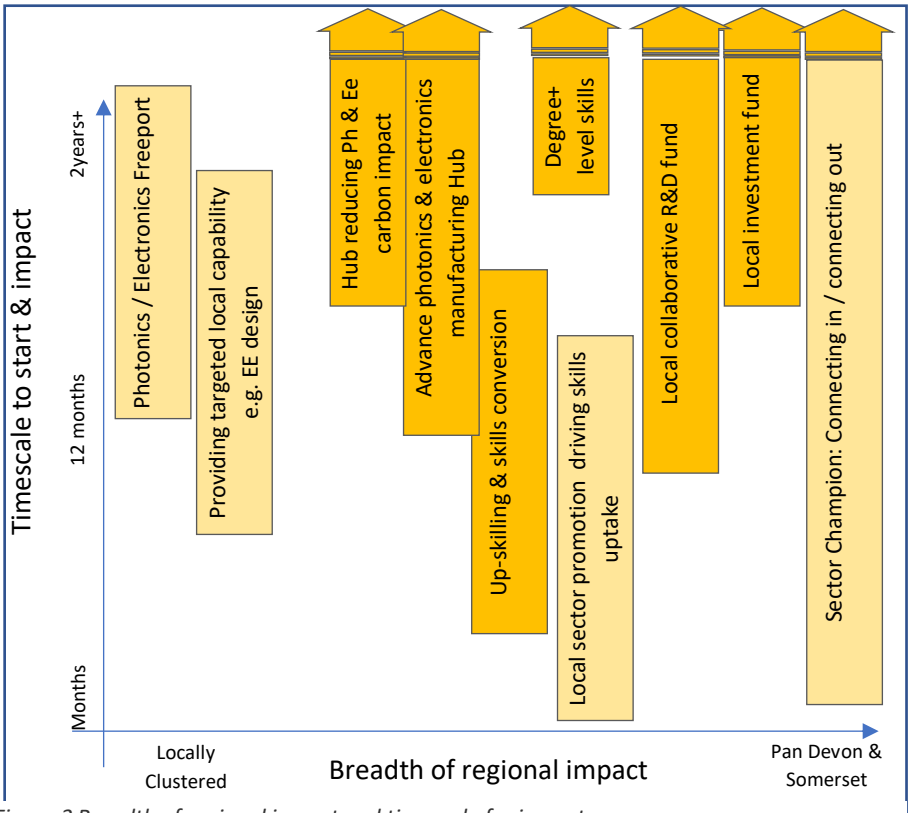


Figure 3 Breadth of regional impact and timescale for impact

Skills initiatives were viewed as having broad impact and benefit across the region. *Training at any level is generally delivered in one location the stickiness of those skills to the location in which they are gained should not be underestimated. For example, those acquiring e.g. automation skills in Plymouth may not see relocation to Somerset as local.*

Finance interventions were seen as potentially taking a long time to set-up and requiring multiple years to show impact. Participants noted set-up time could be minimised by using existing investment / grant vehicles.

Although impact time should be less for localised R&D grants than capital investment projects, even the former can typically have 18 month to 2 year timescales.

Experience at Innovate UK indicates 6 months from launch to start of project is close to the minimum to allow for a full competition and consortia agreements to be signed. Given most collaborative R&D projects require further work to take a development to market the net results can be a direct impact time ~3 years. However many cite indirect benefit of increased collaboration with project partners is felt in less time. Return on capital investment projects, especially if at an early seed stage are likely to be longer still.

Finance initiatives were seen as having perhaps the broadest reach across the region with no intrinsic localisation. Due to the potential to foster new collaboration within the region, local collaborative R&D grants can also be key facilitators to increase regional interconnectivity through the supply chain encouraging more local partnerships. *This in in turn should build greater resilience in the supply chain and stronger regional ties that helps keep companies in the area.*

The exception being interventions associated with freeports or enterprise zones which are by their nature highly localised to only specific areas

The breadth of impact of innovation hubs to some extent depends on their detailed remit and who they undertake projects with. They can certainly have pan-regional and wider impact according to the location of industrial partners. However given it is difficult to work with everyone simultaneously their regional impact tends to start in specific locations and build across the region over time.

The osmosis of key skills to the wider community e.g. in automation also tends to be highest in the immediate vicinity of the centre.

The speed with which RTO hubs can be set-up very much depends on the degree of partnership with existing organisations and leverage of existing structures and physical locations. Embedding a hub in the EPIC centre, or existing university facilities would vastly reduce set-up time. Their impact remains the long term and closely coupled to maintaining ongoing core funding support.

Connecting community functions and benefits can be set-up as quickly as a sector champion can be recruited and get up-to-speed with the local sector and remains for the length of time they are in post. The impact is as broad as the sector champion travels and communicates, extending beyond the region as they interact with the rest of the UK ecosystem.

The 2021 Budget announced priority local authorities for levelling up support[9]. Whilst some priority 1 authorities are in the SW (e.g. Torbay) not all of the region has been given the same priority. This may impact the degree to which breadth of impact across the region is important in aligning to the Levelling Up Fund specifically. Some of the workshop recommendations such as increasing availability of low carbon impact manufacturing space would appear particularly well aligned to the Levelling Up Fund.

5.1.2. Scale and fit to national / Local industry strategy.

Skills support, local sector promotion and connecting activities were generally seen to be at the lower end of the cost scale <£0.5-1million and in some cases much less. Although where new course content for training and skills is required it was noted that the costs and time for generating such should not be underestimated. *Similarly high impact local promotion requires quality content,*

9 https://www.gov.uk/government/publications/levelling-up-fund-prospectus

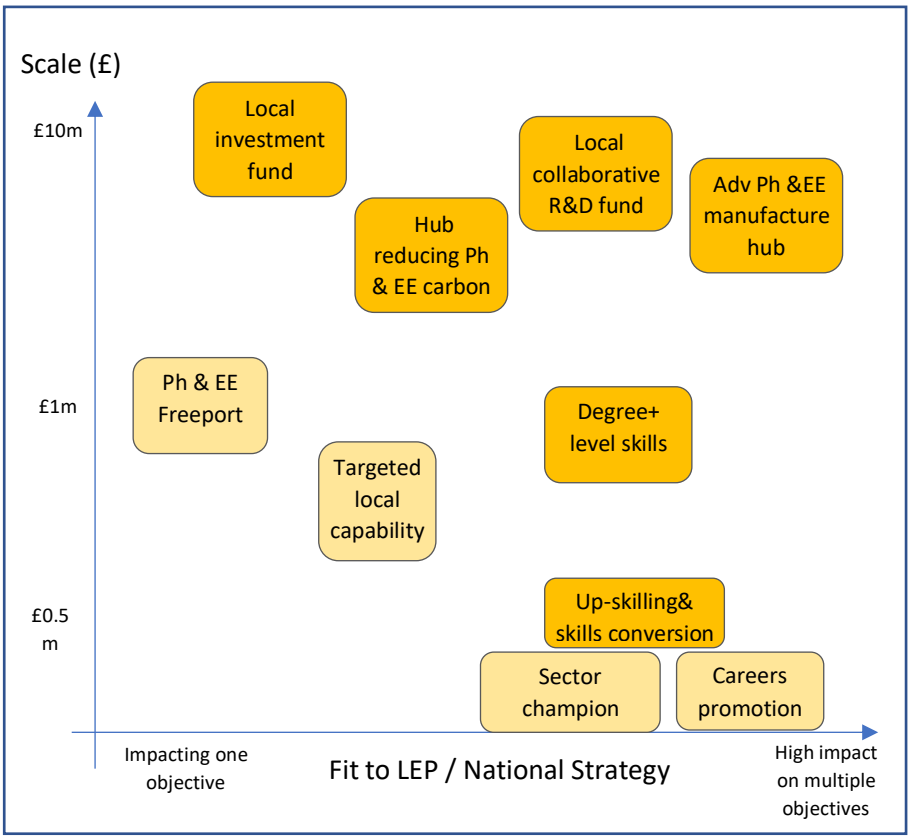


Figure 4 Scale and fit to national and local strategies

as experience from the HPO program promotion shows.

Finance interventions in either local R&D grants or direct investment were viewed as needing to be at the higher scale of investment (~£10m) to be in anyway effective[10].

Collaborative grants need to be large enough so that funds received by individual partners make it worth the overhead of participating. One million spread 5 ways is ok. £200k spread 5 ways is often considered not worth the effort. To support a diverse range of activity one must also fund multiple consortia. The net result is a ~£5m minimum for a single R&D competition and even this won't be able to fund projects of significant scale.

The fit to local and national strategy, especially for direct investment, is less clear. Through the Covid pandemic central government has made loans convertible to equity which in effect set precedence for equity investment. Measure to support the provision of patient capital are also increasing. However most of these rely on the government or government sponsored vehicle being a co-investor alongside an traditional venture investor.

The need to match government backed investment with private investment puts regions such as the SW with low access to venture finance at an even greater disadvantage. Close discussion with government may therefore consider more approaches that do not further disadvantage the regions companies from access to patient / investment capital.

Local R&D grants have a better fit, not least because the advance local capability and build connectivity within the region.

Funding RTO innovation hubs is not cheap, mostly because of the long term commitment required not necessarily the annual costs. However they do need to be able to attract the highest calibre staff and have a budget for expensive capital equipment- especially around automation. They would provide excellent fit to national and local strategies in multiple areas including increasing production supply chain resilience, capturing greater value locally, increasing productivity and facilitating the pathway to a net-zero carbon economy.

[10] The Cardiff Capital region investment fund is £50million in scale https://www.business-live.co.uk/economic-development/new-50m-investment-fund-cardiff-20183454

6. Methodology

The process followed to capture out-of-the-box innovative support concepts was designed around tried and tested methods for generating and capturing novel ideas from a diverse industrial group, adapted to the remote format: namely

1. Participation – ensuring the correct people are present at a senior management level from across the region and broader UK innovation eco-system, plus samples of companies from outside the region.
2. Engagement- ensuring participants are motivated and briefed. Examples of concepts from previous discussions were provided to stimulate thinking
3. Context- The HotSW presented the local industry strategy and LEP thinking around the project to provide relevant context.
4. Facilitation- a knowledgeable facilitator was present in all breakout rooms and pre briefed to help extract ideas and ensure far contribution from all.
5. Capture & review – the online white board Mural tool was used to capture concepts, enable multiple participants to contribute ideas simultaneously and review the contributions of others in real time
6. Prioritisation and differentiation – to provide a basis to differentiate the different concepts.
7. Reporting- to capture and interpret the workshop inputs and provide additional background

The second part of the workshop was originally conceived as a focused discussion on the prioritisation of the concept generated in the initial ideas generate session. However, given that the objective was to generate ideas in advance of any specific funding call or program, it became clear that there are no clear prioritisation criteria – these will only emerge as details of any program emerge. Therefore this element of the workshop was rephased into one of differentiating the concepts against key criteria to enable the LEP, to identify those with best fit as further detail of regional support programs emerge.

Discussions focused on differentiating groups of concepts around on axis of firstly time to implement and impact and breadth of impact across the region and secondly scale and fit to national / LEP industry strategy.

Time allowed for only the most prominent / variable concepts to be discussed.

6.1. Workshop Agenda

10:00	Introduction, agenda, objectives and system familiarisation
10:15	Context – the HoTSW industrial strategy
10:30	Breakout rooms – brainstorming of ideas. facilitator per room
11:15	Coffee /comfort break (compiling of ideas)
11:25	Summary and review from each breakout group
11:45	Prioritisation
12:15	Wrap-up
12:30	Close

Discussions were with 5 minutes of the target times.

6.2. Participants

Thirty-five people participated in the remote brainstorming meeting to generate and differentiation idea for support photonics and election in the region- shown overleaf.

Participants were split into five breakout groups for the core and discussion of ides with a facilitator for each (shown in bold). There were 3 no -shows indicated in italics.

A number of additional organisations were invited to participate from across the region but were not available to attend.