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Crop Improvement Research Club

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National funding context

Research Councils UK

HM Treasury → Department for Business, Energy & Industrial Strategy → RESEARCH COUNCILS UK

Arts & Humanities Research Council

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EPSRC Engineering and Physical Sciences Research Council

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

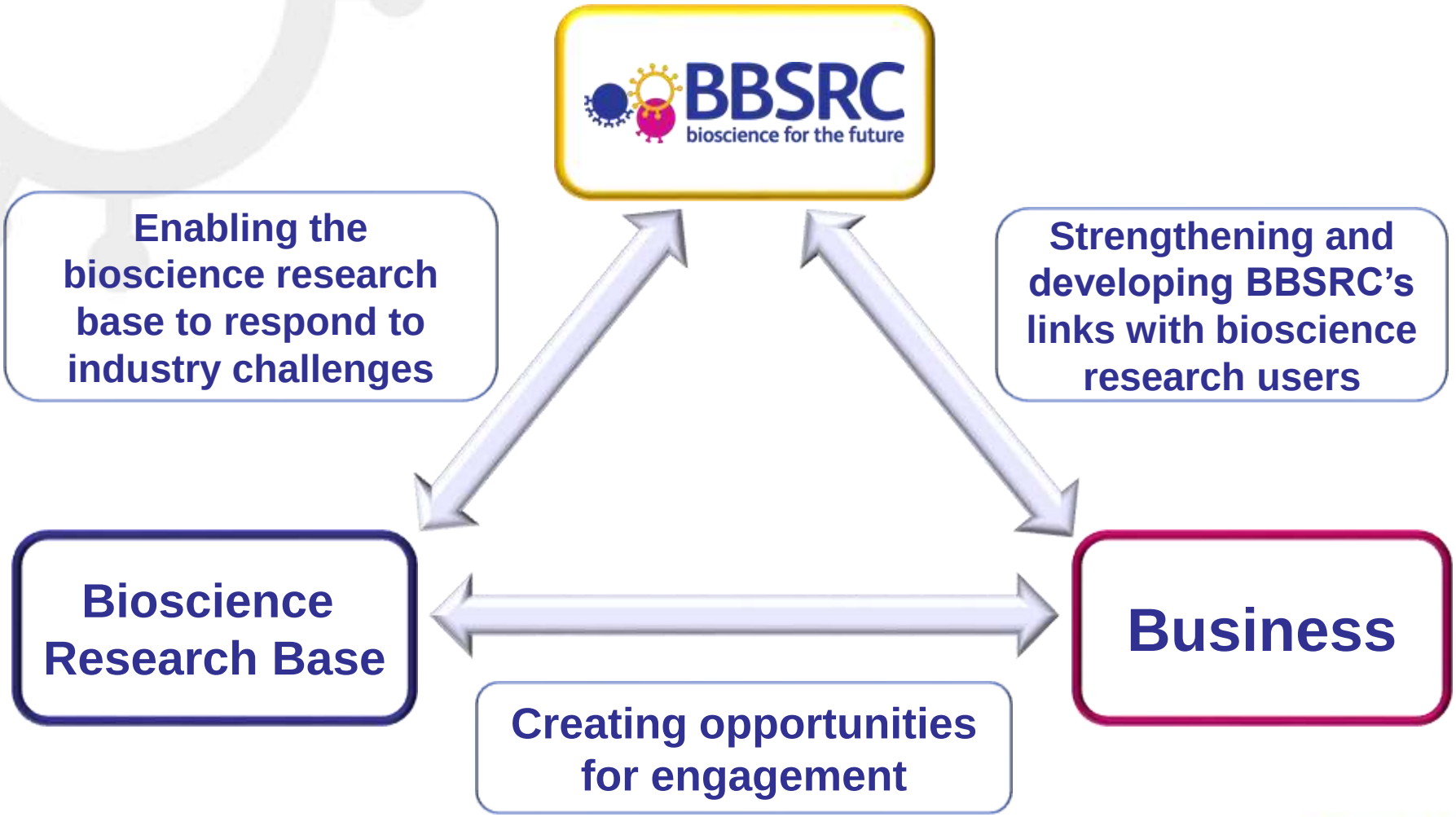
NERC SCIENCE OF THE ENVIRONMENT

MRC Medical Research Council

Science & Technology Facilities Council

~£3 billion budget

BBSRC working with businesses



Support for Agriculture and Food Security

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Plants

Animals

Cereals	Fresh Produce	Production	Livestock	Aquaculture

Pre-competitive Research

CIRC	HAPI	SARIC	ARC	Aquaculture Initiative
Crop Improvement Research Club	Horticulture & Potato Initiative	Sustainable Agriculture Research Innovation Club	Animal Health Research Club	

Collaborative Research

Industrial Partnership Awards, stand-alone LINK, & sLoLa

Competitive Research

Partnerships with Innovate UK

Agri-tech Catalyst & Centres

Sustainable Agri-Food Innovation Platform (SAF-IP)

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CIRC: Programme structure

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£7M to improve the productivity and quality of wheat, barley and oil seed rape for use in food:

- Launched in 2010 as a 7 year partnership
- Led by BBSRC, a consortium of 14 companies, and Scottish Government
- 15 research projects investigating:
  - Grain Processability and Utilisation
  - Pest and Disease Resistance
  - Root Function
  - Yield Improvement
- Further funding for ten PhD studentships has been allocated

"The club enables industry and academic partners to tackle collaboratively specific issues affecting crop breeding and processing"

Dr Peter Werner, R&D Breeder, KWS UK Ltd

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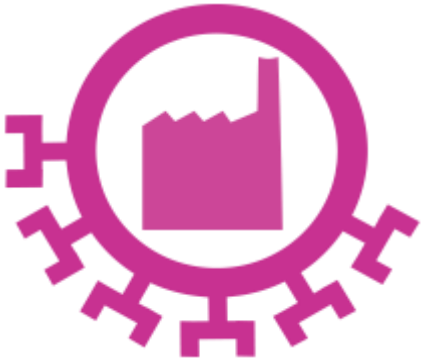
CIRC aims

Support high quality, innovative, **pre-competitive** research to underpin the UK industry in addressing significant challenges to future competitiveness

To strengthen the research community in the areas which underpin **the long-term needs of industry** through interdisciplinary research and the provision of training

To ensure the exchange of knowledge between the science base and industry through effective networking leading to **impact from bioscience research base**



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"One of the most important impacts of CIRC is the creation of a pool of young scientists working on crops. Succession planning in crop science is of strategic importance to SWRI"

Dr James Brosnan, Research Manager, SWRI

"CIRC helps AHDB meet its strategic R&D aims, complements its own research programme, and provides leverage for AHDB resources"

Dr Dhan Bhandari, AHDB Cereals & Oilseeds

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CIRC structure

- Consortium of companies together with BBSRC to **fund pre-competitive research** in strategic areas
- **'Common-pot' funding** – BBSRC contributes 90% of funding, industry consortium contributes 10% (*Industry members subscriptions on sliding scale re: company size).* Additional funding from other funders
- Company members **decide on the research priorities**
- Industry members, via Steering Group, **contribute to review and monitoring of research**
- Company members have **early access to discoveries** – novel products, new methodology, IP
- Regular engagement allows members to meet researchers/other industry leaders, to further **develop research projects/collaborations**
- **Talent development** (PDRA and PhDs targeted to Club areas)

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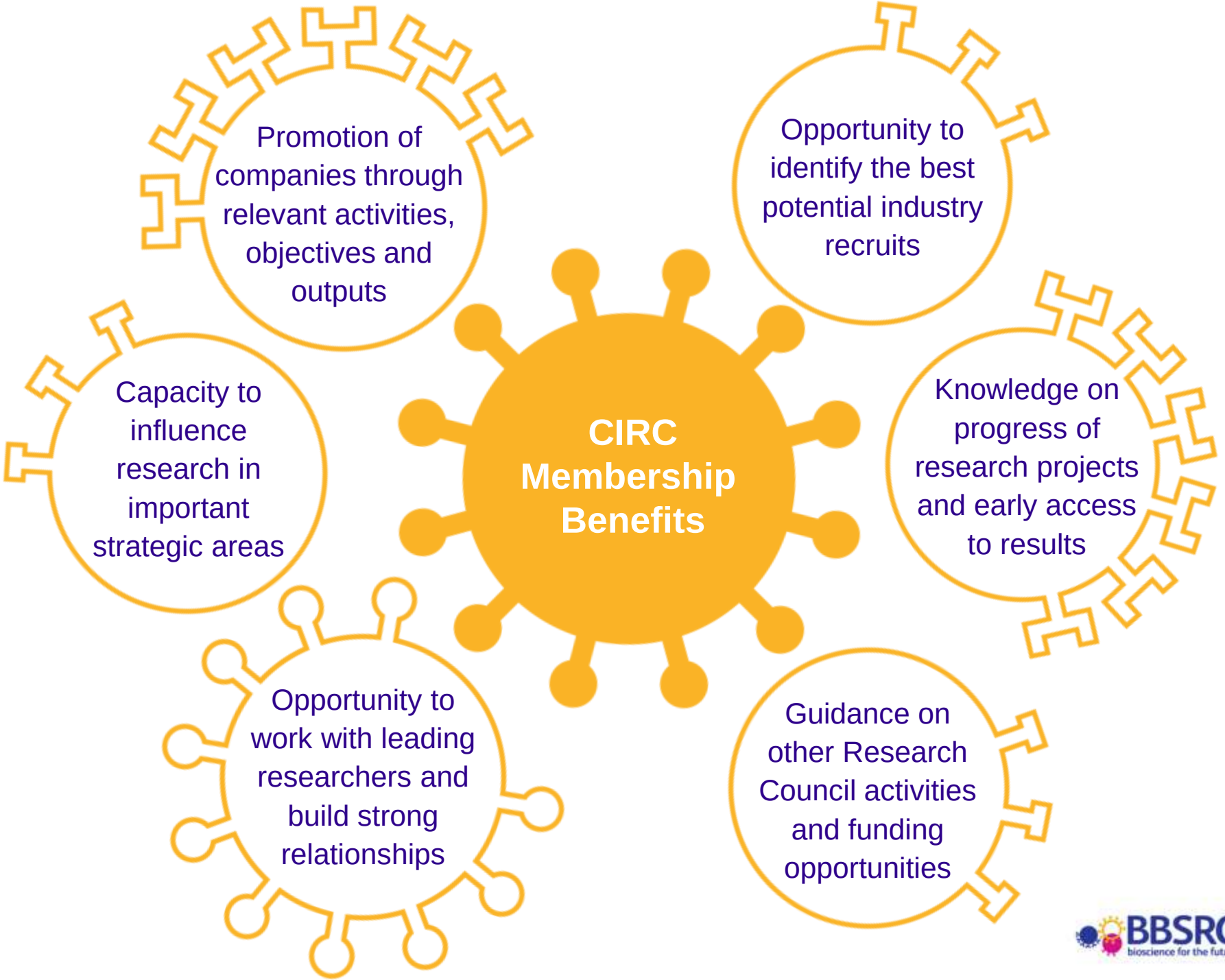
CIRC Membership Benefits
Promotion of companies through relevant activities, objectives and outputs
Opportunity to identify the best potential industry recruits
Capacity to influence research in important strategic areas
Knowledge on progress of research projects and early access to results
Opportunity to work with leading researchers and build strong relationships
Guidance on other Research Council activities and funding opportunities

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CIRC: Project case studies

Releasing the full potential of wheat

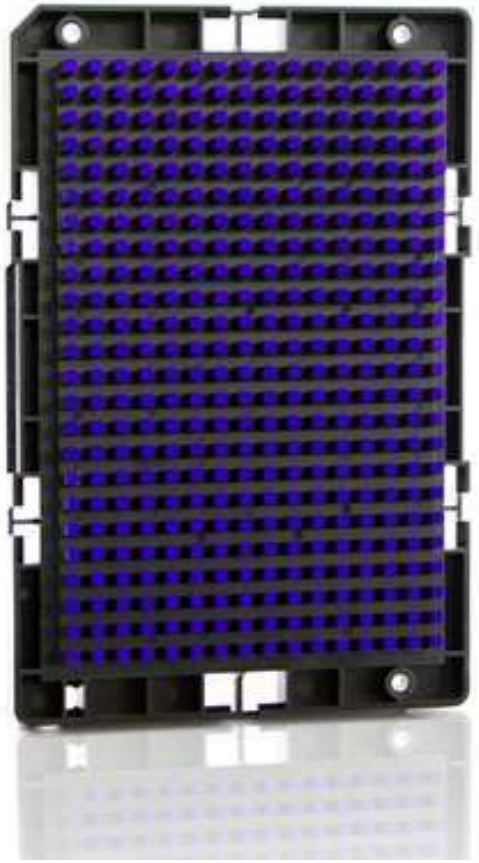
The new tools and knowledge generated will enable plant breeders to improve UK wheat varieties more rapidly than is currently possible.

Prof. Keith Edwards, University of Bristol

- Researchers at the University of Bristol and the John Innes Centre are helping to narrow the gap between the potential and actual yields of wheat to secure sustainable production of one of the world's most important crops.
- The team have developed tools to support new ways of improving UK wheat varieties using marker-assisted selection (MAS).
- The team worked with researchers from LGC and CIRC companies to identify several hundred thousand wheat markers, of which 7000 have been validated and made available online via CerealsDB.
- These molecular markers will allow plant breeders to identify which genomic regions of wheat are linked to traits like disease resistance or increased grain yield.

Axiom 384HT Breeders array

- All have been assigned a chromosome arm location based upon BLASTing to the IWGSC survey sequence data
- 15,393 co-dominant, 7,067 partially co-dominant, 12,683 dominant
- 18,138 have a genetic map position
- ~80% are polymorphic in the Watkins collection, 66% polymorphic in the synthetic collection
- Now putting together a global collection of lines



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Reducing grain skinning in barley

- Delivering high-quality malting barley is important to maintain a competitive UK cereal and Whiskey industry.
- The loss of the outer layer of the barley grain during or post-harvest is called grain skinning, and is detrimental to malting.
- Dr Steve Hoad and his team at JHI are exploring how a plant's genetic make-up influences grain skinning, to improve our ability to breed new barley varieties without this undesirable condition.
- Reduced grain skinning will lead to greater security for the UK barley supply chain and this project will contribute to a more efficient development pipeline for barley breeding.

A sample of skinned barley, image courtesy of Dr Steve Hoad and Dr Maree Brennan, JHI

"Through the CIRC, SWRI established wider links with academic groups. Some of the existing links with academic groups were energised through CIRC activities. Subsequently, SWRI is doing more work with several academic partners"

Dr James Brosnan, Research Manager, SWRI

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New resistance genes to Turnip Yellows Virus in Oilseed Rape cultivars

Turnip yellow virus (TuYV) infects most oilseed rape crops in the UK, reducing the seed yield by up to 30%. Growers have used insecticides in attempts to control the virus however these can be ineffective:

- A new source of resistance to TuYV has been characterised
- Strong resistances from *B. rapa* and a *B. oleracea* wild relative have also been characterised and combined in resynthesized *B. napus*
- Negotiations with breeders to exploit the resistances are underway
- Weeds such as Shepherds purse, groundsel and chickweed have been shown to be reservoirs for field infection as they are hosts of TuYV capable of infecting oilseed rape
- 179 full TuYV genomes from 6 European countries have been sequenced to enhance our understanding of the genetic diversity of the virus

Keith Norman, Technical Director of Velcourt, and Dr John Walsh, University of Warwick, looking at new virus resistant oilseed rape lines at Cereals 2015. Image courtesy of Prof Simon Bright, CIRC coordinator

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New roots to innovation

The funding from CIRC has allowed us to build upon an on-going UK-China collaboration to understand how genetic variation effects the root systems of arable crops.

Prof. Martin Broadley, Nottingham

- Researchers at the University of Nottingham and the James Hutton Institute are developing new systems to quickly and cheaply quantify root quality and architecture in crops.
- Roots are an untapped resource for plant breeders. Crops with better root systems have increased access to the water and nutrients they need to thrive, which leads to improved yields for farmers.
- The project has developed a process to rapidly capture images of root systems at a cost of roughly £0.23 per unit.
- The data generated is being validated using field trials and 3D imaging so that genetic variation within Wheat, Barley and Oil Seed Rape can be accurately linked to root development.

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Key questions

Was there any national context relevant to the establishment of the PPP?

- UK has strength and capacity in academic plant science and a successful private sector
- Pre-existing relationships: e.g. British Society of Plant Breeders (BSPB), Plant Sciences Federation, Agricultural and Horticultural Development Board (AHDB)
- Previous collaborative programmes established trust: e.g. Defra LINK
- Academic networks developed at a similar time: e.g. Wheat Genetic Improvement Network (WGIN), Monogram, Garnet

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Are there any characteristics in your PPP that would allow or impede the implementation of the model in other countries?

Advantages:

- Funding ratio – good leverage for private sector
- Flexible approach to developing outputs and handling IP
- Skills and training provision
- Structured and regular networking leads to a community
- Sharing of resources and experimental materials
- Complementarity with other national funding routes

Disadvantages:

- Requirement for cash contributions from private partners
- Pre-competitive nature of the research may limit industry interest
- Only academic researchers in UK universities or institutes are eligible
- Needs staff time from funders and facilitators to manage relationships

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Why did you consider that a private public collaboration would be of benefit to the work that was planned?

- BBSRC aimed to extend existing funding opportunities to deliver organisational mission
- Industry engagement supported research exploitation
- CIRC enabled academics to propose different hypothesis compared to other national funding mechanisms

What were aspects you struggled with and which would need to be taken into consideration in a European PPP?

- Flexibility to adapt to changes over a 7 year programme
- Changes in public funding opportunities
- Welcoming new industrial members after funding is allocated

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CIRC establishes new capabilities to address industrial challenges:

- 380,000 DNA markers for better wheat
- Standardised lab test for grain skinning in barley
- Improved knowledge of photosynthesis in crops
- High throughput assessment of root systems to screen new crop varieties
- Novel EMI methods to measure root performance and soil moisture
- New genes and markers to combat Turnip Yellows Virus in oilseed rape
- Insight into new gene combinations to reduce pod-shatter in oilseed rape

More information: circ@bbsrc.ac.uk www.bbsrc.ac.uk/circ