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Enterprise Research Centre

Follow-the-Grant -

Identifying the longer-term impacts of Innovate UK collaborative R&D grants

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Background

In this report, we develop and apply a Follow-the-Grant (FTG) methodology to track the long-term impacts of a group of 16 Innovate UK (IUK) collaborative R&D grants over 3-8 years after they were completed. By tracking down project participants, often in new job roles, we follow the progress of the knowledge generated in each project and identify technological and commercial outcomes. We focus on four research questions:

- What were the outcomes of the funded projects? How were these outcomes influenced by individual, technological, organisational, and market factors?
- How was the knowledge developed during the project subsequently utilised by the firm? How long did this process take? What factors influenced this deployment?
- Was the knowledge developed during the project applied elsewhere? How was the knowledge disseminated or transferred?
- What happened to the team members from the original project? How did their involvement in the funded project shape their future activities?

Applying the FTG methodology

The selected projects focused on collaborative R&D, were completed an average of five years ago, and had a project budget exceeding £1m. Initially, twenty-nine projects were selected, encompassing 160 partner organisations. All participant organisations that could be contacted were approached, and using a snowballing strategy, we completed 38 interviews across 16 projects.

There were no statistically significant differences between firms and projects that agreed to be interviewed and those that did not, based on the organisation's status as a lead, the size of the grant, project duration (in years or months), the number of organisations in the consortium, and the number of years since the project finished.

Impacts

The projects we followed generated a diverse range of direct and indirect impacts, which are summarised below. One important aspect to consider about these impacts is that they are interconnected, and not all of them occur at the same time. For instance, improvements in individual experience and knowledge could lead to greater capability and expertise within individuals' own organisations, which might result in securing follow-up funding in the related field and/or business expansion.

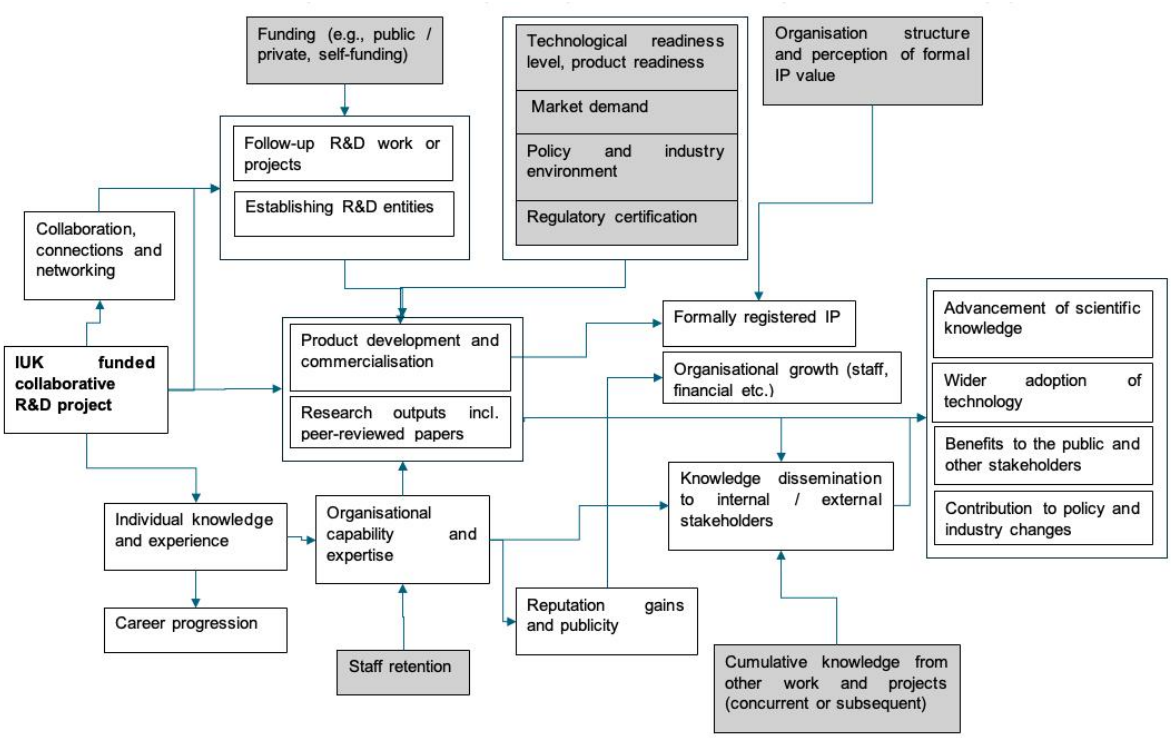
These grants demonstrated that IUK grants could directly promote ongoing collaboration between partners, lead to follow-up R&D projects, or both, when project partners engage in the subsequent R&D work.

Capability benefits	Individual skills and experience, including on project and stakeholder management
	Increased scientific and applied capability within organisations
Staffing benefits	Staff retention and employment gains
	Individual career progression within the same or other organisations
Knowledge and technology benefits	Applied and/or theoretical knowledge on scientific topics and technologies
	New or accelerated product development, product regulatory compliance and commercialisation
	Research outputs, including peer-reviewed publications
	Formally registered IP, such as patents and trademarks
	Contribution to the broader scientific knowledge
Collaboration benefits	Contacts, networks and collaboration (to the individual or organisations)
Promotional and commercial benefits	Publicity, promotional effects and reputation gains (to the individual or organisations)
	Customer acquisition, increased sales and other measures of business or organisational growth
	Changes to the business model and strategic direction of organisations, pivoting
Ecosystem benefits	Founding of research entities (e.g., institutes, laboratories, testing facilities, spinouts)
	Follow-up funding, grants and projects
	Contribution to government, industry or professional body policies or guidelines
Wider societal benefits	Benefits to beneficiaries of the innovative technology (e.g., customers, private companies, patients, residents in the local authorities)
	Knowledge and experience dissemination to internal and external stakeholders

Impact pathways

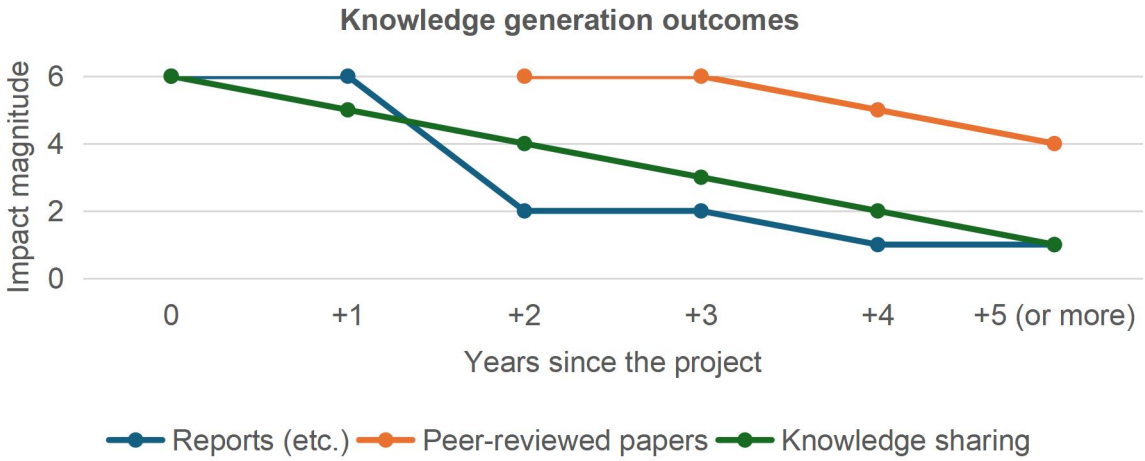
We present a summary of typical impact pathways below. In the figure, white boxes represent impact pathways, and grey boxes represent contextual factors that enabled or inhibited impacts.

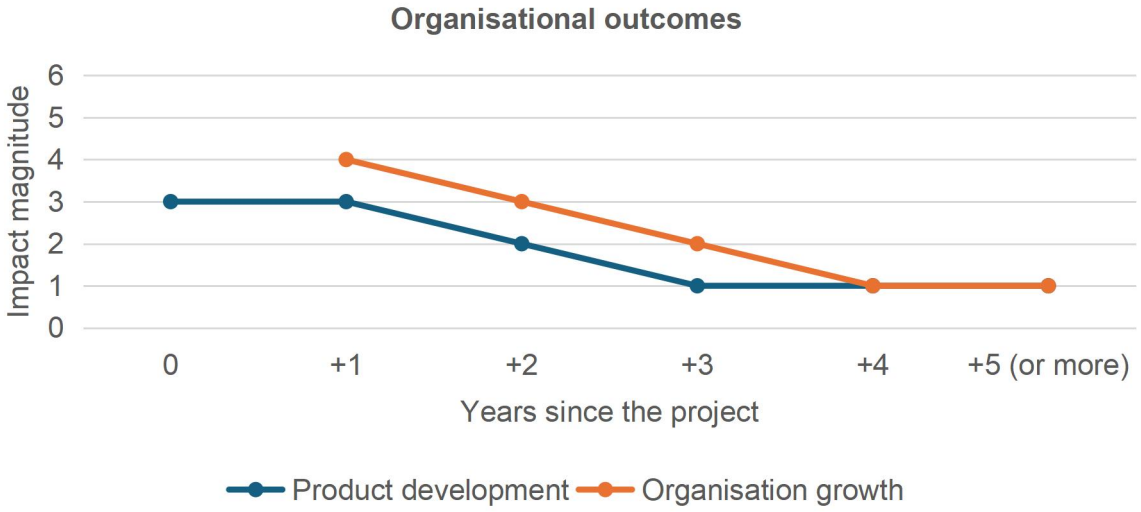
It is notable here that even where IUK projects were not entirely successful in achieving their intended outcomes, they still generated some impacts mentioned earlier, particularly in terms of knowledge and experience gains for individuals and their organisations, as well as additional collaborations. However, 'successful' projects seem to have led to more significant and lasting impacts, including those achieved through mechanisms such as organisational or business growth.



Impact timelines

Different types of impact reflected very different timelines after project completion. Most effects were strongest in the 2-3 years after project completion with many declining sharply by year 5 See figures below where impact magnitude is illustrative only for the purpose of visualisation.





Monitoring and evaluating impacts

Long-term impacts mostly seem to have materialised around year 3 after the project, with most impacts directly caused by the grant occurring after 1 to 2 years. Few new impacts appear around year 5.

This suggests the potential for a tiered approach to the longer-term assessment of the impacts of major projects. Reaching out to the individuals involved three years later would provide an impact update. These contacts could then be revisited five years later, and due to the follow-up, they are more likely to be traceable and participate again.

As in other Follow-The-Thing studies, the majority of interviews in our study were completed due to "snowballing". The high-quality insight provided by project leads and the value of the snowballing approach across organisations suggest a clear research strategy for any future Follow-the-Grant studies. First, prioritise identifying and interviewing the project's technological or scientific lead. Second, use a snowballing approach to identify individuals in other organisations involved in the project. Third, and depending on resource constraints, multiple stakeholders from the same organisation can be interviewed to develop insights about individual outcomes.

Strengthening long-term impacts

The FTG approach identified a range of direct and indirect impact mechanisms. Awareness of these mechanisms may allow IUK and other partners to help strengthen these pathways. For example, several interviewees highlighted that networking and collaboration opportunities were one of the most valuable outcomes from IUK grants for them. This focuses attention on networking and knowledge-sharing initiatives such as the Knowledge Transfer Networks (KTNs), which can promote collaboration opportunities among project partners and organisations from other projects.

A few interviewees also highlighted that the publicity and reputational gains from the project contributed to further R&D and professional opportunities for them and led to sustaining some impacts from the project. IUK may play a role in showcasing ongoing and completed projects to help maximise knowledge dissemination and commercial impact.

The FTG study also identified several external factors that served as enablers or constraints on project impact. Many, but not all, of these factors are outside IUK's control. However, as projects near completion, IUK could assist organisations in identifying potential factors that may limit or constrain impacts and, where possible, mitigate these.

SECTION 1: INTRODUCTION

1.1 Aims and objectives

In this report, we develop and apply a Follow-the-Grant (FTG) methodology to track the long-term impacts of 16 Innovate UK (IUK) collaborative R&D grants over 3 to 8 years after their completion. By tracing project participants, often in new employment roles, we are able to identify technological and commercial outcomes and understand the mechanisms through which these outcomes arise.

Our qualitative FTG approach complements econometric evidence, which supports the positive effects of R&D and innovation grants on innovation outcomes (Zuniga-Vicente et al., 2014) and business growth (Scandura, 2016; Vanino et al., 2019). Spillovers from publicly funded R&D projects may also occur as individuals act as carriers of knowledge and share learning with other companies (Braunerhjelm et al., 2020). However, both the direct and spillover effects of publicly funded innovation projects may fully develop only in the medium to long term, beyond the 2-3 year horizon considered in many evaluation studies.

Our FTG methodology draws inspiration from the 'follow the thing' (FTT) approach developed by geographers to address the increasing complexity of international supply chains for various commodities. FTT involves tracing a commodity as it moves from production through transportation and distribution systems until it reaches the final consumer. As Atkinson (2022) comments: 'Following approaches view commodities as mobile units that also, and importantly, reveal their deeper, more intertwined connections, relationships, and impacts as they travel. Hence, for its proponents, 'following' uncovers more than was previously recognised about the flows and nodes of these 'things', along with the social and cultural impacts they might prompt' (Atkinson, 2022).

Applications of the FTT approach are usually linked with global commodity value chains. In the context of new technologies and innovation, similar concepts for value chains have been introduced, such as the innovation value chain, which tracks connections between investments in innovation (such as R&D) and the development of market-ready new products and services, as well as their subsequent commercialisation (Roper & Arvanitis, 2012; Roper et al., 2008).

Christophers (2011) proposes three arguments regarding the applicability of the 'following' approach to innovation.

- First, a 'following' approach allows us to understand how a technology grant is embedded within its economic, social, and corporate context. This reflects the literature on the social nature of innovation activity and the broader literature on innovation systems.
- Second, the following approach enables us to consider the cumulative nature of innovation activity, with innovation in one period contributing to future success. This relates to evidence on the persistence of innovation and once again highlights the contextual nature of innovation.
- Third, technological change is increasingly transforming our lived experiences, emphasising the need to understand how these shifts occur.

In this report, we develop a Follow-the-Grant methodology and trace the knowledge, intellectual property, and project team involved in each Collaborative R&D project. Through numerous semi-structured interviews with team members and related stakeholders, we monitor the progress of the knowledge generated in each project, focusing on four research questions:

- What were the outcomes of the funded projects? How were these outcomes influenced by individual, technological, organisational, and market factors?
- How was the knowledge developed during the project subsequently utilised by the firm? How long did this process take? What factors influenced this deployment?
- Was the knowledge developed during the project applied elsewhere? How was the knowledge disseminated or transferred?
- What happened to the team members from the original project? How did their involvement in the funded project shape their future activities?

1.2 Anticipated effects

What might we expect to observe as we examine the long-term effects of these projects? Here, more statistical studies indicate some possible outcomes and mechanisms through which these outcomes may occur. For example, innovation grants may produce input, output, or network additionality (Aerts & Schmidt, 2008; Douglas & Radicic, 2020).

Input additionality occurs when receiving grants encourages further innovation investment from innovating firms (Scandura, 2016). Output additionality happens when grant support increases the scale or extent of firms' innovation activities (Czarnitzki & Hussinger, 2018; Hewitt-Dundas & Roper, 2010). Network additionality indicates the potential for grant support to expand firms' partnership activities for innovation, with Spanish data showing a positive relationship (Douglas & Radicic, 2020).

Receiving an R&D and innovation grant by firms in one period can also lead to subsequent innovation and commercial gains. Technological benefits may arise when learning from a grant-funded innovation project informs or creates a foundation for future innovation. Roper & Hewitt-Dundas (2015) suggest, for example, that prior investment in R&D enhances the innovation benefits of future innovation partnerships. New technologies developed with grant support may also result in formal intellectual property, such as patents (Morikawa, 2019).

Commercial benefits may occur when new products or services satisfy consumer needs (Heidenreich et al., 2016). In both cases, securing a grant reduces the technological and commercial risks linked to firms' innovation activities (Astebro & Michela, 2005). Finally, obtaining a grant can generate signalling benefits by indicating the quality of an innovation project or the recipient firm, with potential financial advantages. For example, evidence from both the US and UK indicates that R&D grant recipients are more likely to attract venture capital subsequently (Howell, 2017).

Grant-funded R&D and innovation projects also offer learning opportunities for the project team. The knowledge developed or gained during a project may inform future projects or activities within the same organisation. Furthermore, if individuals move between organisations as carriers of knowledge, they can influence the technological development of other organisations (Braunerhjelm et al., 2020). This kind of learning-by-hiring effect can be especially advantageous for smaller firms (Braunerhjelm et al., 2017) and may be most apparent when individuals transition from high- or medium-tech industries (Foster-McGregor & Pöschl, 2016) or patenting firms (Braunerhjelm et al., 2020).

1.3 Report overview

The remainder of this report is organised as follows:

- Section 2 outlines our Follow-the-Grant methodology and details its application to the final group of sixteen projects we consider.
- Section 3 follows each of these Innovate UK-funded projects, tracking their impacts through the individuals involved and the technologies developed.
- Section 4 summarises the main findings, highlighting mechanisms and outcomes as well as moderating effects. We also examine the different timelines over which the various outcomes happen.
- Section 5 summarises the key learning points in terms of future monitoring and evaluation, future FTG studies and approaches for strengthening impacts.

SECTION 2: APPLYING THE FTG METHODOLOGY

As this study aims to explore the long-term impact of Innovate UK-funded collaborative R&D projects, it employed a qualitative methodology based on semi-structured interviews with beneficiary organisations. To capture a wide range of impacts and perspectives, multiple organisations involved in the same project were interviewed, and sometimes several staff members from the same organisation were also included. This approach allowed us to gather diverse viewpoints on the impact of the same project.

The study aimed to examine the long-term impacts of IUK grants, so we selected projects that were completed on average five years ago and had a project budget exceeding £1 million. The IUK projects included in the study were chosen from the publicly available Gateway to Research database, ensuring representation from various business sectors, innovations, and participating organisations. Initially, twenty-nine projects were selected, involving 160 partner organisations. All contactable participant organisations were approached, resulting in 43 interviews across 38 organisations covering 16 projects with broadly similar characteristics to the larger group of selected projects (see Table 1).

Table 1: Characteristics of projects included and interviewed in this study

	29 selected IUK projects	16 interviewed IUK projects
Number of organisations per project, avg. (min - max), total	6 (1-16) N=160	6 (2-13) N=38
Project cost, avg. (min - max)	£2m (£1m - £6m)	£2m (£1m - £6m)
Duration in years, avg. (min - max)	2 (2 - 4)	3 (2 - 4)
Years since completion, avg. (min - max)	5 (3 - 8)	5 (3 - 8)

IUK provided the participants' names for each organisation and email details through the Data Sharing Agreement. One project had no contacts and could not be approached. For the remaining 28 projects, there were 137 email contacts out of 160 participants: 23 organisations either had no email contacts or consisted of duplicate contacts from organisations that participated in multiple IUK grants during the study period. For each of the 28 projects, 137 participants were contacted up to three times and invited for an interview. Of all the contacts, 15 (9%) individual email addresses were generic, meaning they were sent to the administrative, research, or finance offices and did not go directly to a specified person. This office assisted us in connecting with the right person on a few occasions.

By exhausting the IUK contact sample, we completed 14 interviews, which account for 9% of the 160 organisations. Some individuals could not be reached by email, representing 33% of all contacts, either because the email addresses were generic or because we received no responses. We also tried to contact these individuals via LinkedIn. Additionally, we used a snowball sampling method, asking interviewees to suggest the best person in other organisations and other project team members. As before, we approached these individuals three times by email or LinkedIn, whichever was available.

In the end, we conducted 43 interviews across 38 organisations. This also increased the number of projects covered by the study from 12 to 16, indicating that snowballing mainly broadened the range of perspectives within the same project. Of the 16 projects included in the study, most (13) were covered multiple times (i.e., had interviews from more than one organisation). Most of the interviews were conducted with snowballing contacts (53%),

followed by the original contact sample of Innovate UK (37%) and LinkedIn (10%). Further information on the process can be found in **Table 2**.

Table 2: Summary of the interview process

	Original attempts	Final (after additional attempts)
Interviews completed*	14 (9%)	38 (24%)
No response	68 (42%)	71 (44%)
No contact details	23 (14%)	18 (11%)
Refusals	3 (2%)	3 (2%)
Could not make contact (email bounced, no LinkedIn presence, no snowball)	52 (33%)	30 (19%)
All organisations	**160 (100%)**	**160 (100%)**

Notes: * This number refers to the number of organisations interviewed. Individuals in a few organisations were interviewed more than once and some calls included multiple people from the same organisation, so that the number of individuals interviewed is 43.

Where possible, we interviewed several organisations involved in each project. On average, this covered 49% of the organisations engaged in each project (ranging from 15% to 100%).

We conducted statistical significance tests based on project characteristics to determine whether any project or firm traits increased their likelihood of participating in the interview. These findings should be viewed as indicative rather than conclusive because the overall project sample is small (28), and although the firm sample is larger (158), most available firm characteristics are not independent of the projects. Furthermore, the projects were not selected from all IUK grants using probability sampling, so we cannot generalise to all IUK grants.

In short, there were no statistically significant differences between firms and projects that agreed to be interviewed and those that did not, based on the organisation's status as a lead, the size of the grant, project duration (in years or months), the number of organisations in the consortium, and the number of years since the project finished. Although indicative, this suggests that interview participation was not related to observable project characteristics, which is encouraging.

Interviews were conducted by phone or video, depending on the interviewee's preferences. The length of the interviews was not limited, with an average duration of 29 minutes, excluding introductions and explanations of participant rights. The responses were analysed thematically, emphasising impacts across different project areas and stakeholders.

The findings were presented anonymously in a de-identified manner. Specifically, project titles, organisations and individual names, details of the innovative technology, and other relevant information were omitted.

SECTION 3: FOLLOWING THE GRANT

3.1 Introduction

This section reviews 16 Collaborative R&D grants to evaluate their outcomes and impacts (if any) after completion. Each project summary includes interview material from one to four project partners. Projects are anonymised to safeguard the participants and intellectual property—a summary of key project features is provided in Table 3.

Furthermore, the narratives reflect the views and perspectives of the organisations and individuals who were interviewed. Sometimes, interviewees commented on the actions of other organisations and individuals after the IUK project. These remarks were made to the best of the interviewees' knowledge and were not verified.

Table 3. Summary characteristics of interviewed projects

Project	Technology	Partnership*	Duration (years)	Value band	No. of interviewees
#1	Agricultural monitoring	B-RO	3	£1mil – £2mil	3
#2	Environmental monitoring	B2U	3	£1mil – £2mil	1
#3	Media and entertainment	B2B	2	£3mil - £4mil	4
#4	Connected and autonomous vehicles	B2G & B2U & B-RO	2	£5mil - £6mil	4
#5	Vehicle decarbonisation	B2U	2	£1mil – £2mil	1
#6	Vehicle decarbonisation	B2B	2	£1mil – £2mil	2
#7	Connected and autonomous vehicles	B2G & B2U	2	£3mil - £4mil	4
#8	Healthcare monitoring	B2U & CRO	3	£5mil - £6mil	3
#9	Vehicle decarbonisation	B2U	4	£2mil - £3mil	2
#10	Healthcare monitoring	B2U & CRO	2	£1mil – £2mil	3
#11	Vehicle decarbonisation	B-RO	2	£1mil – £2mil	3
#12	Energy monitoring	B2U	2	£1mil – £2mil	2
#13	Infrastructure monitoring	B2B	3	£2mil - £3mil	1
#14	Vehicle decarbonisation	B2G	2	£1mil – £2mil	4
#15	Transport monitoring	B2U & B-RO	2	£1mil – £2mil	2
#16	Vehicle decarbonisation	B2U	4	£6mil - £7mil	4

* B-RO (business-to-research organisation), B2U (business-to-university), B2B (business-to-business), B2G (business-to-government, incl. local government), CRO (clinical research organisation)

Project #1. Realised agricultural monitoring prototype, which was not commercialised

> *"It was almost as if all the previous funding then didn't go anywhere because we couldn't follow on to the final, modernised version [of the product] that would have been fully commercialisable"*

The partners interviewed for this project agreed that it delivered its intended agricultural technology prototype. Ideally, the project would have resulted in a commercialised product. By the end of the project, although the intended research outputs and scientific advances were achieved, the technology was not sufficiently ready for commercial use in terms of design, user-friendliness, and computing power. According to the research partner, "unless it's about 8 or 9 [Technology Readiness Level], it's not actually taken up, commercially, by end users." The project partners applied for follow-up funding to advance the product to the stage of technological readiness but were unsuccessful. To the best of the interviewees' knowledge, the product has not been used commercially since.

Due to their initial partnership on the IUK project, several project partners later collaborated again. They obtained another IUK grant that incorporated modified aspects of the technology from the first grant, applied in a different geographical and agricultural context. The product outcomes from this new grant could have potential applications in the UK, although the interviewees were not yet aware of them.

This IUK project resulted in significant unintended positive outcomes for both research and industry partners. For the research partner, the IUK grant funded the employment of two team members during a vulnerable period, without which they might have faced redundancy. Instead, the grant enabled their continued progression within the organisation. It secured a position for the most senior staff member, who obtained further research funding and expanded their team from 2 to 6 researchers since the project, leading to employment growth for the organisation.

The senior individual already had substantial expertise before joining the IUK project, so the grant "reinforced rather than transformed" their knowledge and management skills. For instance, research expertise gained has resulted in invitations to co-author additional publications. The research partner continued producing research outputs related to the project's technology and learning for approximately five years after the project concluded. They have also maintained knowledge sharing at industry events, conferences, and through teaching activities.

The industry partner noted that the project introduced them to a novel technology, which was "extremely useful". This individual left the firm involved in the project and has not applied the knowledge gained since, although they may do so in the future. Regarding another industry partner, the interviewee mentioned that a different company improved its core business because the project outcomes enabled it to expand into a new market. It remains unclear whether this company has utilised the prototype or the research insights from the project, and for how long.

Project #2. All the steps were completed to develop an environmental monitoring device prototype, but the "technology just did not work"

> *"Lots of work went into the development of this, but it turns out that the results were not what we would expect"*

The industry partner interviewed served as an advisory figure in this environmental monitoring project. They believed the project achieved all necessary steps to develop the intended monitoring prototype, but its performance fell short of expectations. The prototype's monitoring was "not sensitive, selective enough" to detect the required environmental materials. The industry partner was uncertain about the cause, and it seemed that the other partners shared this lack of understanding: 'it just happened." After the project, the company sought someone to improve the scientific aspects of the prototype to boost its sensitivity, but they were unable to find collaborators or secure funding for additional work (the interviewee was not involved in this phase). Consequently, the company "moved on to other things."

Nevertheless, the industry partner and individuals involved in this IUK project "learned a lot" from participating. The project "pushed" them to explore the environmental monitoring market and various technologies. The interviewee particularly gained a wealth of expertise and knowledge because this was their first IUK grant and their first job after university. They developed an understanding of product development related to the project's technology and identified which products could be practically and commercially viable. This person is now in a senior management position within the company, and they continue to apply the knowledge gained, as the project's subject is their company's "bread and butter". Additionally, the issues explored during the project remain relevant in the environmental monitoring field. This individual also used their knowledge from participating in the IUK grant for another IUK grant.

The interviewee also continues to share their extensive knowledge as they are "occasionally" approached by academics and businesses for advice on environmental monitoring technology. They believe these are valuable collaborations, although not necessarily in-depth, because, for example, "there is a huge difference between what academia can offer and how prototyping the product looks like."

Project #3. Varying impacts for three media and entertainment industry partners

> *"It was a fairly transformational project"*

This project aimed to transform specific digital technologies in the media and entertainment industry. For the industry partner 1, the project's research was used to develop and commercialise a new product. Additionally, the company used the research to improve its existing products targeted at different markets (e.g., life sciences or engineering). The business has continued to use and refine both the new and improved products since the project, demonstrating the long-lasting impact of the IUK grant for this firm. "Commercially, the products have been very, very successful" and have increased company revenue, including revenue from exports.

Without the IUK project, the company estimated it would have taken 4 to 5 years to reach its current stage of product development. This significant "push" helped the company become a market leader with an advantage over competitors (although it is hard to quantify exactly how much). Customers also benefited from the project because they received better products.

The industry partner 2 specialising in the research aspect of the project mentioned that a major outcome for them was that the IUK project “laid the groundwork” for establishing a research entity within a university focused on the project’s topic. Although they also secured funding from other sources for this, the IUK grant was their largest contributor. This research entity initially employed a few staff from another entertainment company, who might otherwise have been made redundant, and subsequently expanded to about 20 staff. The entity filed for and obtained five patents directly related to the IUK project and five additional patents based on technology attributable to the project.

The industry partner 2 also attributed five papers directly to the IUK grant: “we submit a paper, so we submit a patent as well”, as they explained. To the interviewee's surprise, the large international company that owned the industry partner 2 decided not to continue supporting the research entity, leading to its closure about three years after the IUK project. However, a spin-out at a different university “in the making" hired most of the staff. Personal knowledge gains for the interviewee were not substantial because they were already advanced in their field, but the project “solidified their [teaching] and research career” as they continued working on projects related to this topic.

The industry partner 3 did not use “anything major” or “everything that came out” of the project because research findings were “very blue sky.” This company viewed such exploration of emerging technologies as too commercially risky to apply in a real-world context that relies on the reliability of technology within tight deadlines. Additionally, this firm focused on a different aspect of the technology, an area in which the project’s R&D progressed more slowly than expected. The industry partner 1 concurred that more risky outcomes from a commercial perspective were not achieved. Ultimately, the project concentrated on developing products and features with the highest expected commercial value. Thus, the industry partner 1 and the industry partner 3 regarded their collaboration as successful because it provided commercial viability and feasibility assessment for real-world applications.

Although the industry partner 3 did not use major research outcomes, they nevertheless transferred some of the project learnings to its other work, including other R&D projects. The learnings were applied as a “springboard of ideas” – “What happens if we did this, and what happens if we use this?”

The other impacts of this IUK grant mentioned by the industry partner 1 and the industry partner 3 were benefits for several staff involved (three or four in one of the firms). These individuals - including creative and engineering staff - gained experience and skills from the project and have remained with the companies since then, thereby preserving that knowledge internally. The industry partner 3, who did not utilise research findings significantly, perceived the grant as helpful for consolidating a new team, establishing a new base, and providing a focus for developing their work (the company’s base in the UK was established in the same year as the grant). Another ongoing impact of the grant was a continued partnership between the industry partner 1 and 3, both commercial and collaborative. Although both these companies knew each other before the grant, the project provided an opportunity to strengthen the relationship.

The industry partners 1 and 3 also appreciated the opportunity provided by the grant to conduct in-depth research into emerging technologies without the pressures of running commercial businesses. Often in normal day-to-day operations, current “product development and maintenance take precedence over researching,” especially when R&D is highly innovative.

Project #4. A successful project overall, with implications for the wider policy and industry impact in the field of connected and autonomous vehicles

> *"A really successful project in its own right because it was the first time, at that time, that people actually really thought about the autonomy in the round sense"*

By utilising digital technologies, this project highlighted the human aspect of autonomous vehicle technology. All four interviewees agreed that the project achieved its expected outcomes and provided valuable insights.

Furthermore, this IUK grant resulted in several important outcomes for the project partners. One industry partner incorporated some of the research outputs into their product development. They estimated the project's impact on business growth at around 10% (c. £100k), which persisted for approximately 3 to 4 years after the grant. This growth offset the delay in project completion (which was extended), leading to an opportunity cost of time and resources that the company could have used to further develop their business. The industry partner also found the collaboration with the local authority partner to be valuable. Following the project, this led to the signing of a contract with the local authority partner and created opportunities to engage other local authorities. The impact of this further collaboration lasted about 2 to 3 years after the project concluded. Lastly, the industry partner used their experience from participating in this IUK project to secure another IUK grant in a different field. The company felt "slightly more inclined" to pursue another IUK grant due to the familiarity with the IUK process gained from this project.

The academic partner highly valued one outcome of the project, as it changed their organisation's perception of autonomous vehicles. However, the major outcome for this organisation was that the project contributed to the establishment of a research entity related to the project's aim. The senior staff member involved in the project proposed the creation of this entity: the IUK grant marked the first time their organisation secured a science grant, which laid the foundation for knowledge, networks, and confidence that the organisation could be successful in the research entity.

The university-based research entity has continued to undertake interdisciplinary work, including international collaborations, with increased funding, projects, and partners. It has also utilised the learning and methodologies developed during the IUK project. The interviewee explained the project's contribution as follows: "a lot of the work that the [entity] gets from the industry now it might not have got if we hadn't done that project, because it was a showcase of our capabilities." The research entity has produced numerous research outputs that the interviewees believe "inspired a lot of our industry partners to think about their transport projects differently."

In terms of the individual impacts, the largest one was perhaps for the academic partner who proposed the creation of the research entity and (internally) changed job roles to run it ("well, it [the project] changed my life, to be honest"). This person has continued to disseminate the knowledge they gained on the project, including their transformed perceptions, via the education courses in their organisation. This is also true of another staff member from the same organisation who found that the IUK project provided them with valuable knowledge that they continued to apply in their teaching. The project also benefited "a couple" of staff who were fairly new researchers in terms of skill and knowledge development, who then left to progress their careers elsewhere.

Another interviewee from an industry partner left the company involved in the project to become an independent professional about a year after the project concluded, which they said "wouldn't have been able to do (…) if I didn't have a good network and set of contacts and reputation that enables me to win projects in this area" stemming from the project. They

also continued to share their knowledge, for example, by contributing to the development of BSI standards in the field of transportation.

The grant's impacts on the broader autonomous vehicle and transport industry are notable. The academic partner believes that the project contributed by being "part of this momentum" on autonomous vehicle policies. However, the project did not alter public perceptions of autonomous vehicles as, perhaps, was expected, but rather it helped to define some aspects of "what the debate should be about for the future".

For instance, one of the project's industry partners eventually stopped investing in autonomous vehicle research because autonomous vehicles were losing their topicality in the broader regulatory and policy environment. This sentiment was echoed by other interviewees who noted that the momentum on autonomous vehicles slowed a few years after the project ended. "I think most people were anticipating that the adoption of automated vehicles would be quicker than it has been", as one partner put it. This could have potentially affected the impact of one of the project's related outcomes: one of the project's industry partners set up a research entity related to the subject funded by IUK about three years after this grant, but "the hype cycle has dipped and so there hasn't been that rush of customers".

Project #5. Well utilised indirect outcomes but unclear if direct outcomes continued due to organisational changes in this project aimed at decarbonising vehicles

> *"None of project's technology was really directly incorporated into [a spin-out company], but what it did do is it gave me an opportunity to understand something about the market and how the market operates."*

This project's academic partner emphasised that the key outcome was the knowledge generated by this grant on electrifying large vehicles. They mentioned that another industry partner involved in this project was acquired by a large company because of their expertise, including the knowledge gained during the project. To the interviewee's best knowledge, the company continued to produce electrified vehicles, although it remains unclear how the acquisition impacted the influence of this project. Furthermore, the larger company later closed down the project partner's company in the UK. The staff likely transitioned to share their expertise elsewhere, but it is uncertain how the effects of the developed technology persisted after the business closure.

On the other hand, for the interviewed academic partner, this IUK project resulted in a significant positive indirect outcome because the interviewee applied valuable lessons learned from the project in their spin-out company, which was created during the project. The spin-out company does not directly utilise the project's technology. However, the academic partner views the knowledge acquired regarding market research, market operators, and technological limitations in the industrial research context as an important contribution from the project to this company. The benefits were more impactful because the interviewee comes from a scientific background; however, running a company necessitates market and commercial knowledge and an understanding of regulatory processes, which the interviewee gained through the IUK project. This company, founded about a year before the project's conclusion, has grown into a medium-sized firm with around 80 employees.

Additionally, this academic partner consistently shares knowledge gained from the project by consulting for other companies in related manufacturing sectors. Some insights from the project findings also contributed to two or three publications released about three years after the project's completion, thereby enriching the wider scientific community. Lastly, two other staff members who participated in the project have since joined large companies within the same industry, likely utilising their enhanced expertise gained through the IUK project.

Project #6. Cumulative knowledge on limitations of the vehicle decarbonisation technology

> *"We were very focused on the product idea, but in the end, it was the knowledge base that was more important for us."*

Interviewed project partners generally agreed that the project's intended technology for electrifying vehicles was not realised due to "engineering issues" that, according to one partner, "were outside of the scope of the project." Specifically, the required chemicals worked well at certain temperatures but not at those necessary for successful project completion and practical application. For one industry partner, this was an interesting albeit unexpected outcome that they planned to continue exploring with some other project participants. However, to date, these plans have not yet materialised. This partner regarded the knowledge of the technology, its limitations, and testing data from the project as useful.

Similarly, another industry partner initially expected product development to be their main goal for this project but found that the commercial knowledge gained was more valuable. This company reported that immediately after the project, interest in this type of electrification technology "hadn't really kicked off." However, over the past two to three years, they have observed a renewed interest. They recently completed another project on similar technology, revisiting the insights from the IUK grant, although ultimately, the technology was deemed not feasible to implement.

The knowledge gained from the IUK project, alongside other work and projects undertaken by the company, enhanced the company's understanding that the technology could be adapted for use in other industries and made to operate under specific conditions. This industry partner has been sharing this knowledge with their automotive clients, whom they advise on "what works" in relation to this technology. According to them, "it's not turned into any business at the moment, but for demonstrating to new or potential customers that we got this (…) fundamental understanding of this technology. It's been invaluable".

The other industry partner agreed that the main outcome was gained knowledge. This company did not use the knowledge from the project directly for specific product development, but they "use the knowledge in lots of different other ways." For example, this knowledge enabled them to identify problems with certain manufactured components and to use alternative ones. This led to a more efficient product for the company, and they experienced "considerable" sales of their product about four years after the project. They also continued to receive follow-on funding for this technology ("6 – 7 projects since IUK project") and are building cumulative knowledge about it, making it difficult to separate the impact of the IUK grant specifically.

Interviewees stated that personal outcomes from the project included technology-specific knowledge, connections, networking, and teamwork. "The amount of secondary opportunities that come about by working with the companies in these innovation projects is invaluable," according to one interviewee.

Project #7. Research outcomes that laid the groundwork for further research on connected and autonomous vehicles

> *"The biggest impact was to actually support local authorities to understand the future of transportation"*

All four organisations interviewed agreed that this project provided valuable insights into connected and autonomous vehicles (CAV) and their infrastructure needs, showing that the technology was "mature enough to be further developed". The partners applied this knowledge to benefit their organisations and the wider public. For example, the local authority partner has continued to use this knowledge by developing local infrastructure to be more future proof for CAVs. "Anything we put in today, we make sure that it will last us a minimum of 10 years," they said. Additionally, the infrastructure developed during the project was adopted into subsequent projects, thus remaining in use longer than expected. Some of the CAV-related infrastructure is still in place today.

Meanwhile, the industry partner used insights into the limitations of the technology (e.g., security risks or frequent breakdowns) to adopt a specific type of connectivity that minimised the risks. However, they emphasised that this knowledge resulted from combined experiences across several projects, not just the single IUK grant. Similarly, the local authority partners also found understanding technological limitations useful because it highlighted what should not be done and "got us into asking all those right questions and then provided a springboard to develop other work and projects."

All partners agreed that a key lesson of the project was the significance of involving original equipment manufacturers (OEMs) in collaboration with local authorities. One local authority partner took this learning further by continuing to work with some of the project partners and OEMs on another project, which led to the establishment of a research entity for CAVs. This probably would not have occurred without the IUK grant, as it generated both interest and knowledge.

Another local authority partner also wanted to continue exploring the subject after the project, but they lacked the funding, which COVID-19 exacerbated. Currently, however, they are participating in another IUK project and applying some of the learnings from the original grant to expand the current project's results. In fact, one interviewee regarded collaborations as one of the most valuable outcomes of the project because the "consortium with different members went on to bid and were successful in 2 or 3 of the very significant innovation projects." Overall, all the projects and work might have influenced government policy and the industry's direction regarding CAVs. However, the lack of agreement within the industry and among policymakers on CAV standards could explain the limited wider impact on CAV adoption.

The project partners continue to share the knowledge they gained through this IUK grant. During the project, one industry partner became involved in several international standardisation initiatives aimed at advancing CAV deployment, which is still a work in progress (though it was not solely due to this project, but rather the cumulative effects of all CAV efforts). Another industry partner is part of an international consortium that also works on standardisation, so they have shared their knowledge from this IUK project, as well as from other projects, with other businesses. Lastly, one of the local authority partners regularly disseminates knowledge through professional and local authority networks in the UK and internationally (covering approximately 40 European cities and most of the UK to date), although the impacts of this work are "really hard to tell".

The project also benefited the individuals involved. For the local authority partner, the impact was "tremendous," as they were able to disseminate the knowledge (augmented by other project work) nationally and internationally. The impact was similarly significant for another local authority partner, who went from "knowing nothing" to using knowledge and skills to get

the automated vehicles operational. One of the industry partners also gained knowledge of CAVs and assisted their company in developing (now installed) connectivity and testing facilities. However, after the project, this individual left the industry to run their own business in an unrelated field. While they do not apply their expertise in this work, they occasionally share their knowledge when approached for advice by people in their (former) professional network. This person recounted that two of their former colleagues secured more senior roles within their company due to the project. One of the local authority interviewees also believed that many of the project team remained in the field and continued applying their expertise.

Project #8. Lack of consensus about what counts as sufficient impact of the remote healthcare monitoring technology

> *"Has there been any impact [from research]? To say yes, it needs to have gone to NICE or have made a change in the NHS"*

This IUK project developed remote certified healthcare technology, which was tested with end users who have a long-term health condition. The clinical and the academic partners agreed that the technology worked well and was "helping people feel safer and (…) able to live independently in their own homes for longer". The partners were also in agreement that the project did not achieve all of its intended outcomes, mainly because it did not gain a sufficiently high sample for the randomised control trial (RCT). There were a few reasons for this under-recruitment: RCTs take a long time to set up in the medical field, the time was needed to get technology certified, and the software development took longer than expected. The project received a 1-year extension, and even though the certification was achieved quickly "in 3-4 months" it was not enough time to recruit more patients for the RCT. Both partners believed the IUK's focus on the size of the target sample was too rigid and prioritised quantity over quality.

After the project ended, the clinical partner used COVID-19 funding to supply the technology as part of the COVID-19 service to around 500 households. It was assessed independently and showed excellent patient and carer outcomes while lowering healthcare costs. However, the use of the technology was discontinued afterwards because the clinical partner could not "secure sustainable funding," despite exploring various funding avenues. The technology is not currently available in the clinical setting, which is a significant drawback for the clinical partners and indicates a lack of impact.

In contrast, the academic partner viewed the project as proof of concept that was successfully achieved. For them, a major outcome related to the project was receiving funding (not from IUK) to establish a healthcare research entity that continued the work with some of the project partners. This occurred about a year after the IUK project. This research entity leveraged the learning, technological outcomes, evidence, and other outputs generated by the IUK project. They also redesigned the original software from the IUK project because their "understanding has got better and we had more funding." The redesigned version has a registered trademark and is being trialled on a larger scale in a clinical setting. Knowledge from the project continued to accumulate, as the academic partner also received follow-on funding to test remote healthcare for a different health condition, which is underway.

According to the academic partner, without funding for the research entity, the project's technology would not have progressed. For example, "in the first three years [of the project] (…) most of the publication we did was very preliminary, was not in high impact journals." Many research outputs and publications related to the technology emerged ("too many to cite"), mostly after the project. The academic partner values them highly, as the years of testing data represent something that has not been done for that healthcare condition. Furthermore, the software architecture was made open-source, and the academic partner

continues to share knowledge because, as a result of multiple publications and the software's open-source status, they are approached by healthcare and research teams from around the world. The clinical partners were more sceptical about research outputs because they have not led to changes in care within the clinical setting.

There is also some variation in personal outcomes among project partners. The clinical partners viewed the project as a learning experience regarding the limitations and capabilities of technology and the regulatory framework, although they have not really applied this knowledge since. Meanwhile, for the academic partner, the foundation of the research entity "completely changed [their] world" as it had a significant impact on their research. The academic partner also mentioned about 5 PhD students who worked with the project's data and "have moved to different careers in healthcare".

Lastly, the clinical partner recounted positive outcomes for the other partners who supplied software. For them, the benefits included income streams and the experience of developing a product in a clinical environment. The academic partner kept in contact with one of the partner companies and reported that this business developed a commercial product for home care monitoring of a different healthcare condition by adapting technology from the project.

Project #9. Mostly firm-related impacts from the project which aimed to develop vehicle decarbonisation technologies

> *"I think we would probably still have ended up going in the same direction, but at a much slower pace. I think there's even a chance that we might have missed it"*

This project focused on reducing carbon emissions and delivered several significant benefits to the participating companies and served as a foundation for further research. For one industry partner, one of the outcomes was maintaining a collaborative relationship with other industry and academic partners that originated from the project. "We've got ongoing relationships with almost everybody [in the consortium] still," they reported. The company accessed various research funding streams to work on about five projects with some other project partners. Currently, this company is conducting a collaborative PhD with some of these partners. The project partners agree they are "doing some sort of cutting-edge R&D worldwide" on engine and related research. Naturally, work from different projects has enhanced reputation, attracting new customers as well as additional research and funding opportunities.

For this company, another key outcome was a shift in business focus from its 60-year history to different engine work. The firm moved away from a "shrinking market" because the IUK project showed value in a new area. The project also sped up the company's development of specific engine components and the setup of their testing facilities. Currently, a "significant part of all the work" the company does is based on these engine components, which has improved the customer offering and helped sustain the business. The company will apply the knowledge gained from the project, along with other work, to benefit its clients. This industry partner also published about 10 papers and took part in around 20 conferences since the IUK project, some of which resulted in attracting new customers. The staff member involved in the project reported gaining extensive knowledge, which increased their firm's capability and contributed to business growth.

For another industry partner, the most significant outcome was gaining knowledge about the benefits of using a specific fuel type. Consequently, the company filed a patent (not yet granted), with several other patents in progress: according to the firm, “without the Innovate UK project, there would have been no patent." This type of fuel was also launched in the market, although this decision was less influenced by the IUK grant, which instead offered “reasons to believe (…) this indeed is beneficial (…) from a customer point of view."

The interviewees also indicated that during the project, “the world had moved on a bit” from the project’s focus to different types of engine fuel technology, as also evidenced by the change in government direction. This might explain why the main impact from the project for companies was utilising various elements of the project’s research and technology, rather than its key intended outcome. For instance, one industry partner saw the project as a foundation for exploring different engine technologies and adapting testing facilities to other materials beyond those of the project.

Project #10. Great impact of the project’s healthcare monitoring technology which was realised through follow-on IUK funding

> *“The project certainly changed my practice and our practice here in [location] and what we need to do is try and change practice across the UK and worldwide.”*

This project aimed to introduce technological innovation in healthcare monitoring that would guide treatment options. All project partners agreed that the project demonstrated this technology's effectiveness in predicting clinical outcomes and, therefore, its potential to enhance patient outcomes. Interestingly, the academic partner noted that the technology also uncovered new information about the relevant health condition that had not been anticipated.

The industry partner developed the product using technology that was medically certified a few years after the project and was patented (to the best knowledge of the interviewee, who is no longer with the company). The project served as a proof of concept and received follow-on IUK funding for further development in collaboration with some of the original partners. The research outcomes and product from this follow-on study “changed the practice” of the clinical partner involved in both projects. The clinical partner’s use of the product, which is now part of their clinical practice, improved their decision-making regarding patient care. The clinical partner predicts the product could be helpful to about half of their high-risk patients (c. 150 a year). At present, the clinical partner is also examining the cost analysis of this technology as a step towards its wider adoption: “we need to say not only [that] it is clinically beneficial, but it's also financially beneficial.” They also noted that they did not receive the IUK funding to scale up and test the technology in multiple locations across the UK, which, in their view, would have aided wider adoption.

The clinical partner recalled a research paper published as a result of the project a few years after its conclusion and believes that there has been increased awareness in the healthcare field about novel methods of assessing the health condition targeted by the project. Two other project partners noted that they had expected the research publication to appear in a higher-impact journal due to the significance and scope of its findings on clinical outcomes but were unsure why this did not happen. This may have been because the findings were too novel or unexpected.

The clinical and academic partners continue to share their knowledge from the project more widely. For example, the clinical partner continues to present findings from both the original and the follow-up project, including internationally (approximately one national and one international presentation annually). They say, “we talk about it as much as we can." The interviewee believed there was a positive impact arising from this knowledge sharing, as it educated practitioners, “whereas maybe [a year into the project] (…) that information wasn't easily available.”

Meanwhile, the academic partner noted that the project prompted them to collaborate with other organisations in utilising clinical data and biosamples provided by the project. They currently have two collaborative projects: one internal and one external to their organisation. Furthermore, the project “made quite an impact in the field in that it's got into guideline papers” for the relevant European association, due to the participation of the academic partner about three years after the project's conclusion. The academic partner believes they were invited to contribute because of the project as well as their overall experience. The guidelines are at the research level, as the product has not yet been widely tested or adopted.

The project partners also shared personal outcomes from the grant. For the already highly experienced individuals, the contacts, experience managing IUK grants, and ability to assist patients were valuable outcomes. For less experienced staff, including one of the interviewees, the project had a more significant impact. For example, this IUK grant was “one of the first industry projects” for the industry partner, and they learned a lot about the collaborative process and product development. This person left the company involved in the project but continued to apply this experience in another company while working with patient trials.

Project #11. Vehicle decarbonisation knowledge applied differently from the project that was terminated early

> *“It [the project] didn't lead to anything particular, but, generally, it helped raise our profile and the profile of these topics of emissions reduction and alternative fuels”*

The interviewees agreed that the main expected project outcome – deploying a number of vehicles with developed decarbonising technology - was not achieved, and therefore the project was terminated early by IUK. The reason for this was that the project could not acquire vehicles to implement the technology due to operational and supply delays. Nevertheless, the project partners shifted to other deliverables and outcomes that could be achieved within the timelines, providing varying degrees of benefits to the companies.

To begin with, for one industry partner, the key project outcome was gaining market understanding and developing a decision-making tool for advising on different fuel options for specific vehicles. The company still uses a version of this tool to determine operational strategies for their vehicles. Although they could not attribute all the business growth that followed to using this tool, the interviewee reported that their business increased from £50k to £400k a day, which accounts for about one-seventh of the company’s turnover from this sector. The company shared the knowledge gained from the project across the industry, which also boosted their reputation and created opportunities for further business.

For another industry partner, the benefits from the project were indirect: it enhanced their profile and credibility, especially through collaboration with reputable companies in the consortium. This "likely led to other work" for their company, such as acquiring more customers. The IUK project also contributed to the company's cumulative knowledge on the subject, which was further expanded through follow-on grants and work. This industry partner continued collaborating with another company, a relationship that "might not have happened" without the project. On the downside, the company found the project's administrative process burdensome, to the extent that it detracted from doing "real work" on the project.

For the last interviewed company, the project provided knowledge and awareness of alternative fuels and their testing technologies, although they have not utilised any of it since. This company found the collaboration within the consortium beneficial, and their company gained value from the project by being able "to talk to other customers about these new technologies" and understanding the issues customers have with alternative fuel technologies. Similar to another industry partner, for this company, this understanding was also cumulatively acquired from other projects and work running concurrently with the IUK project.

Two interviewees noted that during the project, they gained knowledge about decarbonisation technologies and their real-world implications. One company participated in another similar project concurrently with the IUK grant, which helped enhance the person's learning. The experiential benefits also extended to a few other individuals from the same company, thereby contributing to increased capability within their business, which, taken as a whole, helps the company "to advise governments (…) on policy and strategies." Additionally, two other interviewees emphasised their experience working on IUK and other publicly funded projects. For example, this experience enables one company to allocate R&D effort more effectively.

Two industry partners noted that, at the time of the IUK project, it might have been too early for the type of research the project focused on. Ultimately, such research did not progress significantly in the UK due to a shift in the market and government policy from alternative fuels to electrification over the last five years. One company described it as follows: "after six years, seven years, you don't see many [decarbonised vehicles of a specific type] on the road." Another company believes there will be a return to alternative fuels in the future, also because of challenges with electrifying large vehicles. They said this IUK project and similar initiatives "though they don't have a big political profile at the moment, I think in the future they will."

Project #12. Limited impact of the renewable energy monitoring technology because outcomes could not be commercialised

> *"Initially we thought it is really good to get involved in a research project, but in that [IUK project] we didn't really come out of it with any IP that would have had value beyond just that specific project ".*

Both interviewed companies believed that the project achieved its main outcomes and led to the development of a product that extended beyond the originally intended domains of the project. At the same time, the industry partners felt the project did not realise all of its

outcomes; specifically, they received less data from using the project's technology than expected, and the product's predictive ability was not realised. The interviewees were unsure about the reasons: possibly, the predictive ability was hampered by a lack of data or internal staff turnover (the person working on this left, and it took time to replace them).

Despite this, both companies benefited from the project. The first company gained a "modest increase in capability" by learning about technologies it had not previously known. This knowledge proved useful because the company used these technologies to "do similar things on other projects" about four years after the IUK project. After the project, the company tried to market the knowledge gained, including in other sectors, but the commercial demand was too low for it to develop into a product.

As a result of the project, the second company developed a specific sensing component, which they used in another product and several other projects. The impact of the project lasted for a few years, after which, driven by market demand, the company shifted focus to a different area, making the product obsolete. However, they retained knowledge and insights within the company through a staff member who participated in the IUK grant and continued to apply various aspects of those learnings in their work. The company also benefited because, about a year after the IUK project, they continued collaborating with the academic partners and engaged in consultancy work together. However, the customer they consulted with decided to focus on a different field due to "some external circumstances," so the project benefits did not last.

Another outcome for the firm was that the IUK grant helped the company familiarise itself with IUK's processes. It made the company consider carefully which R&D projects to get involved in, as they decided to participate only if IP or a commercial product could be developed. While they had several opportunities to engage in R&D projects, no opportunities with sufficient promise of commercialisation have yet emerged.

Project partners discussed follow-up collaboration opportunities after the IUK project; however, they did not come to fruition, potentially due to COVID-19 or companies focusing on other priorities.

Project #13. Lessons in commercialising research outputs from the transport infrastructure monitoring project

> *"If we had carried on down the route of what we envisaged when we started, we would have built something that probably wouldn't have been useful in the marketplace at all. The outcome that we've actually got can be commercialised."*

The objectives of this IUK grant changed during the project to broaden the technology's applicability and usefulness in the market. This shift was driven by considerations about the ability to commercialise the developed technology. Other outcomes were successfully achieved. The commercial product resulting from the project gained customers "pretty much straight away", although scaling up remains a challenge, partly due to the slower pace of transport infrastructure policy and underfunding for the necessary infrastructure. Additionally, according to the interviewee, to overcome the valley of death for the product, they also needed funding for commercial, marketing, or market research staff, whereas the IUK grant only funded R&D.

Although the wider impact of the project was not as extensive as expected due to lower adoption of the technology, the company gained benefits. The project aided in maintaining employment for the R&D staff, and because the product development resulted in modest sales, that part of the business was "no longer a cash strain", especially during a period when securing capital investment became increasingly difficult. The interviewee estimated that the project contributed around £0.5 million to business growth since then. However, it is important to note that the firm was involved in several related projects simultaneously, so the outcomes are interconnected.

For the individual involved the main outcome was "learning how to take crazy ideas and turn them into something that you can actually sell and that has an impact in the real world." They also saw a few other people who worked on the project in their company benefit and progress in their careers.

The company continued to disseminate knowledge through a series of webinars in the years since the project though pinpointing the specific impact of the IUK grant is difficult because different elements of the product and R&D from different projects are hard to disentangle.

Project #14. Major impact for some, but not every partner in the project to electrify local authority vehicles

> *"Based on the success of the project and the reassurances that we got with those electric vehicles, the [local authority partner] made a decision to go fully electric"*

This project aimed to electrify and then test electrified local authority vehicles, which all interviewed partners agreed was successfully achieved. The project was successful enough to win national and international awards, contributing to media coverage and broader dissemination of knowledge.

One of the local authority partners continued to operate its electrified vehicles after the project concluded and is still testing and experimenting with them. The IUK project demonstrated that electrified vehicles could be used effectively and provided information about the circumstances and conditions for their use, such as the age of the vehicles. The interviewee highlighted the importance of this detailed learning. This knowledge influenced the business case developed during the project. As a result, the IUK project increased understanding and confidence that electrification could succeed. This led the local authority to decide to fully electrify all its vehicles of a particular type using follow-on debt funding. At the time of the interview, the electrification was about halfway complete, helping to reduce carbon emissions in the area. However, for another local authority partner, the impact was not sustained beyond the project, as the electrified vehicles were decommissioned (the reason remains unclear).

Another important outcome for the local authority partner was sharing their experience and knowledge of their electrification journey with over 100 other local authorities in numerous conferences and events. "We went above and beyond to advocate, and I think it gave a lot of confidence to the local authorities", the interviewee recounted. The interviewee highlighted another local authority that was also inspired to electrify fully. For the interviewed local authority employee, this widespread knowledge sharing is a large individual benefit they gained from the project: "Prior to starting this project in [year], I had nothing to do with

vehicles, so I learned from scratch". They emphasised that local authorities "are desperate" to know "what works, why it works, why it doesn't work", which is the knowledge the IUK grant generated.

One of the project's industry partners also reported significant impacts as a result of the project. The company invested heavily in the technology after the project because, despite the proof of concept on electrification of specific vehicles, the technology faced "lots of technical challenges and lots of reliability problems". This industry partner undertook three larger follow-on projects and several smaller ones to continue developing the technology in subsequent years, with the last one finishing in 2024. Overall, this created significant commercial opportunities for their business. A key highlight was a commercial engagement and collaboration with a large international company to work on electrifying some of their vehicles (about 250), which led to substantial environmental benefits.

Another outcome for this industry partner was that they developed their engineering team, which has grown from about 13 to 45. About half of the engineers are still employed with the same company, disseminating knowledge from the project. This industry partner also continues to spread their knowledge about electrification to other local authorities and businesses through commercial or collaborative routes. For example, they "managed to convince [a client], rightly or wrongly, that hybrid was not the way to go when electric was the way to go".

The industry partner personally learned from being involved for the first time in multi-partner collaboration and its processes, which they applied by being selective about grants to participate in ("when it matches 100% with the development we're going to do anyway"). The other interviewee from the same company, who has since changed jobs, also benefited by gaining technology, industry knowledge, and stakeholder management experience. Their current role allows them to share this knowledge with "hundreds of" other businesses and local authorities.

Another industry partner shared a contrasting impact story. This company still uses electrified vehicles, including for another trial, although during the IUK project, they concluded that the technology "wasn't viable" for their own vehicles due to breakdown risks. They believe the project generated good publicity for their business, which enabled them to share their expertise with other UK clients on "whether or not it'll [the technology] be suitable for their [organisations]." Clients use this information for their decision-making, and some have chosen to electrify. A smaller outcome for the company was that this IUK grant was their first publicly funded project, making the project management experience valuable. Currently, they are involved in a self-funded follow-up project with other partners using vehicles electrified during the IUK project in an infrastructure-related trial. They don't think they could have done this trial without the previous IUK grant because "we couldn't have done this [trialling] on the brand-new vehicles which belong to our clients".

Project #15. Impact of a somewhat turbulent AI transport monitoring project developed via personal initiative

"The proof of concept is there (…), but it was far from usable"

The interviewees generally agreed that this project experienced a somewhat turbulent development, as some partners withdrew, including the software provider responsible for developing the necessary AI technology. This situation threatened the project's continuation until another industry partner introduced their software developer to redesign and progress the work. The primary result of the project was the proof of concept for the AI monitoring technology. While the software functioned "100%", it faced issues because its data extraction and predictive capabilities were challenging. The interviewees concurred that one reason for this was COVID-19, as participating companies intended to provide data for the AI could not grant access to their sites and/or shifted practices during the pandemic.

The industry partner, who had extensive experience in both the industry and technology, could see the potential in the technology, but "nobody was prepared to put more money in" after the project ended. This industry partner was also motivated by the funds and efforts already invested in developing the technology and did not want to see them go to waste. Originally, this company attempted a follow-on grant with the other project partner, which was unsuccessful. Consequently, the company decided to continue funding the AI technology on its own. The technology was redesigned and modified from the original version, making the project completely different; thus, the outcomes are not direct, although they have been sustained to date because the company continues to use the product. For the firm, this new business venue represents an important outcome that is "starting to come to fruition" in terms of return on investment and sales. They also believe that not securing a follow-up grant has made the technology more "universal" (i.e., not tied to specific suppliers) and, therefore, more marketable.

For the research partner, the main staff who worked on the AI algorithms left the company to pursue a PhD, which potentially explains why the organisation did not apply or utilise those algorithms after the project. However, when considered alongside other projects that the organisation undertakes, this IUK grant contributed to building organisational capacity in data analytics, machine learning, AI, and related fields. The organisation shares this cumulative experience with other organisations and businesses. For example, the organisation has made teams aware of this project and its learnings, so interested internal and external stakeholders can approach them if they wish.

Project #16. Main direct outcome of a zero-emissions engine technology unclear, but many indirect outcomes for some partners

"We didn't expect that we'd need to deal with a different type of physics."

All four interviewed partners agreed that this IUK project demonstrated the viability of a zero-emissions engine product. However, the project did not produce a fully functional product or enable scaling for manufacturing additional units, possibly due to the technical difficulties linked to the innovative engineering technology. "I'm fully aware that the main difficulty they [project partner] encounter would be to actually convince other customers to really buy the product," noted one interviewee, recalling that by the end, the project's focus shifted from improving the technology to commercialising it. It remains unclear how product commercialisation progressed because the manufacturing partner went into liquidation.

Nevertheless, the project yielded several outcomes for other project partners. The academic partner reported gaining knowledge and experimental capabilities from the project, which enhanced their existing scientific understanding of the subject. The primary achievement for the academic partner was the creation of a research entity for experiments related to those conducted in the project.

Supplemented by funding from other sources, this research enabled the organisation to develop "a much better capability in running [project type of] experiments in general." The academic partner particularly valued that the project identified scientific knowledge gaps in the physics processes ("I think that's what drives our following work"). The organisation continued this work with other industry partners and a separate PhD project after the IUK grant, extending the project's reach to other fields.

The IUK grant and the subsequent work led to several academic publications and conferences that generated both fundamental scientific knowledge and industry-specific insights. The advancement of this scientific knowledge personally benefited the academic partner and impacted some post-doctoral researchers who worked within the research entity, enabling them to progress their careers at other academic institutions and in businesses.

Another industry partner agreed that the project's innovative engineering work enhanced skills and knowledge within their company and supported two individuals in employment. They did not perceive any changes to the business resulting from the project and could not recall any specific outcomes that benefited their subsequent work (notably, this person held a project management role rather than R&D). Unfortunately, their company went into liquidation a few years after the IUK grant ended. The interviewee believed that staff who gained experience on the project found gainful employment after the business closed and continued to apply their knowledge.

For another industry partner, the main outcome of the project was that it connected their firm "with an industry that we are not particularly strong in," which served as a "catalyst" for developing further relationships. Since receiving this IUK grant, the company has worked extensively on two or three projects with the academic partner on the related subject. About 1.5 years after the project, this collaboration helped the company make their product more efficient and, therefore, more cost-effective for their customer.

Based on the contacts and networks built during the project, the organisation also gained new customers in other business sectors, a trend that continues to this day. They kept connections with other industry partners to a lesser extent, believing that others benefited from these connections in tangible ways, such as expanding their business. Networking also brought personal benefits to this industry partner. Since this was their first IUK grant, they gained experience in collaborative work, familiarity with IUK processes, and scientific and technological knowledge, which proved useful in subsequent projects. The interviewee recalled a junior staff member who worked on the project and presumably developed engineering expertise as a result.

For the third industry partner, it was beneficial to explore novel technologies related to their business during the project. They did not receive immediate outcomes after the project due to their focus on commercialisation: “we've got a goal where people are going to place orders (…) and [not] just to do research for the sake of research." There was less learning regarding some engineering aspects of the technology that they continued to discuss with the other project partner before it went out of business. This industry partner was already very experienced in their field, so they did not feel that the project significantly enhanced their knowledge.

SECTION 4: KEY FINDINGS: IMPACT TYPES AND PATHWAYS

4.1 Diversity of project impacts

In this report, we examine the impact of 16 IUK-funded collaborative R&D grants that were completed, on average, five years ago. This involved interviews with 43 individuals from 38 organisations, including private companies, academic institutions, clinical organisations and local authorities. Following these grants, a wide range of long-term impacts, with varying strength and causal links to the IUK grant, were identified.

In the interviews, organisations tended to focus on technological and product developments, knowledge generation, and research outputs as the key expected outcomes of the IUK project. When asked to recount any unintended impacts from the project, the interviews highlighted various impact types, including firm impacts, reputation gains, follow-up collaborations, the founding of research entities, and, particularly, multiple types of learning and knowledge gained from the project.

Table 4 summarises the long-term impact caused, either directly or indirectly, by the IUK grants we examined, without any specific order of priority.

Table 4: Summary of case-study benefits

Capability benefits	Individual skills and experience, including on project and stakeholder management
	Increased scientific and applied capability within organisations
Staffing benefits	Staff retention and employment gains
	Individual career progression within the same or other organisations
Knowledge and technology benefits	Applied and/or theoretical knowledge on scientific topics and technologies
	New or accelerated product development, product regulatory compliance and commercialisation
	Research outputs, including peer-reviewed publications
	Formally registered IP, such as patents and trademarks
	Contribution to the broader scientific knowledge
Collaboration benefits	Contacts, networks and collaboration (to the individual or organisations)
Promotional and commercial benefits	Publicity, promotional effects and reputation gains (to the individual or organisations)
	Customer acquisition, increased sales and other measures of business or organisational growth
	Changes to the business model and strategic direction of organisations, pivoting
Ecosystem benefits	Founding of research entities (e.g., institutes, laboratories, testing facilities, spinouts)
	Follow-up funding, grants and projects
	Contribution to government, industry or professional body policies or guidelines
Wider societal benefits	Benefits to beneficiaries of the innovative technology (e.g., customers, private companies, patients, residents in the local authorities)
	Knowledge and experience dissemination to internal and external stakeholders

One important aspect to consider about these impacts is that they are interconnected, and not all of them occur at the same time. For instance, improvements in individual experience and knowledge could lead to greater capability and expertise within individuals' own

organisations, which might result in securing follow-up funding in the related field and/or business expansion.

These grants demonstrated that IUK grants could directly promote ongoing collaboration between partners, lead to follow-up R&D projects, or both, when project partners engage in the subsequent R&D work. Such connections among impacts, as well as their relationship to other factors that enhance or reduce them, suggest the existence of specific impact pathways, which are examined in the following section.

4.2 Impact pathways

Alongside exploring and identifying various impacts, following these projects enabled us to identify different pathways through which impacts from IUK grants appear. We provide a summary of typical impact pathways in **Error! Reference source not found.**. In the figure, white boxes denote impact pathways, and grey boxes indicate contextual factors that either enabled or hindered impacts.

The discussion about impact pathways starts with the question of what defines a successful IUK project. It seems that IUK grants could be classified based on their success in achieving the intended outcomes – whether it is technology, proof of concept, product, or research – along with the timeline after the project. In this study, we found that even projects considered unsuccessful in this regard produced some impacts mentioned earlier, especially in terms of knowledge and experience gains for individuals and their organisations, as well as additional collaborations. However, successful projects tend to have resulted in more significant and enduring impacts, including those resulting through mechanisms such as organisational or business growth.

The primary impact of the IUK grant is on the individuals involved, as they serve as channels for enhancing expertise, knowledge, capability, and networks within their organisations. There appear to be differences between those who remained with their organisations and those who did not. The individuals who left their organisations, like others, reported personal impacts from the project, mainly related to knowledge and experience. However, they were less likely to apply this knowledge, or to apply it significantly, in their subsequent roles. In contrast, the interviewees still with their companies described more impactful outcomes for themselves and their organisations; for example, they contributed to translating the project's R&D learning into various organisational impacts. Additionally, a few interviewees mentioned disruptive effects on utilising project learning and thus generating impact due to staff turnover. This led us to conclude that staff retention could be a pathway to creating and maintaining impacts. However, for obvious reasons, it was more difficult to contact project participants who changed jobs or whose companies had been dissolved, so few of them participated in this study, and we do not assert that these findings would always be applicable.

Personal initiative, leadership, and prior experience were evident in several projects where individuals advanced IUK R&D outcomes, resulting in substantial and lasting effects, such as widely sharing and advocating research findings or establishing research entities. Typically, these individuals held senior positions in their organisations, although capturing other characteristics proved challenging.

Following these grants also showed that impacts could be increased, enabled, or limited by factors largely outside of the project's control (shown in grey in **Error! Reference source not found.**). A clear example is that further R&D work or the creation of research bodies would not be possible without funding. Product commercialisation, in particular, has several

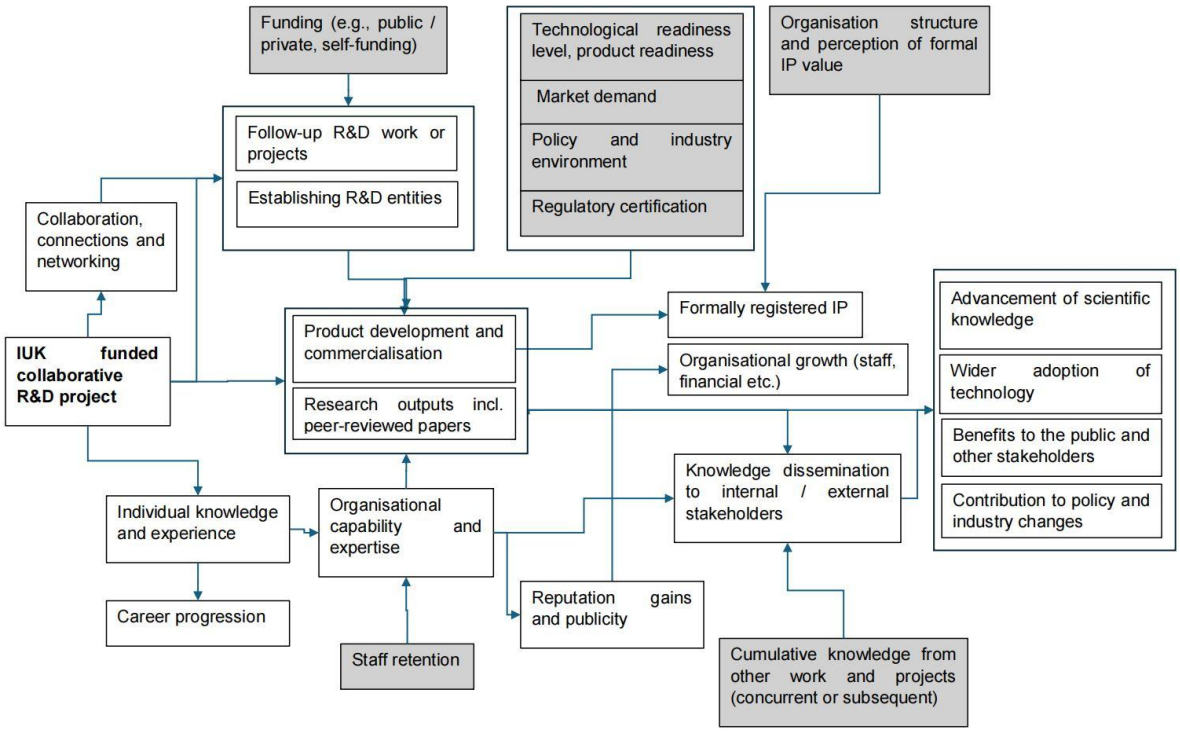
additional external pathways to impact: the product needs to have a sufficient technological readiness level, be in demand in the market, have relevant regulatory approval, and even exist within a supportive policy and environmental context for that technology (which may be industry-specific).

Similarly, the cumulative knowledge and experience gained from other projects or work—whether ongoing with the IUK grant or completed afterwards—affects the impacts of the IUK project in a way that is not straightforward. The extent of impact from the IUK projects may be reduced in organisations and for individuals who have acquired R&D experience from multiple sources, as some interviews have shown where respondents could not attribute impacts solely to the IUK grant. Conversely, cumulative knowledge can strengthen and enhance other impacts, such as further R&D activities, knowledge sharing, product development, and business growth, which might not have happened with just the IUK grant.

There also seems to be a connection between impact types and organisation type. For instance, academic and research partners appeared more focused on research outputs and follow-up R&D work, while industry or commercial partners showed more interest in products. This finding is particularly clear when it comes to formally registered IP. Only three organisations interviewed told us that the project resulted in IP, while others tended to explain why their organisation does not patent; for example, because they are a local authority. This conclusion is not straightforward, as some commercial companies reported they do not patent because they want to keep their IP out of the public eye. Therefore, when we say that some impacts do not materialise, it may be because the project partners were simply not interested in them. However, this is a generalisation: some academic partners were involved in product development and IP generation, while some private companies produced research prolifically.

Finally, few interviewees discussed the wider implications of IUK projects beyond their immediate stakeholders, such as the industry, society, policy, or scientific knowledge. Those who mentioned such impacts typically described them as contributions rather than transformations, like raising awareness instead of changing attitudes. This partly results from the nature of collaborative R&D projects: the technologies involved were new and experimental, making broad adoption difficult. Moreover, long-term impacts are influenced by many factors, complicating the ability to directly link project outcomes with significant changes in the wider environment. For example, while most interviewees noted that their IUK projects produced research outputs, they often struggled to identify specific changes affecting stakeholders not directly involved. This is also true for other forms of knowledge sharing, as few interviewees cited practical results from their ongoing knowledge exchange.

Figure 1. Impact pathways of IUK grants. External influencing factors are depicted in grey.



4.3 Impact timelines

In the discussion on impact pathways, we observed that impacts might occur at different times and be influenced by IUK projects to varying extents. In Figure 2, we summarise the impact timeline and the degree to which impacts can be attributed to the IUK project (i.e., impact magnitude).

During the interviews, held about five years after most IUK projects concluded, many impacts on organisations were still ongoing. However, the attribution of the IUK project decreased with time. The most significant impact seems to occur within the first year after the project ends (if at all). The magnitude of impact diminishes over time mainly because more factors influence the events. For example, the product developed through the IUK grant continues to be iterated or modified without the grant's input, and additional knowledge and information are gained from other sources, which adds to the knowledge obtained from the IUK grant, and so on. IUK projects also contribute less to impacts resulting from other influences (e.g., business growth) because this requires inputs from outside the project.

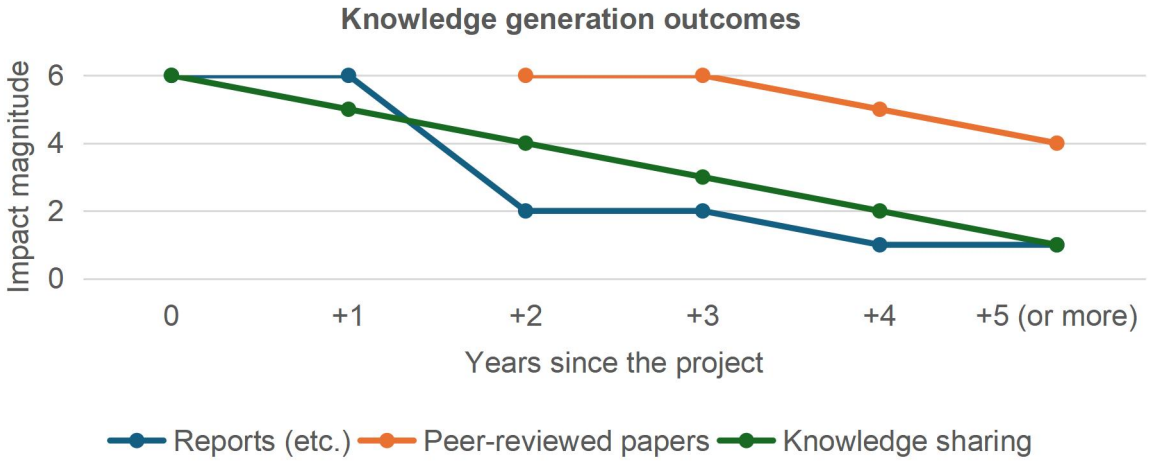
The declining influence of an IUK project on impacts is not a negative outcome. This is because the accumulation of knowledge, experience, and associated benefits from other sources seems to enhance the overall impact.

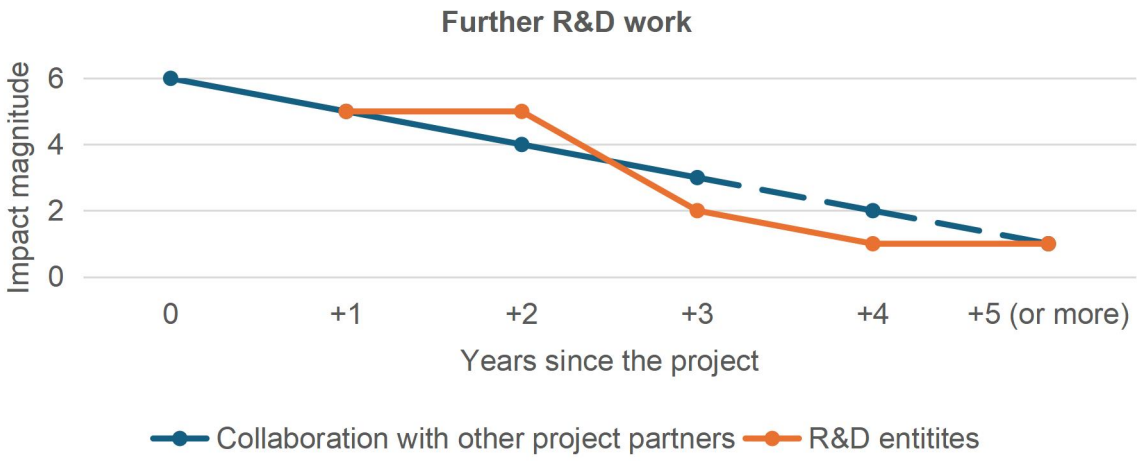
All types of impacts can last for years after the project, but in this study, we identified several factors that prevent these impacts from continuing. The main factor is, of course, organisations closing down (including research entities). We had few interviewees from companies that closed down, and more interviewees discussed other project partners going out of business. Generally, closing down raised questions about the ongoing exploitation of project outcomes. Other inhibiting factors include product obsolescence, companies shifting to entirely different areas of work, individuals leaving the organisation, and the lack of follow-up funding or collaboration to carry on the work.

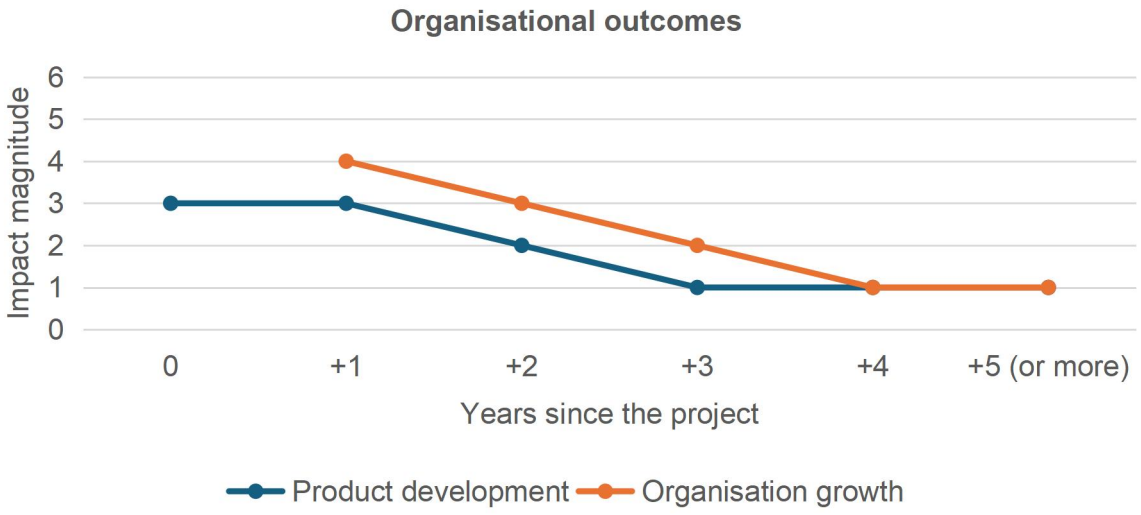
Following these grants, it is possible to make some general observations on how impacts vary in terms of their timeline and magnitude:

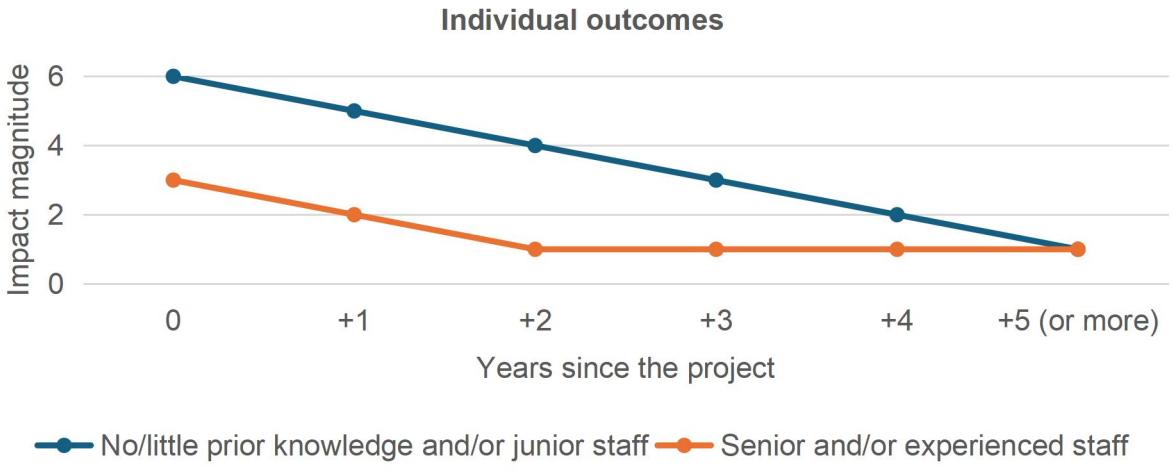
- ***Research reports*** - that is, grey literature (project reports, industry reports etc.) tended to primarily come by the end of the project or shortly after.
- ***Journal publications*** - take longer because of the peer-review process, so they typically came out about 2 - 3 years after the project ended.
- ***Further R&D work*** - typically ceased roughly about a few years after the IUK project, however, some organisations kept on collaborating.
- ***R&D entities*** - require funding from outside the project, which lowers the impact of IUK grants on their founding.
- ***Organisational outcomes*** - stand out because of their variability ranging from customer acquisition through capability enhancements to business model changes. Some organisations reported very strong impacts from the project, while for others, impacts were modest to small, for instance, because they used only some aspects of the grant's technology
- ***Organisational growth*** (e.g., sales, employment etc.) - tended to lag sometime because they are caused by other impacts (and external factors).
- ***Individual outcomes*** vary depending on the person's prior experience and the seniority of their position. More junior staff or employees previously unfamiliar with the project's technology were impacted much more, sometimes going from practically no or low knowledge to being experts and advocates in the field. Meanwhile, established professionals tended to "solidify" or "reinforce" and add to their knowledge and careers due to the project.

Figure 2. Impact timeline and the degree of influence from the IUK grant over impacts. Note that impact magnitude is illustrative for the purpose of visualisation.




Further R&D work
Impact magnitude
6
4
2
0
0
+1
+2
+3
+4
+5 (or more)
Years since the project
Collaboration with other project partners
R&D entitites


Organisational outcomes
Impact magnitude
6
5
4
3
2
1
0
0
+1
+2
+3
+4
+5 (or more)
Years since the project
Product development
Organisation growth


Individual outcomes
Impact magnitude
6
4
2
0
0
+1
+2
+3
+4
+5 (or more)
Years since the project
No/little prior knowledge and/or junior staff
Senior and/or experienced staff

SECTION 5: RESEARCH AND POLICY IMPLICATIONS

Our FTG analysis indicates implications for monitoring and evaluating project impacts, as well as for future policy development. We discuss each in turn.

5.1 Monitoring and evaluating impacts

One goal of this study was to determine when the longer-term impacts emerged after projects concluded. Our interviewed projects finished, on average, about 5 years ago, ranging from 3 to 8 years. In organisations that reported impacts, several effects appeared to be ongoing at the time of the interview, although, as described in the Impact timeline section, the influence of the IUK grant diminishes over time. Long-term impacts tend to have materialised around year 3 after the project, with most impacts directly caused by the grant occurring after 1 to 2 years. Few new impacts are observed around year 5. Therefore, a timeline of 4-5 years post-project seems sufficient to capture most longer-term impacts.

A timeline of 4-5 years is also recommended to balance data collection and recall issues. Many interviewees mentioned that they do not remember well what or why something happened, especially if they changed jobs or were involved in multiple R&D grants (sometimes, several IUK grants). For example, one interviewee initially focused on a different IUK grant (the one that followed the grant in question), despite being prompted and referencing both before and during the interview to the original grant.

Longer evaluation periods are, of course, possible; however, as time passes, it becomes harder to reach project participants. Even five years after project completion, we encountered many unavailable email contacts, and some project partner companies had dissolved since receiving the grant. Similarly, individuals may leave their organisations, retire, fall seriously ill, or pass away. Therefore, initiating contact sooner would likely result in a larger pool of interviewees. Additionally, those interviewed earlier are more likely to stay in contact with other project partners within a shorter timeframe, enabling them to provide their contact details.

This indicates the possibility of adopting a layered approach to the long-term assessment of major project impacts. If some monitoring occurs at the point of project completion, contacting the involved individuals three years later would offer an update on impacts and help keep an active contact list. These contacts could then be revisited five years on, and because of the follow-up, they would be more likely to be traceable and to participate again. Their impact stories would also be of higher quality since they would only need to recall more recent events rather than the entire past five years.

A key element in any long-term follow-up of projects is the IUK contact database. This acts as the first point of contact with project participants. Some operational issues emerged here, which limited our ability to engage certain organisations. For instance, several contacts were generic organisational emails, making it harder to identify the individuals leading or involved in the projects. In a few cases, when firms dropped out of the project or changed their names, they were still recorded in the database. There were also some duplicate emails, and a significant proportion of organisations (14%) had no recorded email. Some listed individuals were finance managers who did not have the necessary involvement in the project to capture its impacts. Future follow-up projects would be easier if the contact database were maintained beyond the application stage and included the email of the project's scientific or technical lead.

5.2 Follow the grant

As with other Follow-The-Thing studies, most of our interviews were conducted through "snowballing" the interview sample, meaning we asked initial interviewees to recommend the most suitable person to speak to from other organisations involved in the project. This snowballing method also proved successful in securing contacts for multiple partners within the same project.

To contact project participants without contact details or whose emails bounced, we also used LinkedIn Premium alongside snowballing. The outcomes were mixed. LinkedIn Premium demands extra funding and allows only a limited number of contacts each month. Additionally, many project participants could not be found on LinkedIn, including due to others with similar-sounding names. Only a few interviewees responded on LinkedIn, although one of these responses led to snowballing the entire case study for the project.

The quality of insights provided by interviewees varied according to their roles within each project. The most detailed and well-expressed impact stories came from the organisation's most senior members involved in the project. When we interviewed several individuals from the same organisation, these discussions tended to confirm previous insights rather than reveal new information about organisational impacts. Nonetheless, these additional interviews helped deepen the understanding of more personal impacts.

In cases where individuals left the organisation, they served as a valuable source of information when no one else from the organisation could be contacted. However, their understanding of the impacts on their previous organisation was less comprehensive.

We also found that when asked to comment on impacts for other organisations or individuals, interviewees tended to use more speculative language, suggesting that they were less certain about the project's effect on these stakeholders. For example, most interviewees could not definitively state whether other project partners had developed IP due to the project.

The high-quality insights provided by project leads and the value of the snowballing approach across organisations suggest a clear research strategy for any future Follow-the-Grant studies. First, prioritise identifying and interviewing the project's technological or scientific lead. Second, use a snowballing approach to identify individuals in other organisations involved in the project. Wherever possible, interview staff from multiple organisations per project to obtain different perspectives on impact. Third, and depending on resource constraints, multiple stakeholders from the same organisation can be interviewed to develop insights about individual outcomes.

In the current FTG study, we have relied on interviewees' perceptions and understanding of what occurred during and after the IUK project. We also left it to interviewees to define what they considered the project's key outcomes, which may not align with IUK's own definition of key outcomes or objectives. In any future FTG studies, we recommend supplementing primary data for long-term evaluation with documentary evidence, such as final IUK reports.

5.3 Strengthening long-term impacts

The FTG approach identified that long-term impacts from IUK projects occur through a range of direct and indirect mechanisms, as shown in Figure 1. Many of these mechanisms happen naturally but recognising them may enable IUK and other partners to strengthen these pathways. For example, several interviewees highlighted that networking and collaboration opportunities were among the most valuable outcomes of IUK grants for them, even when the key innovation outcomes from the project did not materialise.

This was also significant because it established contacts and networks, which sometimes resulted in further R&D work, product development, and the foundation of research entities. It highlights the importance of networking and knowledge-sharing initiatives such as the Knowledge Transfer Networks (KTNs), which can encourage collaboration opportunities among project partners and organisations from other projects.

A few interviewees also pointed out that the publicity and reputational benefits from the project contributed to further R&D and professional opportunities for them and helped sustain some of the project's impacts. This was especially true for organisations in emerging sectors. Promotion effects were also beneficial in enabling different organisations to share the knowledge gained from the project, particularly if they were not academic organisations.

IUK might help highlight ongoing and finished projects to maximise knowledge sharing and commercial impact.

The FTG study also recognised several external factors that acted as enablers or barriers to project impact (Figure 1). These included follow-up funding to sustain R&D, bringing a product to a commercially viable stage, market demand, and knowledge gained from other sources. Interestingly, the broader policy and industry environment was sometimes reported to hinder these impacts due to limited interest or slow progress in technological or infrastructural change.

Many, but not all, of these factors are outside IUK's control. However, as projects near completion, IUK could assist organisations in identifying potential factors that might limit or constrain impacts and, where possible, mitigate these. For example, IUK could leverage cumulative knowledge from similar projects or encourage the adaptation of technology to broaden its appeal to other applications.

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