Department for
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Innovate UK

CATAPULT PROGRAMME: A FRAMEWORK FOR EVALUATING IMPACT

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Contents

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This framework has been developed by Hannah Lockley and Khalid Khan from the Department for Business, Energy and Industrial Strategy (BEIS), in collaboration with David Legg and Dan Hodges at Innovate UK.

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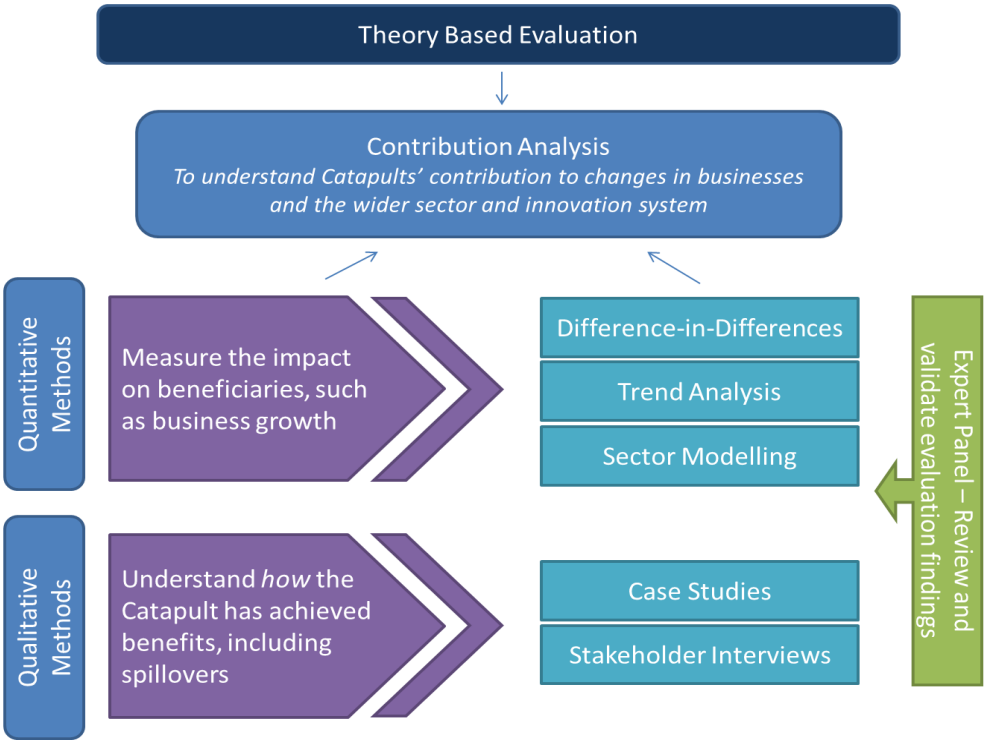
Executive Summary

The Catapult programme is a network of technology and innovation centres that aim to bridge the gap between research findings and their development into commercial propositions. The network provides leading-edge technology and expertise, and encourages greater collaboration between research and business. With their services the network aims to foster world-leading science and innovation in businesses and drive economic growth.

This paper outlines an overarching evaluation framework of how the Catapult programme will be evaluated by independent researchers at the individual Catapult level. Publication of the framework is the first step towards setting-up evaluation. It needs to be complemented with consistently defined and collected data across all the Catapult Network to enable evaluators to implement proposed methods.

Each Catapult will draw its evaluation approach from this framework in a way that is specific to its objectives and sector(s). The figure below outlines the high level mixed methods approach that will inform contribution analysis - a theory based evaluation method chosen due to the complexity of the Catapult programme, and the implications this has for more rigorous quantitative evaluation.



The evaluation will collect information from surveys, case studies and interviews, which are designed to understand performance against key overarching strategic objectives, and the general impact of the work of each Catapult. Therefore, the

evaluation will assess each element of the Catapult logic models – inputs, activities, outputs, intermediate outcomes, longer term outcomes, and overall impacts.

Introduction

The UK Catapult network was established by Innovate UK following a recommendation of the Hauser Review[1] that the Government should invest in 'translational infrastructure' through a network of technology and innovation centres.

Catapults are not-for-profit research and development (R&D) centres (although many of the partners they work with may seek a return on investment) where UK businesses, scientists and engineers work together to transform high-potential ideas into commercial products and services, generating economic growth. The centres offer facilities and expertise to enable businesses and researchers to solve key problems and build new commercially viable products and services. Partly funded by the Government[2], they focus on priority sectors that are seen to have potential for driving economic growth.

To fully understand how the Catapults are working and how they are translating new ideas into innovative products and services, it is essential to measure their impact. Robust impact measurement can enable Catapults to understand how they "transform the UK capability for innovation in specific areas"[3] but more importantly it can provide a robust estimate of how "they help drive future economic growth"[4]. This evidence could lead to more effective innovation policy-making and better future investment. This is also central to Innovate UK's and BEIS's commitment to better monitoring and evaluation. Innovate UK's Delivery Plan[5] states that:

> *"Understanding the impact of what we do is crucial. A strong evidence base helps us ensure we are getting value from our use of taxpayers' money, directing our activities at the areas where we are most effective at driving economic growth, and enables improvements in programme design and implementation."*

This paper sets out the overarching framework to evaluate the impact of the Catapult centres, the rationale for the methodology, and data list. As individual Catapults are at different stages of maturity, this framework covers the existing Catapults as well as future Catapult centres. For more information on the Catapults see Annex A.

1 BIS (2010) The Current and Future Role of Technology and Innovation Centres in the UK
2 Since 2012 around £200 million of government funding has been allocated to the first five years of the programme. The Catapults are expected to raise further research income and private sector funding.
3 Catapult website
4 Catapult website
5 Innovate UK Delivery Plan 2016/17

Purpose

The aim of this overarching framework is to:

- Outline how the progress of existing and future Catapult centres can most effectively be measured and their impact assessed.
- Provide a high level impact evaluation approach, including methodology and required data collection.

While this framework focuses on individual Catapults, the findings from the evaluations will also be used to assess the impact of the Catapult network as a whole, in terms of both overall impact of the network and the benefits of collaboration within the network.

The remainder of the document outlines a high level overview of the Catapult programme; presents a high level logic model and evaluation objectives; lists evaluation challenges in innovation evaluation; and more specifically, in the evaluation of Catapults. Finally, the framework presents anticipated evaluation methods and data metrics.

Catapult programme background

The Catapult centres are a network of world-leading centres designed to transform the UK's capability for innovation in specific areas and help drive future economic growth. Many companies in the UK have the ambition to grow and bring new products and services to market. However, few have all the resources, competencies, expertise, equipment or contacts they need to develop and commercialise their ideas. The Catapults bridge the gap between these ambitious businesses, the expertise of the UK's world-class research communities and the cutting-edge equipment and facilities that can enable and accelerate innovation. They help address market failures which prevent commercial interests or existing RTOs from investing to meet the needs of these businesses into the longer-term.[6]

In Autumn 2010 the UK Coalition Government provided over £200 million of additional funding to Innovate UK to establish seven Catapults. It clarified specific objectives and suggested that the role of the centres would be to:

- Enhance business access to leading-edge technology and expertise
- Reach into the research base for world-leading science and engineering
- Undertake collaborative applied research projects with businesses

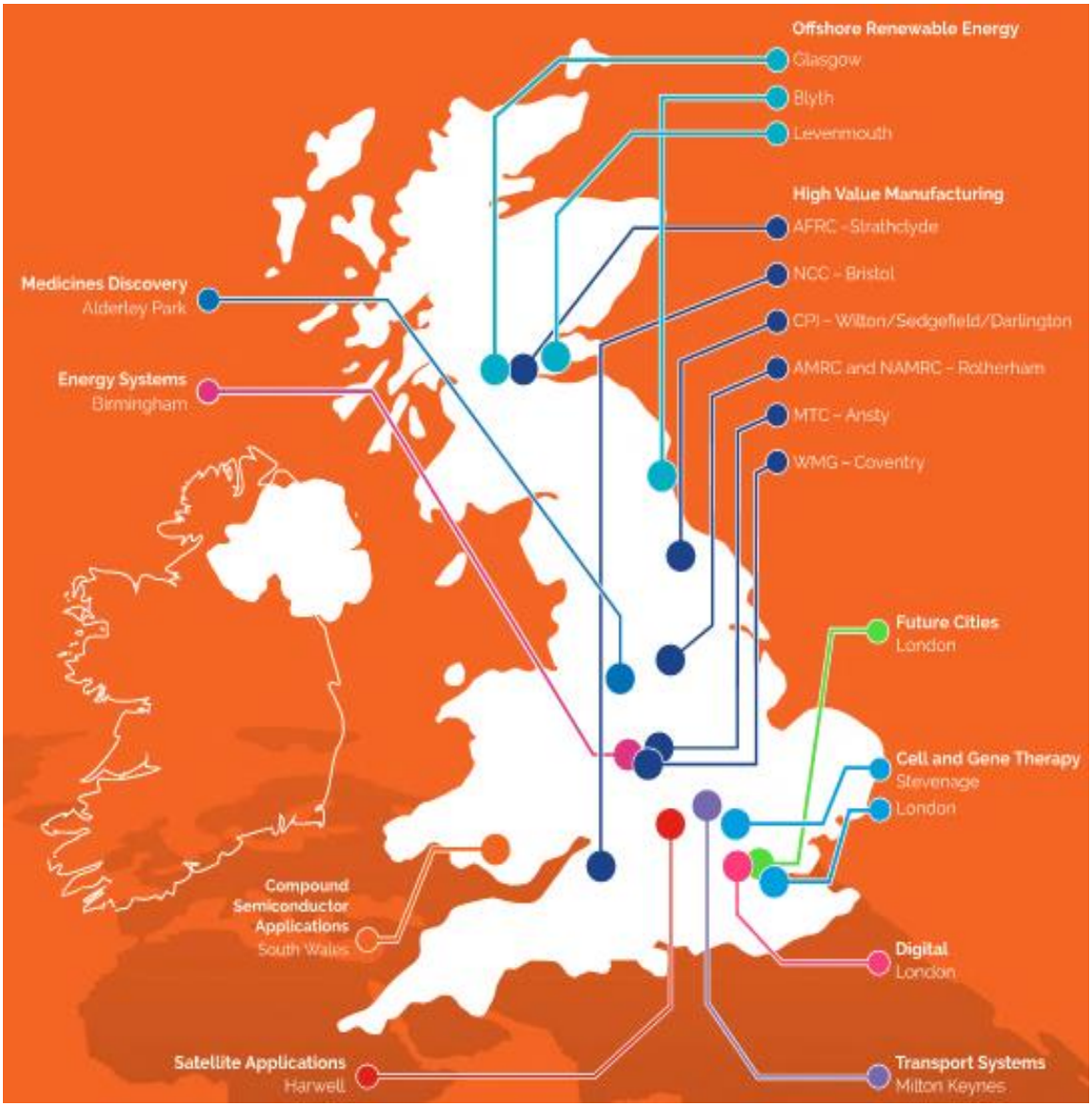
[6] https://catapult.org.uk/impact/ and https://catapult.org.uk

- Undertake contract research for businesses
- Be strongly business-focused with a highly professional delivery ethos
- Create a critical mass of activity between business and research institutions
- Provide skills development at all levels.[7]

The Catapult network transmits its impact to relevant industrial sectors and the UK economy through providing critical inputs to innovation and R&D such as access to state of the art facilities and expertise.

The figure below indicates the locations of the Catapult centres across the UK.

Figure 1: Catapult locations, 2017 – Source Innovate UK



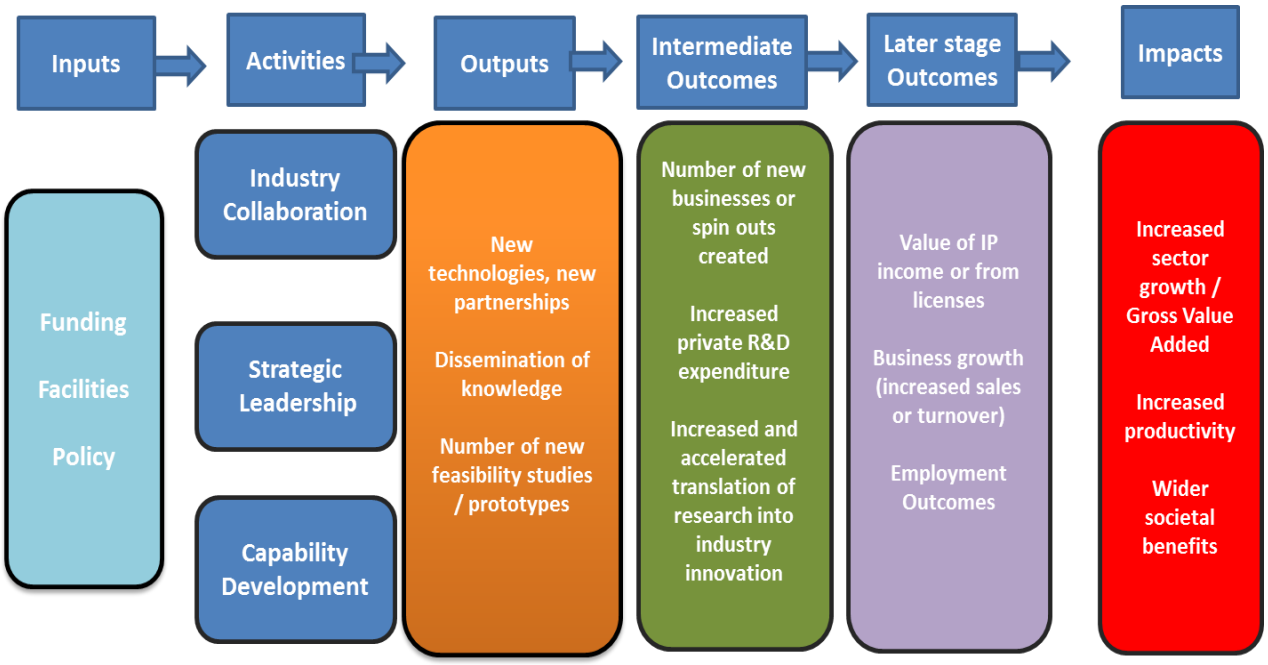
[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/368416/bis-14-1085-review-of-the-catapult-network.pdf

Logic Model

Each existing Catapult has developed a logic model that outlines how its inputs and activities lead to economic and social impacts. Though these relationships are not linear, by presenting relationships between the inputs (i.e. Catapult services), outputs (such as accelerated technological development) and outcomes (such as higher economic growth and wider societal benefits), the logic model guides the design of monitoring and evaluation activities.

Since individual catapults operate in different sectors; address different market failures; and have different objectives, it is not possible to present a logic model that is applicable to all Catapults. To demonstrate how a logic model and its component parts can be used in a theory-based evaluation approach, an illustrative logic model is presented below. Annex A presents objectives and logic models for all the existing seven Catapults. It is expected that all new Catapults will develop their own logic model(s) to facilitate effective monitoring and evaluation.

Figure 2: Illustrative logic model



Evaluation Challenges

Evaluating innovation policy is not straight forward because multiple actors, through multiple interventions, support R&D activities to address barriers at different levels. For example, at one level the Catapult network provides innovation infrastructure for businesses to test their ideas and, in some cases, develop prototypes. At the same time it cultivates a network for businesses, industry experts and academics to discuss problems and share experiences. Simultaneously, it may also offer technical expertise or facilities to reduce the cost of conducting R&D. The combined impact is expected to be more than the impact on a specific business; it extends to the innovation system in the local area as well as at a national level. There may also be challenges due to the commercial confidentiality of data and projects, where Catapults are working with commercial partners. This could make disclosure of information challenging in some circumstances.

This complexity and interconnectivity poses some significant challenges for evaluators, both methodologically, i.e. how to identify the additional impact of a Catapult, and practical issues such as collection of data.

Perhaps as a result of this complexity, there is currently an absence of agreed tested approaches for evaluating the impact of investment in the type of activities that Catapults undertake. A Frontier Economics report undertook a review of the international evidence on the impact of innovation centres, and found 18 studies had attempted to measure economic impact, each taking a different approach. Seven used a counterfactual in their design, and just one of these had made a clear effort to justify the credibility of the chosen counterfactual. This seems to demonstrate the challenge of creating a credible control group in evaluations of innovation centres. This challenge is recognised in this framework, and the evaluations conducted under this framework are not expected to result in a single figure which robustly summarises the impact of a Catapult as a whole.

In addition to the conceptual and data issues, the operational model of the Catapult network and its objectives add a number of key challenges for evaluators, which are described below:

Timescale

The impacts associated with innovation investments often take many years to materialise (both for businesses and for the innovation system), so any innovation evaluation needs to capture impact spread over long time periods. For Catapults there are two specific reasons to take this into account. Firstly, by design the Catapult network aims for long term and sustainable impacts such as increased sector growth. Therefore, it is expected that there will be a number of years between the activities of the Catapults and any national innovation system level impacts—

such as those intended “to transform the UK’s capability for innovation in specific areas”.

Secondly, evidence from past evaluations, both in the UK and in other countries, show that benefits from funding innovation competitions take a number of years to materialise and this is likely to be similar for Catapult activities, such as collaborative partnership projects. For example, evidence from a retrospective evaluation of Smart[8] showed that around a third of companies that received a grant from April 2011 to March 2013 had achieved commercial outcomes by 2015. It is anticipated that other outcomes will materialise as monitoring continues but timings will differ between sectors. For example, sectors that involve high amounts of regulation (such as the health sector) will take longer to implement R&D and consequently see later outcomes as a result. Given this, the Catapult evaluations will need to build evidence over time, starting with short term inputs, activities, and outputs, and then building to medium and longer term outcomes and impacts.

Baseline

Robust evaluation requires a comparative or counterfactual perspective to measure the additional impact associated with the intervention, whether that is at the business or sector level. As some proposed evaluations are partially retrospective, it will be necessary to run additional surveys to collect business baseline information, i.e. data on the situation before a business used a Catapult service. This method relies on accurate recollection and therefore may not provide a precise estimate of the baseline. To address this, the evaluation frameworks developed to date propose that all the existing and new centres in the Catapult network should, from now on, collect detailed management information on the businesses they support.

Attribution

Determining whether a particular policy was responsible for an outcome relies heavily on the ability to identify a counterfactual group. Ideally, the counterfactual will be as similar as possible to the treatment group to isolate the treatment effect, this includes propensity to engage with the treatment activity. In the context of the Catapults, using a counterfactual of businesses who have not engaged with Catapults will therefore introduce selection bias, where any positive outcomes observed could be accountable to the motivation and ambition of those businesses that have worked with the Catapults, compared to those that have not sought out, or taken advantage of that opportunity.

[8] Innovate UK (2015) Smart funding: assessment of impact and evaluation of processes

There are a number of further complexities to consider as well; the variety of activities involved, the multiplicity of industries and location of Catapults, the diversity of businesses within and across Catapults, and the range of anticipated outcomes (e.g. behaviour changes, economic and competitive impacts). As a result of these factors, it will not be possible to carry out a fully robust impact evaluation, where the intervention being measured is isolated from extraneous variables and therefore allow for full attribution. An observed outcome to a particular activity will often be a combination of activities by each Catapult and sometimes a combination of multiple Catapults alongside other interventions and external factors. Where feasible, this evaluation will use a counterfactual approach and complement it with a mixed methods design, combining different sources of evidence to examine whether an intervention had the intended impact or, if not, whether contextual factors limited its effectiveness.

Additionality

A challenge for the economic evaluation is to accurately understand the additional impact the activity of the Catapult has had on outcomes, taking into account:

- *Deadweight:* outcomes that would have happened anyway. For example, R&D projects that would have occurred at the same quality, pace, and impact without the Catapult network
- *Displacement:* whether one intervention transfers an aspect of the activity from a pre-existing activity, hence not a true increase (for example, staff numbers generated from a Catapult activity being conversely depleted from a similar activity)
- *Substitution:* whether one activity is simply replaced with another similar activity. (For example, a business replaced an existing R&D project to benefit from R&D grant on a different project)
- *Spillovers:* whether the Catapults have had an impact on organisations not directly involved with the Catapult (for example, technology or knowledge developed in a Catapult leads to further R&D activities in businesses not linked to the original project).

Evaluation Objectives

As previously stated, each Catapult will have its own sector and intervention specific objectives, and will have different mechanisms through which their services achieve the intended outcomes. There are however broad, consistent aims across the Catapults as outlined in the introduction. Therefore, the overarching evaluation objectives across Catapults are to better understand:

1. How the Catapult centres have performed against their delivery plan and programme objectives.
2. What economic and social impact the Catapult activities have had; understanding the contribution made from the Catapult to businesses, academia and the wider research community.

More specifically, the evaluation will seek to answer the following questions:

- To what extent do Catapults reduce the risk of innovation and accelerate the pace of business development?
- To what extent do the Catapults develop the UK's skills and knowledge base and its global competitiveness?
- How do Catapults help businesses grow and what contribution is made by the access to expertise and equipment in developing new technologies and markets?
- How effective are the Catapults at providing innovation support that leads to the creation of business investment and growth?

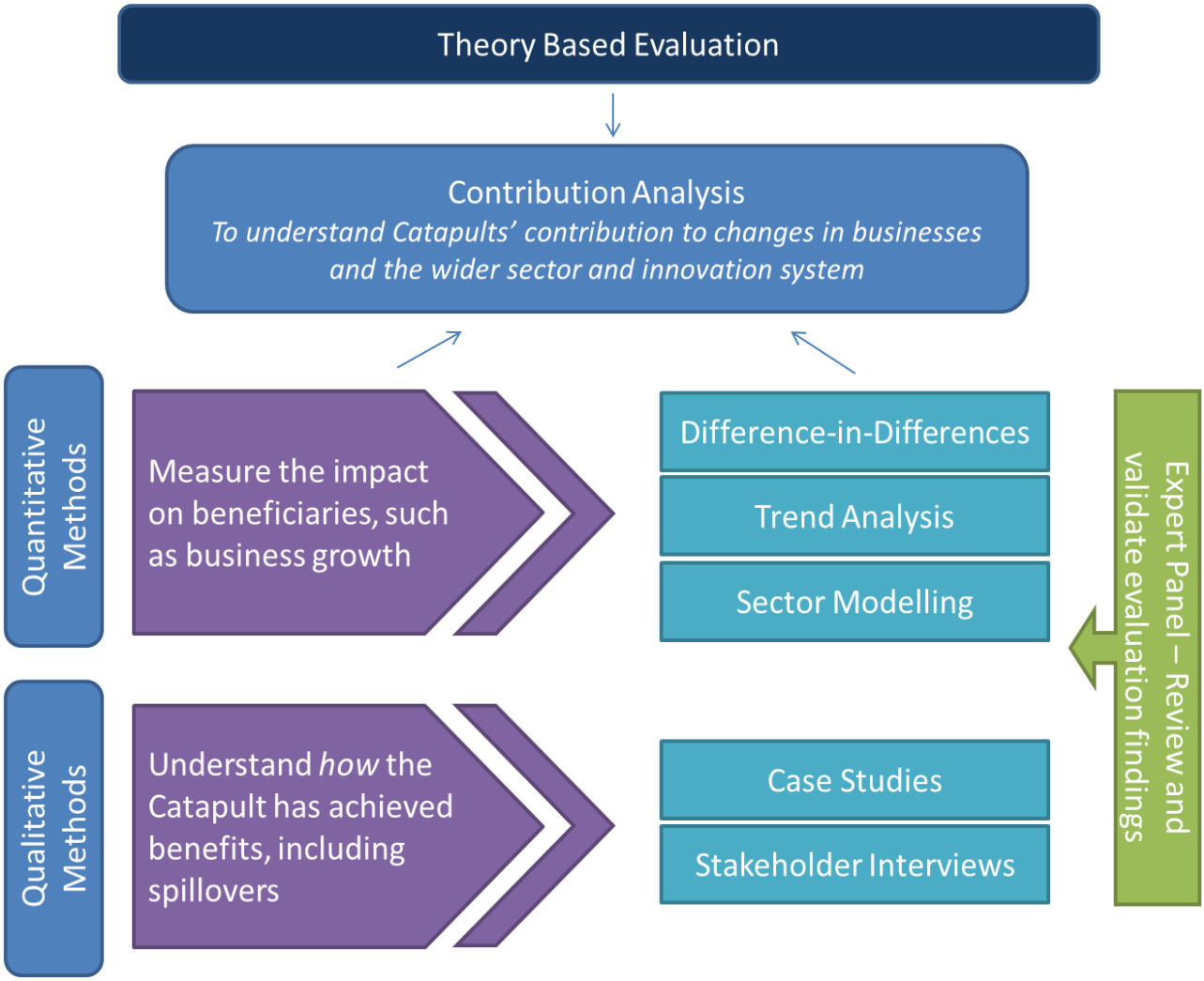
Each Catapult will also have its own specific objectives that will be evaluated. These are outlined in **Annex A**.

Catapult Evaluation Framework

Given the diversity of interventions, multiple objectives, and other challenges in the innovation area, this framework addresses evaluation objectives with a combination of appropriate evaluation methods. The overarching approach proposed is contribution analysis, which will be used to help understand the specific contribution of Catapult Centres on the outcomes and impacts. The evaluation will develop a narrative to understand the direct and wider impact of Catapult centres by triangulating evidence from different sources. To establish impacts it will rely on quantitative methods and for a deeper understanding of mechanisms it will adopt qualitative methods.

Specifically, it will use quantitative evaluation methods, such as difference-in-difference analysis, to estimate the extent of the additional impact of Catapult centres' activities in terms of business outcomes, such as turnover changes. Whilst for a more enhanced understanding of the channels through which Catapult services benefit businesses, sectors and the wider innovation system, the framework will use case studies and in-depth interviews with businesses, Catapults, and wider stakeholders. Finally, it will use industry expert panels to validate the evaluation findings from contribution analysis. Figure 3 provides a simplistic outline of how various methods will contribute to a deeper and more nuanced picture of Catapults' contribution.

Figure 3: Schematic of the Catapult evaluation approach



Theory-based Approach

In order to address the evaluation objectives and to understand the mechanisms that lead to the intended impacts, a theory-based evaluation approach is chosen. This approach provides

> *"an overarching framework for understanding, systematically testing and refining the assumed connections (i.e. the theory) between an intervention and the anticipated impacts."*[9]

A theory-based approach examines why a policy or activity has worked and under what conditions, based on the theory that has been developed in the logic model. It reviews every link identified in the logic model, proposes a theory of change and identifies any additional factors that need to be in position for a successful outcome. Evaluation theory offers a number of options for a theory of change, however this framework uses contribution analysis because of its focus on understanding the causal mechanism and developing a reasonably robust 'contribution story' (i.e. the narrative description of the theory of change and its supporting evidence).

Contribution Analysis

The aim of the Catapult evaluation is to understand and quantify the contribution that the Catapults make to businesses, their industry sectors and the wider economy. Also to explain the role that the Catapult activities have in producing these outcomes.

Contribution Analysis (CA): an approach for assessing questions about cause and effect relationships and inferring causality in program evaluations. It is particularly useful in situations where the programme design is not experimental, i.e. situations where the programme has been funded on the basis of a relatively clearly articulated theory of change and where there are administrative constraints to implementing an experimental design.

Contribution analysis helps to confirm or revise a theory of change; it is not intended to be used to surface or uncover and display an implicit theory of change. The report from a contribution analysis is not a definitive proof of causal relationship, but provides evidence and a line of reasoning from which evaluators can draw a plausible conclusion that, within some level of confidence, an intervention has contributed to the documented results.[10]

[9] HM Treasury (2011) *The Magenta Book: Guidance for Evaluation*
[10] Better Evaluation

Evaluators implement CA in 7 iterative steps[11]:

Step 1: Set out the cause-effect issue to be addressed
Step 2: Develop the theory of change
Step 3: Assess the resulting contribution theory
Step 4: Gather the existing evidence on the theory of change
Step 5: Reassess the contribution story and challenges to it
Step 6: Seek out additional empirical evidence
Step 7: Revise and strengthen the contribution story [go back to earlier step if needed]

As every logical link and its causal context is explored, CA is more resource intensive but robust than alternatives. The most valuable aspect of CA is in the contribution story that it informs. Understanding the 'what' and the 'how' of the contribution story is important for the development of future policy and allocation of resources for Catapults.

Over time this approach will also help to build the evidence base for innovation projects in general. However, as CA is a theory-based approach, it's equally important to consider evidence where the scheme didn't have an impact in order to avoid confirmation bias (interpreting information in a way that confirms pre-existing beliefs and ignoring alternative explanations).

Mixed Methods Approach for Evidence Collection and Analysis

In order to gather evidence for the contribution analysis, a mix of quantitative and qualitative methods will be used. The selection of specific methods will depend on the context, activity, processes and anticipated outcomes for Catapult centres. By employing multiple methods, the evaluators will be able to triangulate and overcome limitations of a specific method and as a result will produce more reliable evaluation results.

Quantitative Evaluation Methods

Catapult evaluations will select a quantitative method or methods to measure the impact of Catapults' services on the businesses they directly worked with. These methods make use of a counterfactual group of varying quality for impact measurement.

We expect the evaluations to consist of the most robust method for future Catapult evaluations. However in the case of retrospective evaluations, data limitations may restrict an evaluator's options. We expect these methods to provide a quantitative

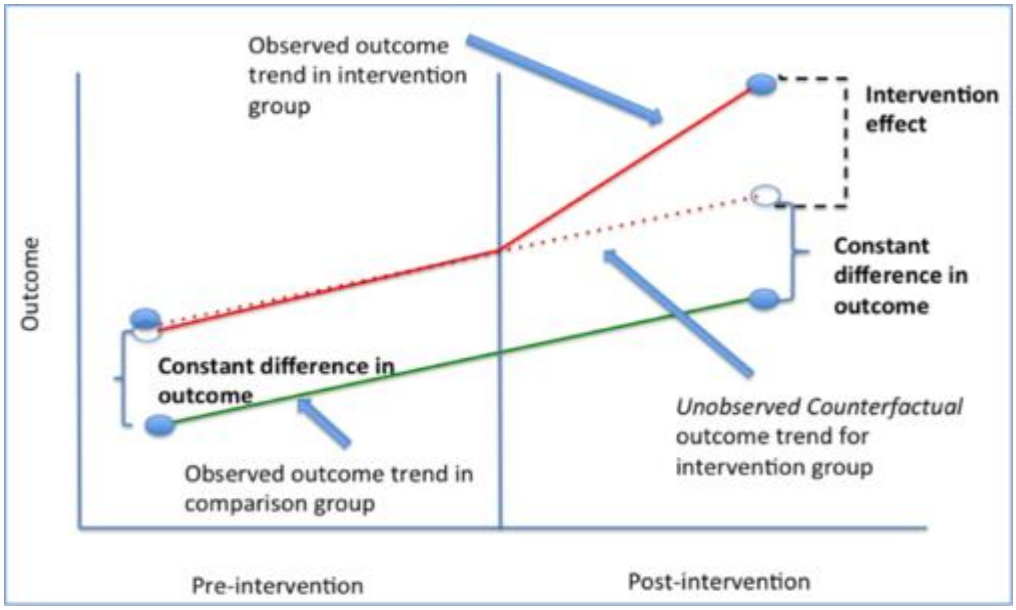
[11] Theory Based Approaches to Evaluation - Treasury Board of Canada Secretariat

measure of impact which could be extended to analyse the Value for Money or economic impact of each centre. Where possible a counterfactual group will be used, whether from identifying a 'non-treated' group to survey or through data linking. This may not be possible where sample sizes are not large enough to enable comparison or the Catapult operates in a small sector and is unlikely to have a 'non-treated' group, although in these instances the potential for other sectors to provide a control group will be considered. More detail on the quantitative methods of this evaluation are outlined below.

Difference-in-differences (DiD)

DiD is the most feasible and robust option, providing a statistical estimate of an impact effect of an intervention. To achieve this, DiD compares the outcomes of businesses in the 'treatment group' (i.e. those that engaged with a Catapult centre) and a counterfactual 'comparison group' (i.e. those that did not engage with a Catapult centre but are as similar as possible to participants). The aim is to have a comparison group which is identical to the treatment group in every way apart from the fact that they did not receive 'treatment'. Figure 4 below illustrates graphically the DiD approach to measuring impact.

Figure 4: Difference-in-Differences[12]



For the Catapult network, DiD will test the impact of a Catapult on business outcomes measured by key metrics of turnover, employment and productivity. Where feasible, this method will be used to develop evidence of impact at business level for the contribution analysis.

[12] Columbia University: Mailman school of public health

Data Requirements

DiD requires data on businesses' performance for a period before and after their engagement with a Catapult (assuming a sufficient duration for the expected outcome to emerge has elapsed), and for comparison, the outcome of businesses who did not engage with a Catapult over the same time period.

The comparison group will have been subject to the same time varying and environmental factors and therefore in theory any difference observed between the two groups is attributable to the Catapult centre. The evaluation will identify the comparison group businesses from a range of administrative datasets such as the ONS's Inter Departmental Business Register (IDBR), Catapult data, industry data and commercial datasets such as FAME (Forecasting Analysis and Modelling Environment), ensuring that the businesses included in both groups are statistically comparable across a number of factors, for example size and age. Survey data will also be collected for specific evaluations.

DiD has some limitations. It assumes that all changes in outcomes between the treatment and control group are due to the intervention. If any other factor affects only one of the two groups (e.g. motivation towards business growth) and is difficult to account for, then the estimated impact could be biased. Also, DiD requires baseline data. This will be particularly challenging for the retrospective analysis if baseline data is not available from third party sources. Although as baseline data collection improves, employing this method should become easier and the results more robust.

Trend analysis (TA)

TA will be the main method to understand changes in an industry trend. For a complete picture it is expected to be used in conjunction with DiD — where DiD will focus on businesses and TA perhaps on industry and sector level. TA may be especially useful in retrospective evaluation when business level data is unavailable or costly to collect. TA can show how businesses/industry has(ve) performed after using Catapult services by comparing to a past trend, and will make a valuable addition to the contribution story on wider impacts of Catapult Centres.

More formally, trend analysis compares post-intervention results with a projection of the historical trend that a sector, for example, experienced prior to the establishment of a Catapult. The historical trend establishes a counterfactual and any divergence from that trend could be attributable to the intervention, provided other factors are accounted for. A key assumption in TA is that without the intervention the past trend would have continued. This method is more likely to be adopted where a counterfactual group is not possible to compare to, for example where the Catapult operates in a sector of limited firms/beneficiaries.

TA will be carried out to assess the change in indicators and outcomes which are applicable at a sector level. This should show whether a Catapult has made a contribution towards any observed growth in the sector it is operating in. Any narrative drawn from trend analysis will be situated in the context of other factors known to have impacted the sector, with statistical controls introduced for these factors if possible.

Trend analysis will provide descriptive analysis for contextual purposes. For new sectors (such as Intelligent Mobility under Transport) or small sectors with little data available or no Standard Industrial Classification (SIC) code, trend analysis will provide a means to collect and analyse data for future comparison.

Where it is not possible to conduct rigorous counterfactual methods, such as DiD analysis, TA may also be an alternative method for measuring the business level impacts of engaging with a Catapult.

Before-after analysis

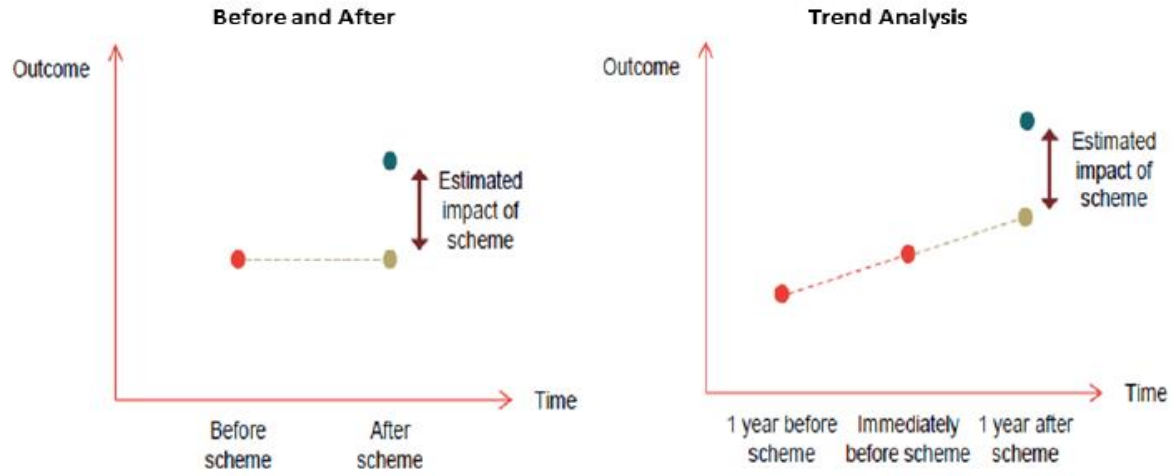
This method is the simplest but least robust quantitative method for impact evaluation and is expected to have limited use within the Catapult evaluations except when there is limited historical data to enable TA.

The approach involves a comparison of outcomes immediately before an intervention with outcomes after the policy has been introduced. So the outcome observed before the policy intervention acts as the counterfactual. The method assumes that outcomes would remain constant in the absence of the intervention. Any succeeding changes in the outcome are attributed entirely to the policy introduced.

While this method is somewhat similar to Trend Analysis, figure 5 below demonstrates the differences between the two approaches. Before-after analysis is carried out by analysing and making comparisons (relative to the baseline) of indicators relating to the sector and business outcomes. At a sector level, current indicators will be compared with baseline observation of the same indicator. In some cases analysis will focus on changes in business behaviour and attitudes towards practices. Analysis will focus on organisations that have interacted with the Catapult (“supported organisations”), with data collected through surveys.

Where before-after analysis is adopted, it is only likely to be used for the interim or retrospective evaluation, not for a long-term impact evaluation or a full economic evaluation. This is because the before-after approach is unlikely to provide a credible estimate of the impact. Where used, it is expected that it will be incorporated in a well-designed statistical analysis with control variables.

Figure 5: Comparison of Trend Analysis and Before/After Analysis – taken from unpublished Frontier Economics framework report



Qualitative Evaluation Methods

Qualitative, in-depth case studies and stakeholder interviews will add explanation to the quantitative results. The quantitative methods are useful to measuring ‘what’ impacts are, whereas qualitative information can explain ‘why’ a specific impact is observed and what mechanism is behind the impact. For example, case studies could explain how a business has benefited from their interaction with a Catapult directly or indirectly, thus complementing DiD and trend analysis. Like the quantitative methods, qualitative information will feed into contribution analysis.

Case studies

Case studies are commonly used in the evaluation of complex programmes, because they enable evaluators to explore the specific mechanisms that drive impact.

The case studies for each of the Catapults will cover the main activities identified in the logic models. Case studies will be selected from a range of existing Catapult projects, detailing the role of the Catapult, its impact, any potential spillover effects and exploring what might have happened in the absence of the Catapult.

In order to ensure a range of outcomes are covered, case studies will need to be selected in a systematic way covering a diverse collection of firms, rather than selecting favourable cases. It’s anticipated that at least 30 case studies will be collected for each Catapult over the duration of the evaluation and there will be a longitudinal element to some case studies. Cases for longitudinal analysis will be over-sampled to account for attrition. Analysis from the case studies will explore the processes by which the Catapult had impact, what has worked well, and what could be done better in the future.

In-depth interviews with key stakeholders

Similar to case studies, qualitative interviews will aim to unpick elements of the Catapults’ additionality, including displacement and substitution effects, where quantitative methods have limited application. Stakeholders’ views (sector bodies, funders, universities etc.) will be used to assess the reputation of the Catapults, as well as the Catapults’ role in generating and disseminating knowledge.

Interviews are a valuable tool to inform the contribution analysis and will have a wider coverage compared to case studies. They will assess aspects such as whether a Catapult is perceived as a centre of excellence and also the Catapult's role in supporting the sector capacity. Stakeholders’ views and perceptions will contribute to

determining and measuring the impact of a Catapult when combined with results from other methods.

The following table summarises which of the methods discussed will be adopted by the established Catapults.

Table 1: Summary of current Catapult methodology

Main Evaluation Methods	Catapult						
	High Value Manufacturing	Satellite Applications	Transport Systems	Future Cities	Digital	Offshore Renewable Energy	Cell and Gene Therapy
Case Studies	✓	✓	✓	✓	✓	✓	✓
Surveys	✓	✓	✓	✓	✓	✓	✓
Interviews with key stakeholders	✓	✓	✓	✓	✓	✓	✓
Econometric analysis via difference-in-differences	✓	✓	✓	✓	✓	✓	✓
Sector modelling through trend analysis or before-after analysis	✓	✓	✓	✓	✓	✓	

Expert consultations

Expert stakeholder consultations will be used when specialised input is required to understand wider impacts at sector level and the local or national innovation system level, and to verify the evidence collected through other methods.

The expert stakeholders are likely to be first engaged for interviews in the early stages of the evaluation. This will help researchers gain a comprehensive understanding of the sector the Catapult is operating in. They may also highlight links and possible impacts to other related sectors.

In addition to using experts to assess the impact of the Catapults' activity on the sector, market-based research may also be undertaken at a later point to supplement this assessment.

Expert stakeholders could also be consulted at a later point, as part of an expert panel, to help interpret and validate the findings emerging from the evaluation. Expert panels are useful when issues are complex, quantification of impact is difficult, and technical expertise is needed to understand impact of complex technologies. They can also identify areas where future rounds of evaluations could focus.

Sector experts will be invited to review, assess and validate impacts identified from quantitative and qualitative methods (as used in the case of the Research Excellence Framework).

Organising an expert panel may be challenging as there may be a limited pool of independent experts to choose from. Particularly in smaller sectors where many experts are already involved with the Catapults, or are board members, or are involved in steering groups that are part of the governance of running the Catapults.

Survey data collection

Evaluations will use surveys, namely beneficiary surveys, to obtain data from businesses that have received support. These surveys will collect standardised information across all respondents[13]. The data will be used to estimate the economic impact of a Catapult and make comparisons about how the programme is impacting on different beneficiary groups.

[13] For more information on surveys, see: http://learningstore.uwex.edu/assets/pdfs/G3658-10.PDF

For some Catapults, a non-beneficiary survey will also be carried out, alongside or instead of data linking, to provide a counterfactual group and help assess additionality. Non-beneficiary firms are identified as those firms which are similar to the beneficiary firms but have not interacted with a Catapult. Their reported business outcomes can be compared to beneficiary firms to estimate the extent to which a Catapult has delivered additional benefits.

Survey findings will help to explain the contribution of a Catapult towards achieving economic impacts and in assessing the theory of change. They can also be valuable in identifying spillover impacts which affect organisations not directly engaged with the Catapults. A key rationale for the Government investing in Catapults is to accelerate the commercialisation of research and innovative projects, which create spillovers and wider impacts[14]. If these are not captured then the impact of the Catapults' will remain underestimated. Surveys can help to identify where spillover impacts are occurring, for example by asking beneficiaries who they have collaborated with on innovation projects. If possible, these businesses can then be contacted to assess the extent to which this collaboration led to additional benefits in other areas of their business, or additional collaborations with other relevant businesses.

[14] Some of the spillovers the Catapults may create are:

- Market spillovers - when a firm creates a new product, or reduces the cost of producing a product, some of the benefits will be passed on to buyers and other firms.
- Knowledge spillovers – knowledge created by one firm is typically not contained within that firm, and thereby creates value for other firms and other firms' customers.
- Network spillovers - relate to interdependencies between certain technologies. As a result of these relationships, each firm pursuing one or more of these related technologies creates economic benefits for other firms and their customers.

Data for Robust Evaluation

In addition to data collected by the independent evaluators, data collected by Catapults is vital for developing a more complete picture of impact at business, industry and economy level.

As strategic priorities for each Catapult are different, there will be an agreed set of data collection in line with each Catapults' specific delivery plan, logic model, and evaluation plan. The evaluation framework has been developed to cover a wide range of impacts. For example, the quality of Catapults' interaction with businesses, universities, other stakeholders and markets; their strategic leadership; the ability to leverage their resources; methods for identifying and managing risk; and wider impacts that their activities generate.

In order to achieve this more complete picture of impact, Catapults will identify indicators that cover each stage of the logic model and show progress against their delivery plans. To illustrate this below we take each stage of the logic model and give some example indicators that may fit in that stage. In practice, each Catapult will need to reflect on its own delivery plan and logic model, working with the evaluators to define a list of indicators that suit them best and meet their evaluation needs.

Inputs: what resources go into Catapult? For most of the existing Catapults there are already systems in place to capture the inputs that are identified in their specific logic model. For this stage, some example indicators include: public investment received, expertise, facilities, and commercial income.

Activities: what activities does a Catapult undertake? These will flow from the delivery plan, including strategic objectives. While some commonality is possible, these will be specific to a Catapult. Some examples for this stage may include: business capability development, events to engage with academics and businesses, and collaborative R&D projects.

Outputs: what results from the activities? The outputs from the Catapults activities are broad and covered in detail within each individual Catapult evaluation framework. Key output indicators will inform the evaluation design and survey work. These relate to details of partners that the Catapult has worked with and the type of activity this has involved. Output information collated by each of the Catapults will feed into the outcome sections below.

Intermediate outcomes: short-term and immediate changes or benefits from Catapult activities. Similar to other stages, the outcomes will also reflect strategic vision, logic models and objectives of individual catapults. The

data list may cover, where applicable, private R&D investment, and the number of patents, new businesses or spin outs that have been launched. As we move into the outcomes elements of the logic model, it is increasingly likely that events occur outside of the Catapults themselves, namely in the businesses they engage with. As such, it might be that these indicators are primarily sourced from evaluation data, rather than in-house data.

Later stage outcomes: longer-term changes or benefits from Catapult activities. These will be explored as part of the longitudinal design of the evaluation (both quantitative and qualitative) to show how intermediate outcomes have translated into new or improved products or processes; with associated employment, revenue, or other performance effects. Also, indicators could measure any cost reductions that have been achieved as a result of the new technologies or standards through resource savings, or the amount of capital investment plus any international effects on exports or foreign direct investment. As before, later stage outcomes will vary between Catapults.

Impact indicators: Impacts such as enhanced business productivity and the wider societal benefits will be derived from the survey results produced by the evaluation and also wider independent data sources, such as ONS for health and carbon impacts, where applicable.

Table 2: Indicators that can show wider impact of the catapult activities (with the exception of funding / income, not all indicators in this list are relevant to all Catapults):

Data item/indicator	Relevance to impact measurement
Collaborative R&D funding, including that leveraged from the private sector	Funding information can help to evaluate the input and activity sections of the logic model.
Commercial income	
Other public funding received	
Sales Order Book (ytd) (contracted work secured but not yet delivered)	To understand the longer term stability of the Catapult
Utilisation of testing facilities (if applicable)	A key activity in the logic model of some Catapults and an aim behind setting up Catapults.
Spin-outs created	This information can be collected to evaluate wider impacts of the Catapults to their sector and the innovation system. Including dissemination, reach and taking a pioneering role.
New processes and products developed	
People benefitting from skills development	
International collaborations	
Academic or trade papers published	
Booked value of Intellectual Property	
Patents registered	

Contact Data

The ability to conduct the evaluation and measure impact requires accurate contact information for businesses, collaborators and experts that have engaged with Catapults. Therefore, it is vital to collect the necessary contact data at the appropriate point of intervention. This would not necessarily mean any engagement, but should focus on instances where the Catapult and company are undertaking some formal activity together. In these instances, all Catapults must ensure sufficient data is collected on those organisations to enable the evaluation framework to be implemented. The table below outlines the minimum data that Catapults needs to put in place at consistent bases to enable evaluation activity.

Table 3: Minimum Data collection summary

Data item	Purpose for collection
Business Name	To contact businesses for case studies and surveys.
Trading and registered address	To understand the link between place and catapult impact.
Contact name and details (e-mail, phone etc)	Business surveys achieve a higher response rate if a named contact is available.
Companies House Number[15]; Unique Taxpayer Reference (for unregistered businesses)[16]	In order to match with ONS data for long-term impact assessment.
Staff (FTE)	To understand the size of businesses engaged in Catapult activities.
Turnover (if trading)	As above
Type of business	Whether from the private sector, public sector, another Catapult, an academic organisation, an international organisation or other.
Type of project / relationship (e.g. collaborative, contracted)	To better understand type of projects being undertaken.

[15] A unique reference number allocated by the Registrar of Companies to a limited liability company or unlimited company at the time of first registration of that company (max. 8 characters). https://www.gov.uk/government/organisations/companies-house .
VAT or PAYE information can be provided if not registered with Companies House.
[16] A unique 10-digit number, https://www.gov.uk/find-lost-utr-number

Data Protection

All data provided to the evaluation researchers and Innovate UK, and the data collected through evaluation activity, will be treated in confidence. Results will be reported in aggregate form and no individuals or businesses will be identifiable, unless previously agreed to (e.g. for case study examples). The evaluation and data collection will take place in accordance with the Data Protection Act 1998 and security measures will be in place for any linking, transfer or sharing of such data. Catapults should ensure that they have data sharing agreements in place that allows for legal and secure transfer of information for evaluation purposes.

Annex A

The following outlines the high level objectives and any developed logic models for the individual Catapults. These objectives are subject to revision following the drafting of scheduled new Delivery Plans and the logic models will be revisited as part of the evaluation process.

Cell and Gene Therapy Catapult (CGTC)

The CGTC was established in 2012 with the core purpose of building a world-leading Cell and Gene Therapy (CGT) industry in the UK, helping CGT organisations across the world to translate early stage research into commercially viable, investable therapies. This involves assisting collaborating organisations throughout their route to market, including providing funding, expertise in research, clinical trials, regulation, and manufacturing. The CGTC's strategic goal is to build a £10bn industry in the UK by:

- Increasing cell therapies in UK clinical trial and clinical use;
- Helping create investible propositions leading to cell and gene therapy companies that succeed and stay in the UK; and
- Demonstrating that the UK is the place to do this work, with increased inward investment.

More information about the CGTC be found at this link https://ct.catapult.org.uk/, and a recently published annual review at https://ct.catapult.org.uk/wp-content/uploads/2016/03/The-Cell-Therapy-Catapult-Annual-Review-2015.pdf.

The strategic objectives as set out in the Cell and Gene Therapy 2013-18 Delivery Plan are:

- Accelerating the journey from concept to commercialisation by removing the technical, commercial, organisational, and regulatory obstacles.
- Connecting the innovation landscape by forming partnerships with key components of the research base to grow and serve the newly developing industry.
- Turning Government action into business opportunity by leveraging reforms put in place to facilitate research in the NHS, making the UK the premier destination worldwide for cell therapy clinical trials.
- Investing in priority themes by ensuring that we pursue cell therapies with maximum health and wealth potential.
- Continuously improving our capability by developing our processes and transferring them to the manufacturing base.

The delivery plan explains that the routes that the Cell Therapy Catapult will grow the industry in the UK to substantial and sustainable levels are by:

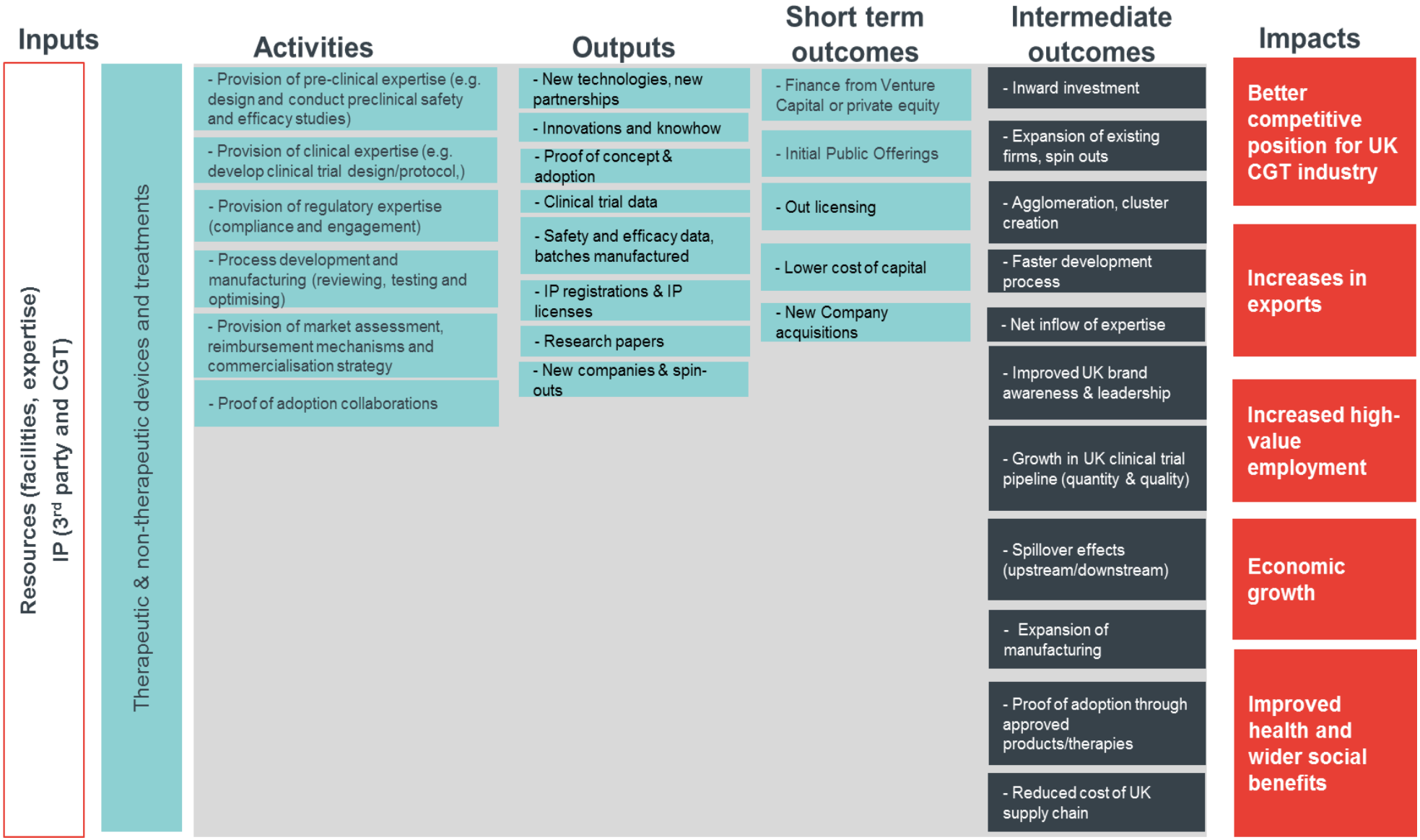
- Taking products into early-stage clinical trials and de-risking them for subsequent commercial investment.
- Providing clinical expertise and access to NHS clinical partners.
- Providing technical expertise and infrastructure to ensure products can be consistently made to GMP and delivered cost effectively.
- Providing regulatory expertise to ensure that products can get to the clinic safely and in the shortest time possible, and also obtain subsequent approval for use.
- Providing opportunities for collaboration, both nationally and globally.
- Providing access to business expertise, and preparation for investment so that commercially viable products are progressed and investable propositions are generated.

Medicines Discovery Catapult (MDC)

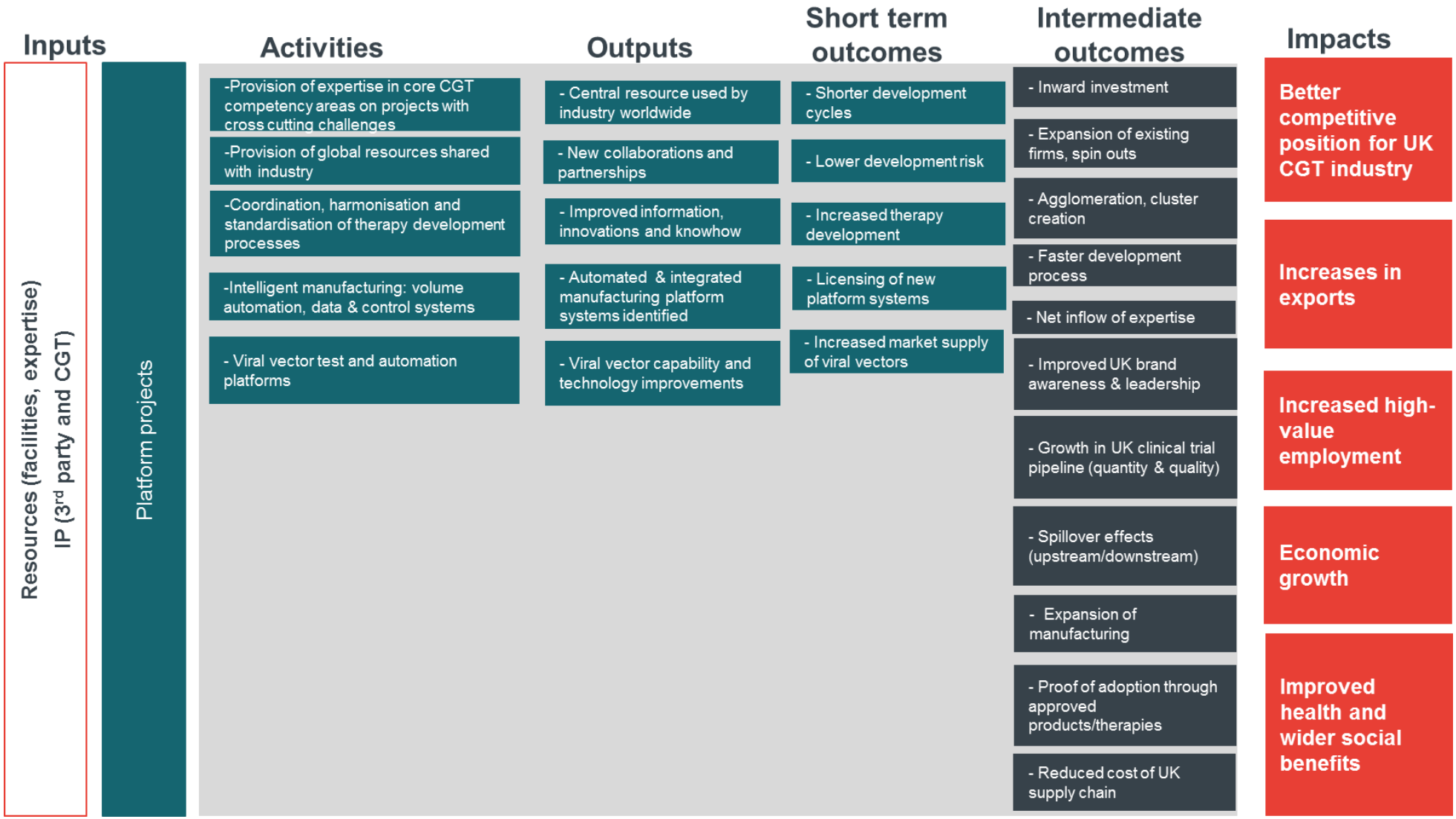
The MDC was established in April 2016 at Alderley Park in Cheshire. The MDC aims to develop and validate new ways of discovering new medicines and supporting this key UK strength in pharmaceutical, biotechnology and contract research organisations. Its lab facilities at Alderley Park are open for use by all its partners, and include cell culture labs, physical measurement labs including mass spectrometry and multiple methods of bioanalysis and an extensive range of in vivo labs with facilities for surgery, drug administration and continuous sampling. Further information about the MDC is available at this link https://md.catapult.org.uk/.

As the MDC is relatively new, they have yet to have their evaluation framework scoped and logic model developed. The logic models that have been developed for CGTC are shown on the following pages.

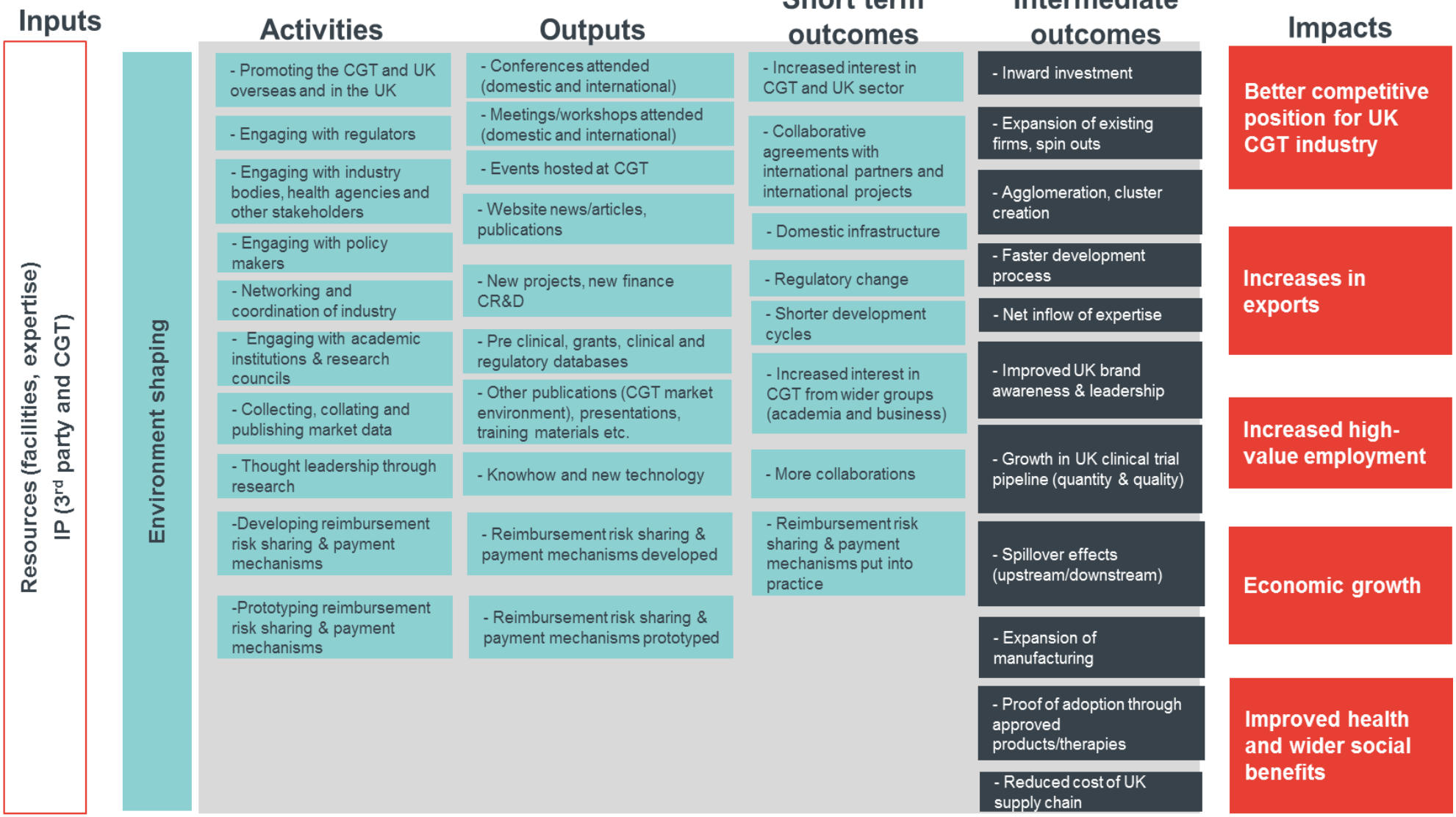
Cell (and Gene) Therapy Catapult Logic Model for **therapeutics & non-therapeutics projects**– *taken from an unpublished report by Frontier Economics (January 2017)*



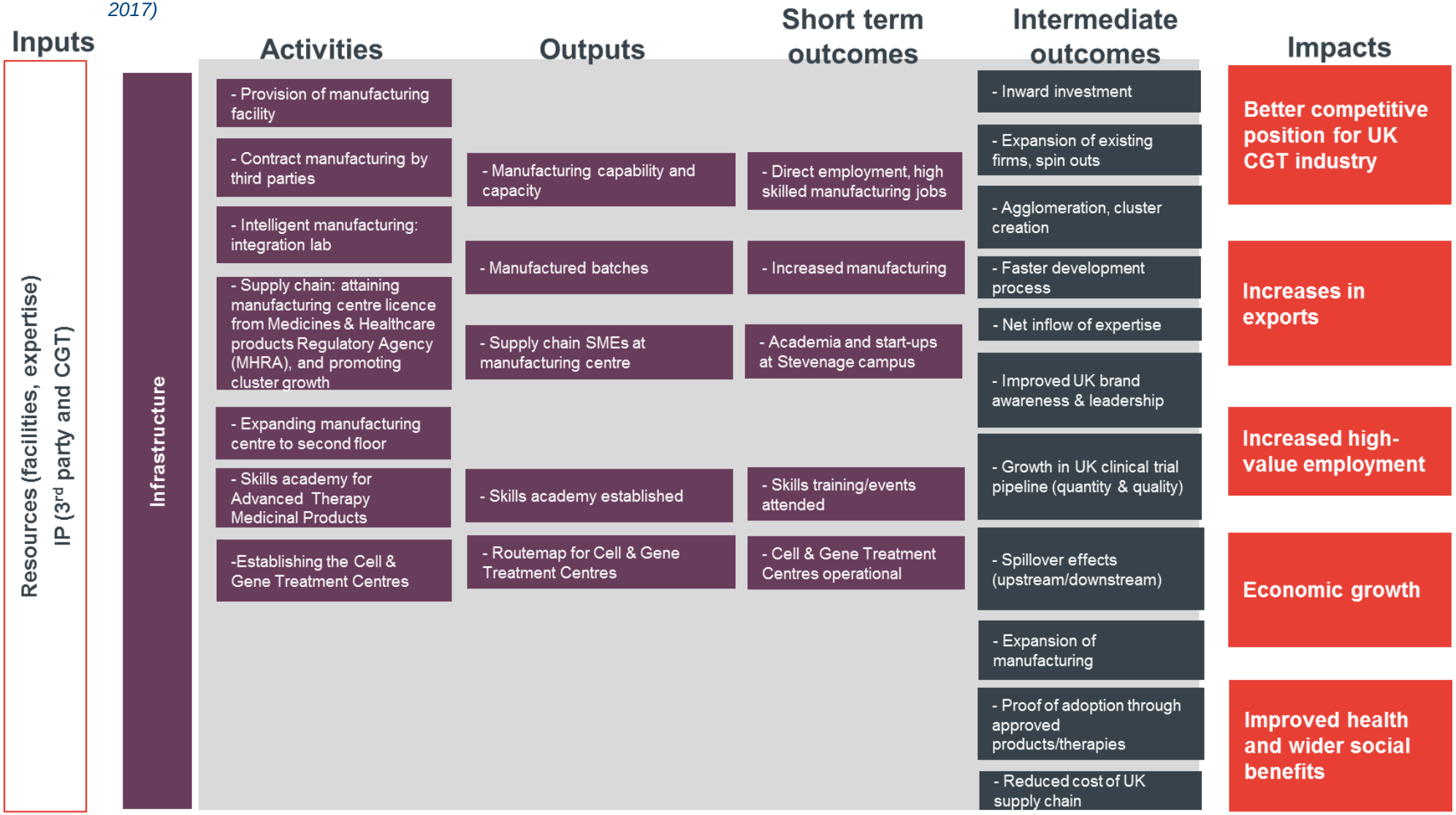
Cell (and Gene) Therapy Catapult Logic Model for **Platform Projects** – *taken from an unpublished report by Frontier Economics (January 2017)*



Cell (and Gene) Therapy Catapult Logic Model for **Environment Shaping** – *taken from an unpublished report by Frontier Economics (January 2017)*



Cell (and Gene) Therapy Catapult Logic Model for **Infrastructure** – *taken from an unpublished report by Frontier Economics (January 2017)*



High Value Manufacturing Catapult

The High Value Manufacturing Catapult (HVM Catapult) brings together a network of seven specialist innovation Centres[17] across the UK, with expertise spanning from the processing of basic raw materials, through to high integrity product assembly processes. More information about the HVMC can be found at this link https://hvm.catapult.org.uk/.

The long-term goal of the HVM Catapult is to grow the contribution of the manufacturing sector to the UK economy by helping to accelerate new concepts to commercial reality. To achieve this, the HVM Catapult provides businesses with the facilities, people, networks, and skills to scale-up and prove-out high value manufacturing processes, moving projects through the Technology and Manufacturing Readiness Levels 4-7.

The strategic objectives, as set out in the HVMC 2016-17 Delivery Plan, are:

To improve the competitiveness and business performance of its stakeholders by providing novel and effective technology solutions across a range of manufacturing sectors in order to:

- Enable higher growth rates in manufacturing within the UK.
- Grow the HVM Catapult in a way that supports the manufacturing sector and to grow UK based industries.
- Support the creation and sustenance of the HVM Catapult assets to provide the cutting edge equipment and the skilled resources that UK businesses need to commercialise their world class technologies.
- Ensure a higher proportion of globally available manufacturing opportunities are secured by the UK.
- Attract inward investment to set up UK manufacturing capabilities and to re-shore manufacturing in the UK
- Support the growth of manufacturing gross value added (GVA) within the UK economy

To stimulate and de-risk investment in innovation, accelerate growth and anchor high value development activity in the UK by:

- Providing businesses with access to leading-edge technology and expertise, and a route to input into the debate on where public investment can be of most value.
- Reaching into the knowledge base for world leading science and engineering by building strong partnerships with academia and the Research Councils.

[17] The Centres are: Advanced Forming Research Centre (AFRC); Advanced Manufacturing Research Centre (AMRC); Centre for Process Innovation (CPI); Manufacturing Technology Centre (MTC); Nuclear Advanced Manufacturing Research Centre (NAMRC); National Composites Centre (NCC); and the Catapult Centre at Warwick Manufacturing Group (WMG).

- Undertaking collaborative research and development projects with businesses, including contract research and development.
- Being strongly business focussed with a highly professional delivery ethos.
- Creating a critical mass of activity between businesses and the research base.
- Providing a platform for skills development at all levels.

To sustain HVM Catapult as a networked group of physical centres that bring together expertise, equipment and skills to help new and existing businesses accelerate the commercialisation of innovative technologies that focus on:

- Securing UK manufacturing technologies against scarcity of energy and other resources.
- Increasing the global competitiveness of UK manufacturing technologies.
- Exploiting new technologies to design and develop products and processes faster.

A summary logic model for the HVM Catapult as a whole was developed when scoping the evaluation framework and is shown on the following page.

High Value Manufacturing Catapult Summary Logic Model – *taken from an unpublished report by SQW (April 2016)*

Context	Activities	Outputs	Outcomes
Market failures preventing investment in innovation by UK manufacturing firms, risk, uncertainty externalities. *Increasingly competitive international market for high value manufacturing investment, talent & R&D* ↓ **Objectives** *Grow the contribution of the manufacturing sector to the UK economy.* *Accelerate products and processes from concept to commercial reality* ↓ **Inputs** *Annual expenditure of c.£220m p.a., on third-third-third model* *Headcount of* *c.1,800 staff*	**Strand 1: Industry Support** • Product/process research and development (incl. collaborative R&D and commercial research projects) • Business capacity development • Facilities • Relationship development	• New and/or improved products and process developed • Business investment • Skills enhancement • New relationships • New businesses created • Funding bids submitted • Business cases made / rejected	• Product and process improvement • Business innovation capacity and capability • Business performance improvements • Investment and funding leverage • Business resilience • Environmental performance • Sector wide outcomes e.g. GVA
	Strand 2: Strategic Leadership • 'Doing' through undertaking research and strategy development etc. • 'Thinking' through policy engagement, horizon scanning etc. • 'Connecting' through hosting events, involvement in industry groups/panels etc.	• Research outputs produced • Though leadership publications • Interactions with organisations & agencies developing industry regulations and standards • Connections made	• Changes to behaviours, attitudes and investment of industry base • Influence of policy and research • Resilience of the sector and supply chains
	Strand 3: Competence Development • Delivery of training and on-the-job learning/knowledge transfer • Studentships • Placements • Apprenticeships	• Staff engaged in training / competence development • Qualifications • Employment	• Improved individual skills / employment • Sector wide outcomes e.g. upskilled workforce

Transport Systems Catapult (TSC)

The TSC was established in 2013 to tackle the dual challenges of under investment and rising congestion across all transport modes and transportation networks. The TSC works with the industry to develop solutions that focus on Intelligent Mobility (IM) using new and emerging innovations and technologies to transport people and goods more efficiently. With a clear emphasis on collaboration, the TSC brings together complex and diverse organisations across different modes, networks and systems of transport and connecting infrastructure. The aim is to overcome barriers to innovation by providing a unique platform for meeting the world's most pressing transport challenges in a changing and congested world. More information can be found at https://ts.catapult.org.uk/.

The TSC has three main categories of activity:

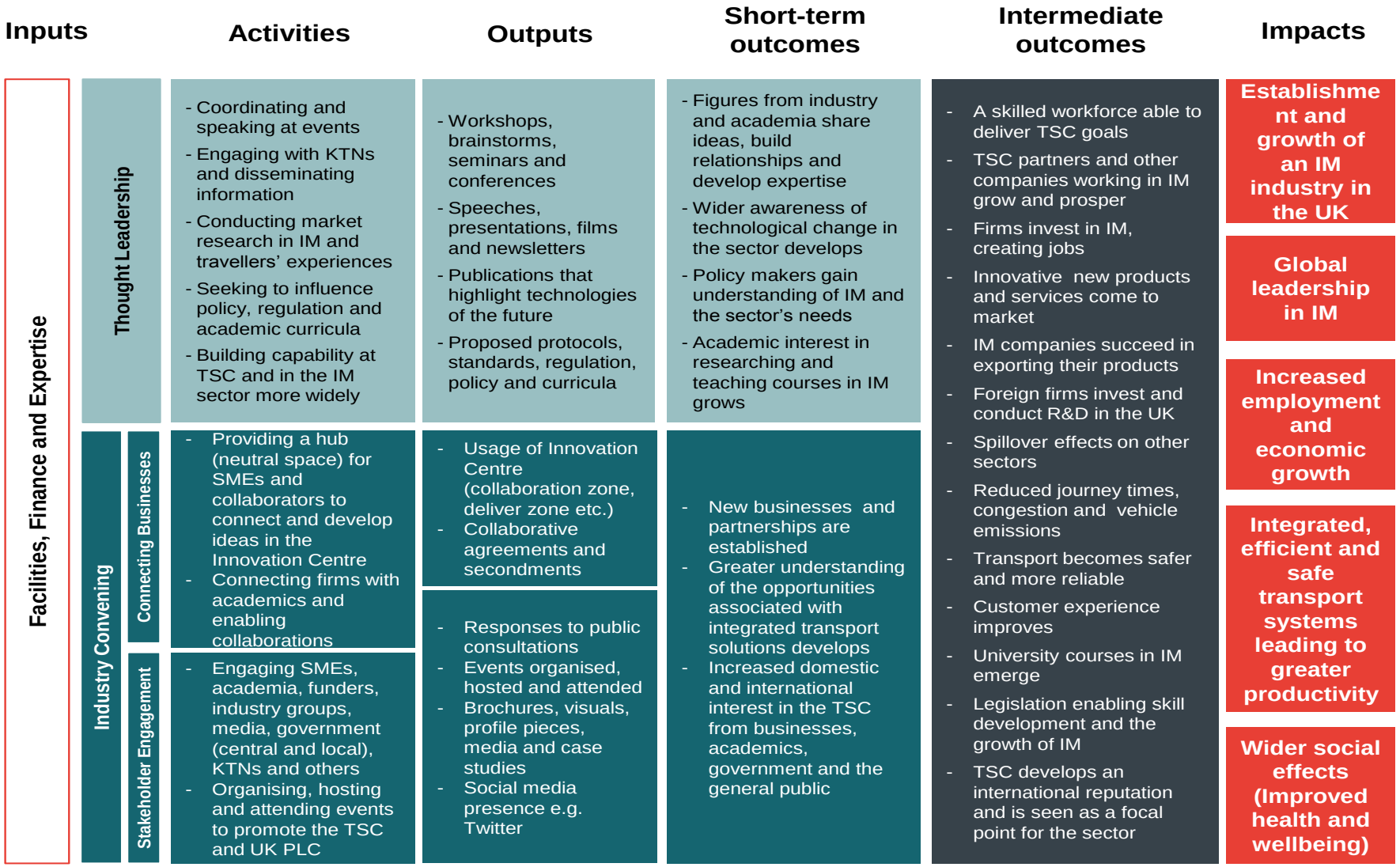
- Thought Leadership: creating, leading, gathering and disseminating expertise and knowledge on IM in order to influence and shape the future direction for new and existing businesses and industries through technical strategies and unique assets.

- Industry Convening: connecting people and businesses with an interest in the wider aspects of IM to share knowledge, and influencing collaboration in order to pursue common interests. In addition to connecting businesses with potential collaborators and industry partners, the TSC provides a focal point for the wider opportunities of, and enabling innovation and technology in, the IM sector through national and international stakeholder engagement and partnerships.

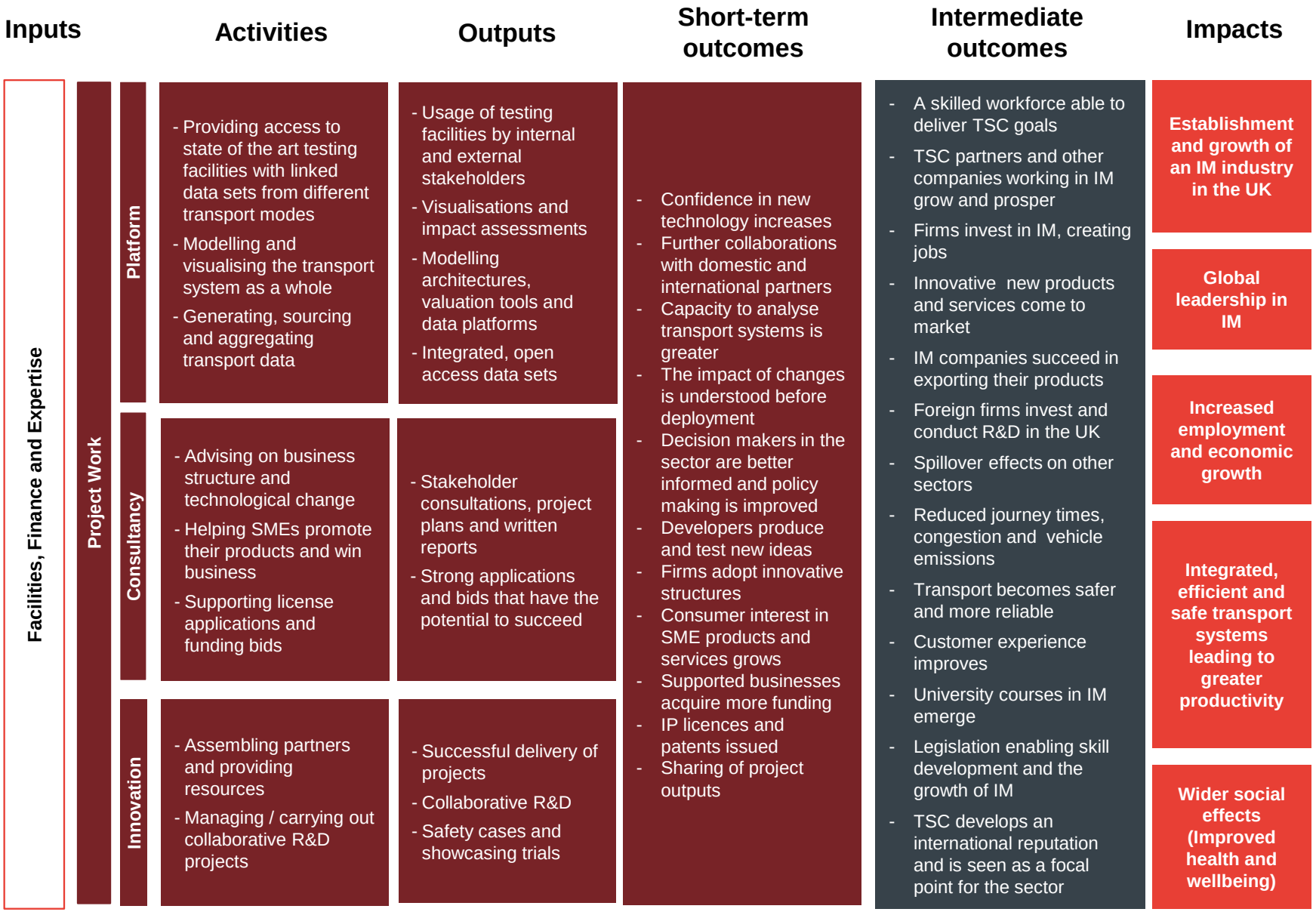
- Project Work: the TSC performs three types of project work. Platform projects aim to achieve industry-wide benefits in areas where no individual player has sufficient incentive to invest. Consultancy involves assisting private enterprises to address specific business challenges. Innovation projects focus on the development of new technology.

The logic models that were developed for TSC, covering these areas of activity, can be found on the following pages.

Transport Systems Catapult Logic Model for **Thought Leadership and Industry Convening** – *taken from an unpublished report by Frontier Economics (March 2016)*



Transport Systems Catapult Logic Model for **Project Work** – *taken from an unpublished report by Frontier Economics (March 2016)*



Future Cities Catapult (FCC)

The FCC was established at the end of 2013 and is based in London, at the Urban Innovation Centre. The FCC aims to be a global centre of excellence on urban innovation; a place where businesses, universities and city administrations come together to develop solutions to the future needs of cities. Its role is to help UK businesses create the products and services that cities across the world need if they are to have a strong economy, a resilient environment and an improved quality of life. Its primary focus is on the challenge of urban integration: how cities can take a more joined-up approach to the way they plan and operate. Innovating integrated city solutions, and the products and services that enable them, presents a huge global opportunity and is an area where the UK has significant strengths. Further information about the FCC can be found at http://futurecities.catapult.org.uk/.

The FCC has three main categories of activity:

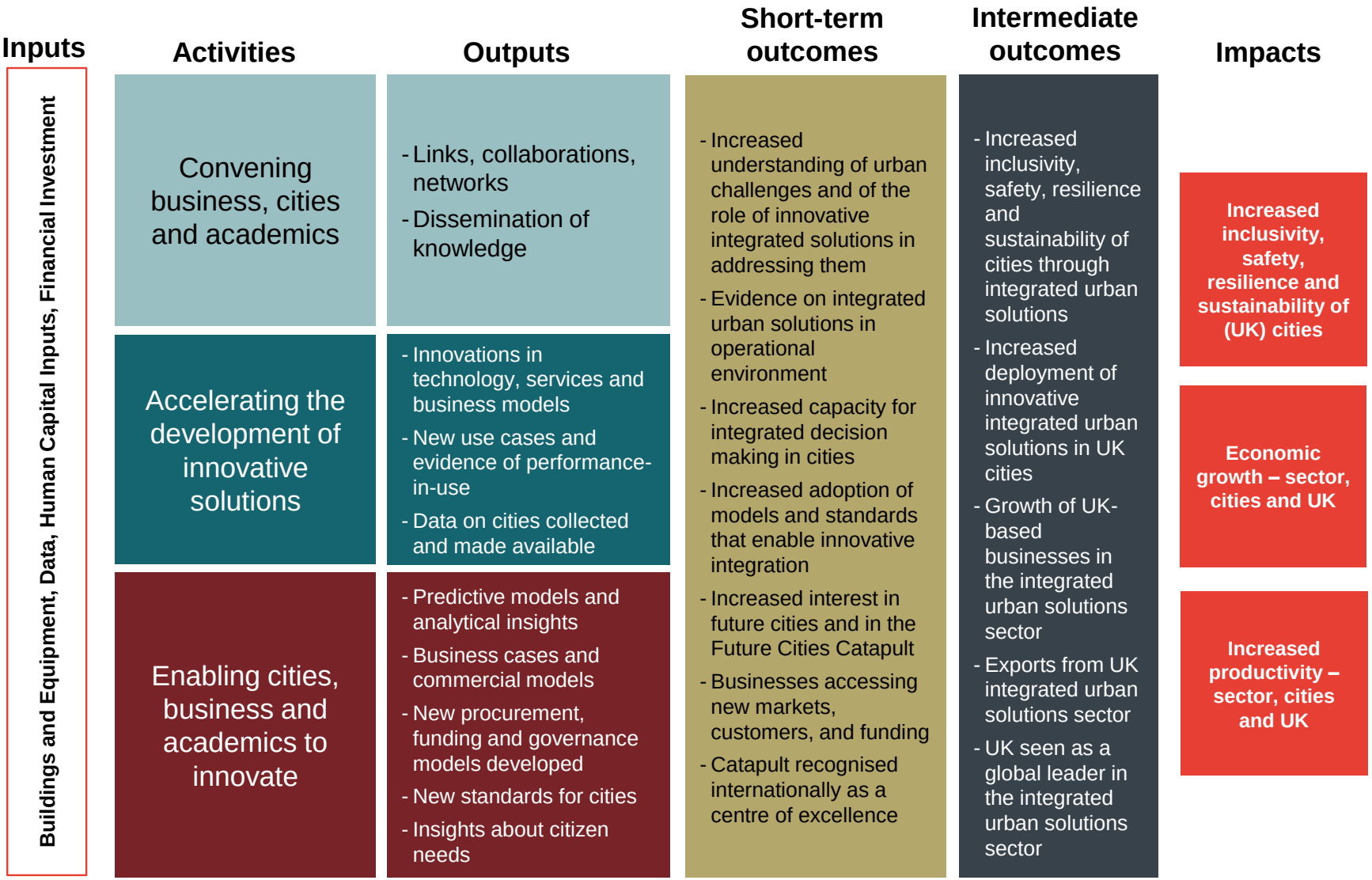
- Convening businesses, cities, academics: the Catapult organises and attends events, engages stakeholders, fosters collaboration and provides a space for collaborators in the Urban Innovation Centre. It supports the Cities Standards Institute- a joint venture with the British Standards Institute. The convening activities of the Catapult mainly aim to overcome coordination failures, but also address information failures by sharing knowledge on cities, citizens' needs and integrated solutions.

- Accelerating the development of innovative solutions: the Catapult is involved first hand in projects that aim to overcome information failures by: demonstrating integrated solutions at scale; generating information on cities and on citizens' needs; and improving the flow of information on cities and citizens' needs.

- Enabling innovation: providing expertise to enable cities and business to develop effective solutions. This work aims to overcome coordination failures – individual organisations may not have a sufficient incentive to invest in developing new techniques to assess the case for integration, or in modelling capabilities that can predict the effects of integration; and information failures – individual cities may not have sufficient resources to understand how integration could solve or mitigate some of the issues they are faced with.

The logic model developed for FCC can be found on the following page.

Future Cities Catapult Overview Logic Model – *taken from an unpublished report by Frontier Economics (March 2016)*



Offshore Renewable Energy Catapult (OREC)

The OREC began operations in early 2013 with its head office located in Glasgow and a focus on wind, tidal, and wave energy. In 2014, the Catapult merged with the former National Renewable Energy Centre (NAREC) based in Blyth which is where most of the Catapult's testing facilities are now located. The Catapult's vision is of 'abundant, affordable energy from offshore wind, wave and tide.' To realise this vision, the Catapult defines its main mission as to 'Accelerate the development, testing, commercialisation and deployment of offshore renewable energy technologies, enabling a vibrant sector driven by research and innovation, collaboration and enhanced knowledge, which generates affordable, low carbon power and considerable UK economic benefit.' Further information about the OREC can be found at https://ore.catapult.org.uk/.

The OREC services that support the development of the offshore renewable energy sector can be broadly grouped into:

- Collaborative R&D (CR&D): The Catapult regularly engages in R&D projects with clients ranging from academia to large industrial groups. Additionally, the Catapult leads and initiates Joint Industry Programmes with a view to increasing R&D cooperation in the offshore renewable energy industry.

- Testing and assurance: In addition to using its testing facilities for its own R&D projects, the Catapult also allows other industry stakeholders to use these facilities for reliability, design or life testing of the developed technology in question.

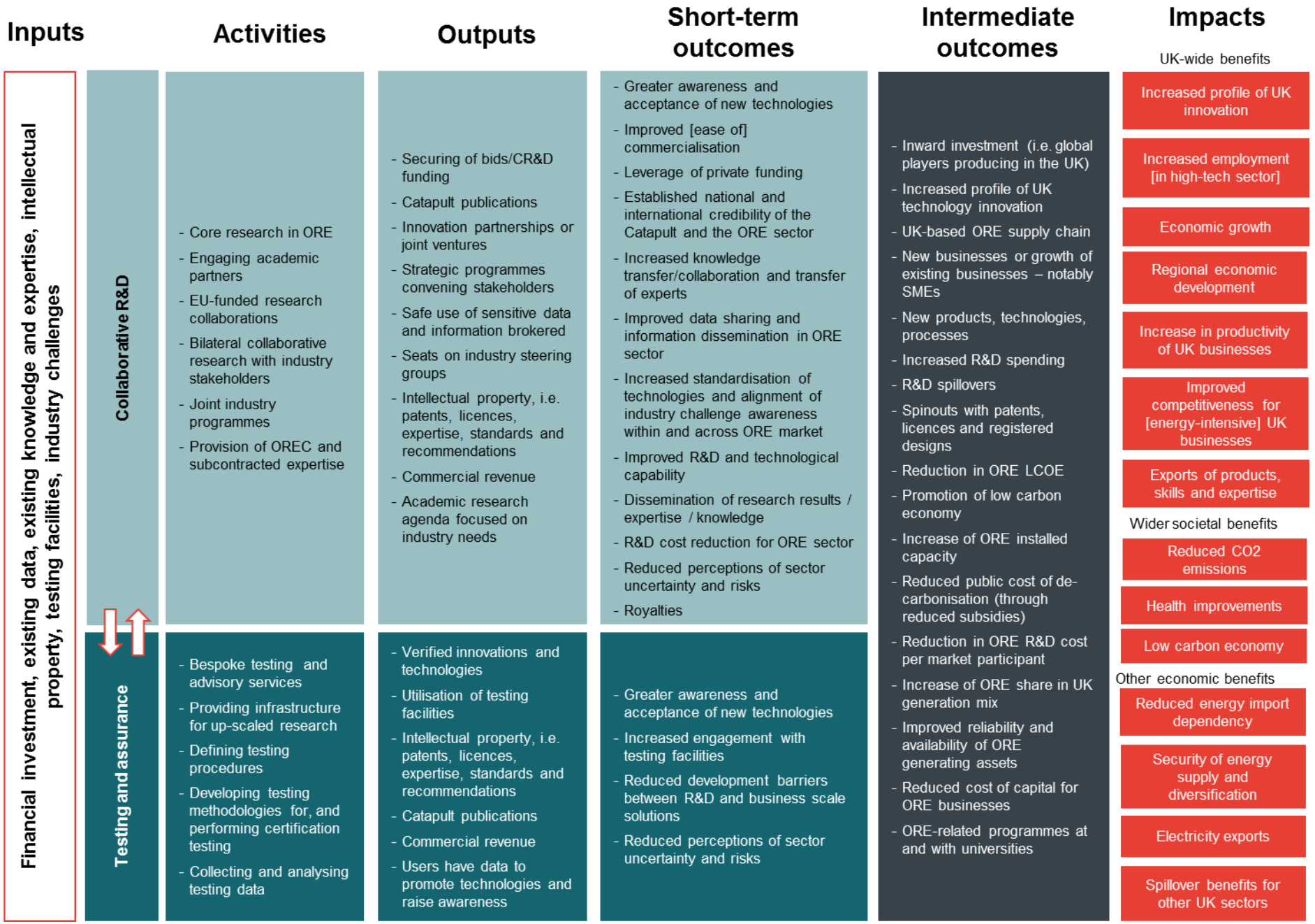
- Commercialisation: To develop the offshore renewable energy sector faster and more efficiently, the Catapult offers commercialisation support to its clients. These projects can range from support for early-stage technologies, for instance developed by an SME, to the commercialisation of products and services developed in-house.

- Thought leadership: Using internal expertise and knowledge gained from R&D projects, testing activities or commercialisation support, the OREC engages in numerous activities to accelerate the growth of the offshore renewable energy sector through an increased focus on identifying the industry's needs for sustained mid- to long-term development.

The logic models that were developed for OREC, covering these areas of activity, can be found on the following pages.

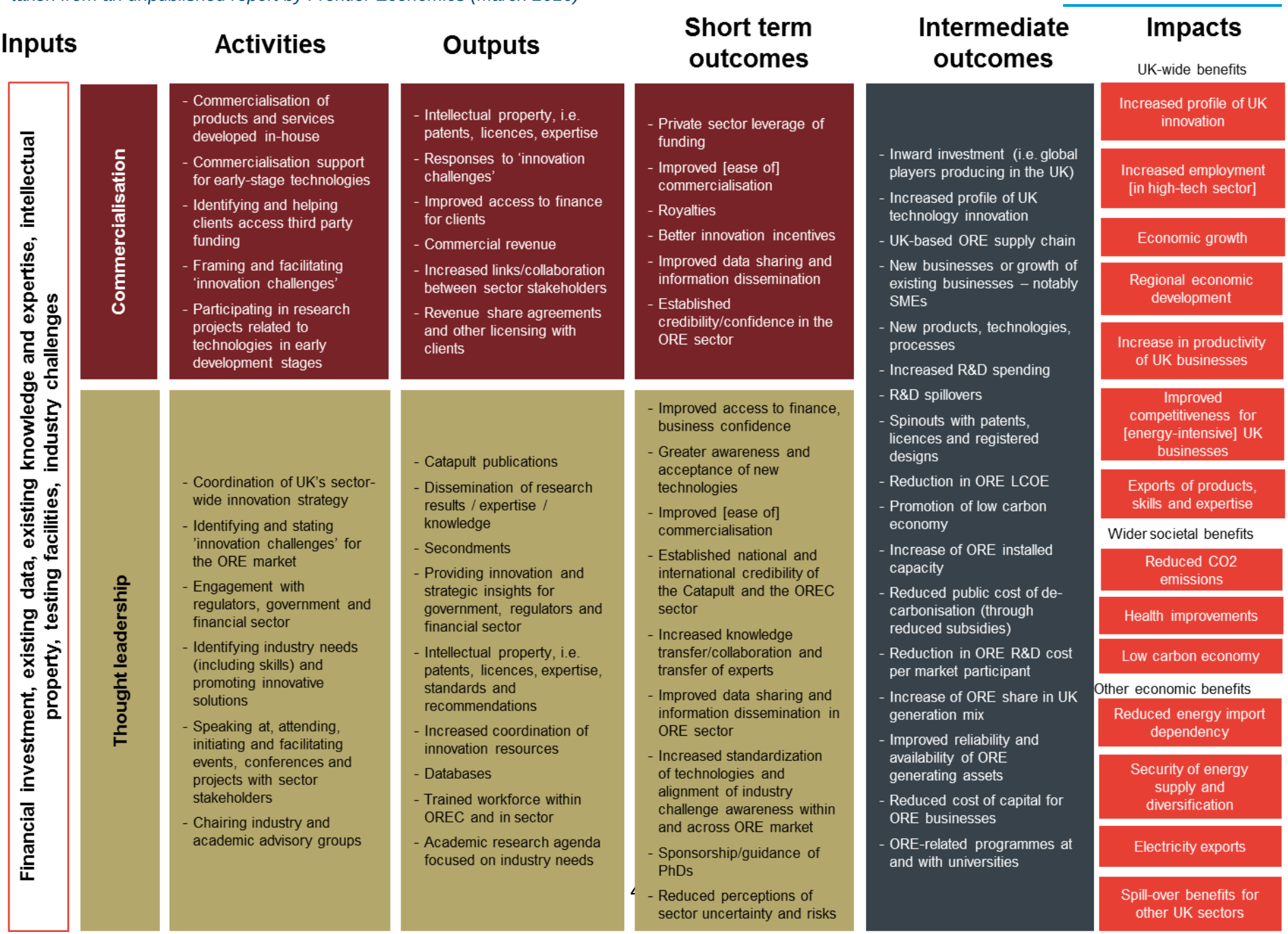
Offshore Renewable Energy Catapult Logic Model for **Collaborative R&D and Testing and Assurance** –

taken from an unpublished report by Frontier Economics (March 2016)



Offshore Renewable Energy Catapult Logic Model for **Commercialisation and Thought Leadership –**

taken from an unpublished report by Frontier Economics (March 2016)



Energy Systems Catapult (ESC)

The ESC was formally created in April 2015, making it the newest of the Infrastructure Systems Catapults. The ESC aims to bring the worlds of industry, academia and Government together to build consensus on the transition pathways to a future energy system, and to accelerate the development of new technology-based products and services in the energy sector. It will position the UK as a global leader in building industries and business models to respond to the challenge of building a connected energy system, opening new export markets. Further details of the ESC can be found at https://es.catapult.org.uk/.

The Catapult's activities are still evolving but are built around three strategic capability areas. Each is targeted at a specific area where intervention will have the greatest leverage in building new energy markets and driving economic growth.

- Develop whole systems expertise – the ESC will establish a whole energy system analysis capability through in-house development and engagement with Industry, Academia and Government

- Build tools that help innovators connect with the system – this will support new market development and create a range of offers to smaller companies. The aim is to establish an innovation capability covering systems integration, multi-vector architectures, consumer insights and knowledge exchange.

- Demonstration capability - in the development, deployment and management of large-scale, multi stakeholder, real world demonstration and scale-up environments. This will involve delivering the large-scale demonstration phase of the Smart Systems and Heat programme and evolve the learning and tools for multi-vector system validation.

As the ESC is a relatively new Catapult, it is yet to have its evaluation framework scoped and logic model developed.

Satellite Applications Catapult (SAC)

The SAC was established in May 2013 and is located at Harwell. The Catapult promotes, develops and facilitates the commercialisation and advancement of the satellite applications industry. It is closely aligned with the UK Space sector and works with the UK Space Agency. The Innovation and Growth Strategy Growth Action Plan (GAP) set a target for UK Space related revenue of £40bn by 2030 with an interim target of £19bn revenue by 2020. By 2030, the Catapult aims to contribute c. £4-5bn of industry growth. More information on the Satellite Applications Catapult can be found at https://sa.catapult.org.uk/ and https://sa.catapult.org.uk/wp-content/uploads/2016/04/Delivery-Plan-Public-version-March-2015.pdf.

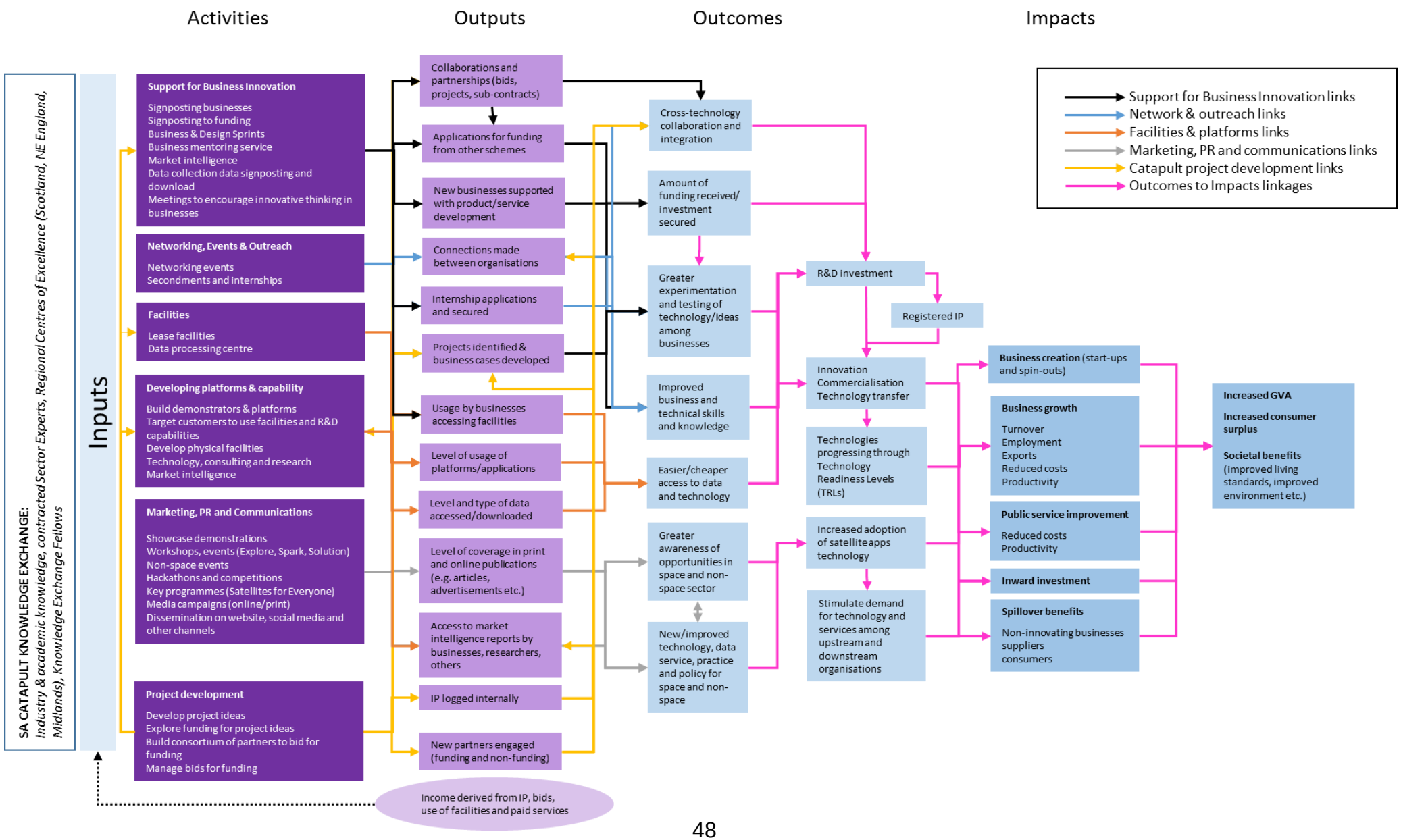
The SAC supports businesses and other organisations through its activities organised under three strategic elements:

- Enabling Business - to support businesses (of all sizes) to access and develop opportunities in the space sector
- Energising the Market - to stimulate demand for satellite technology (both latent and new demand)
- Empowering the Technology - to assist in the commercialisation of satellite technology and develop market expertise to allow both space and non-space sector organisations to utilise satellite assets, services or data.

The SAC's activities span a number of sectors such as maritime, transport systems, agriculture and others.

The logic model developed for SAC, covering these areas of activity, is shown on the following page.

Satellite Applications Catapult Logic Model– *taken from an unpublished report by SQW (January 2017)*



Digital Catapult (DC)

The DC was established in 2013 and its head office is based in London near Kings Cross, with other offices situated in Brighton, the North East and Tees valley (Sunderland), Northern Ireland (Belfast) and Yorkshire (Bradford). The DC has been established to support digital innovation across the UK economy in activities that rely on digital technologies and data to deliver new or significantly improved products, services, processes, or new organisational methods. In the first phase the focus was on data and its application across all industry sectors, where the DC had originally identified four 'challenge areas' or areas of opportunity:

- Organisations sharing and mixing closed datasets;
- Sharing and use of personal data, that is, of data relating to a specific individual where the individual is identified or identifiable in the hands of a recipient of the data;
- Sharing digital creative content; and
- Sharing data generated across the Internet of Things (IoT) in the UK.

The DC is in the process of changing its strategy and has identified four technologies for particular focus;

- Data-Driven**:** new ways to work with personal data with more control and trust; applications of blockchain and smart contracts; cybersecurity, particularly for emergent threats
- Connected**:** the internet of things and associated enabling networking technologies, such as low-power wide-area networks and 5G
- Intelligent**:** artificial intelligence and machine learning
- Immersive: augmented, virtual and mixed reality, and related new forms of human machine interface

These are applied across the economy, but with a likely specific focus in three market sectors:

- *Digital Manufacturing* - Accelerating adoption of digital technologies to increase productivity and the creation of new value in UK manufacturing. Enabling adoption of digital technologies in the production process, in the supply chain and in the life cycle of products.
- *Digital Health and Care* - Enabling people to live longer, happier, healthier lives through digital technology.
- *Creative Industries* - Making the UK the best place in the world to create content for Virtual Reality. Creating new markets for the UK's Creative Industries using emerging digital technologies such as blockchain and smart contracts, virtual, augmented and mixed reality systems.

Further information about DC can be found at https://digital.catapult.org.uk/.

The overview logic model for the DC can be found on the following page.

Digital Catapult Overview Logic Model – *taken from an unpublished report by Frontier Economics (January 2017)*

Inputs

Financial investment, human capital, facilities, existing data, research, partnerships, in-kind contributions

Activities

1. Support for Business Innovation

- Open Innovation processes between larger corporates and start-ups.
- EU, International or UK collaborative R&D projects
- Convening around the creation of standards
- Co-creation of open source code libraries and other forms of technology innovation solutions

2. Facilities

- Provide large-scale test beds
- Providing access to equipment, skills and space

3. Engagement, events and market intelligence

- Ecosystems convening and facilitating conversations across sectors
- Coordinated market led analysis that lead to policy recommendations

Outputs

1. Support for Business Innovation

- Provide pit-stops and open calls to facilitate commercial opportunities and sign-post potential market information opportunities between large and emerging companies.
- Advance solutions through expert input in national and international R&D projects.
- Leverage role as 'neutral convenor' to accelerate development of standards.
- Collaborate with ODI and other partners to facilitate data exchange and reduce risks.

2. Facilities

- Provide accessible infrastructure to enable prototype and scale up testing of new products
- Create leading edge immersive production and demonstration facilities

3. Engagement, events and market intelligence

- Collaborate with others in digital and innovation space to share knowledge and information
- To draw on expert network and harness internal capability to produce leading market analysis of current and future themes.

Outcomes

Industry Collaboration

- Growth of existing businesses
- New products and services launched to market
- Match contributions to our work

Capability Development

- Others replicating or building on our work

Strategic Leadership

- Acceleration and creation of standards and policies
- Increase number of applied proofs of concepts and accelerate innovation transactions

Impacts

GVA growth
Societal benefits
Productivity

Compound Semiconductor Applications Catapult (CSAC)

The CSAC will be up and running in 2017, located in Wales. Compound semiconductors are at the heart of many devices we use today; from smartphones to tablets and satellite communication systems. They are central to development of the 5G network, new high-efficiency lighting, the next generation of electric vehicles and new imaging techniques for a variety of uses, from security to health diagnostics. The global market for compound semiconductors is expected to be £125 billion by 2025 and the UK has the potential to access a significant proportion of this thanks to its world-class research base in this field, which has led to the creation of many companies along the value chain.

The CSAC will accelerate the use of compound semiconductor devices within five key areas of application: healthcare, the digital economy, energy, transport, and defence and security. It will operate 'post foundry', focussing on challenges around four technology streams: power electronics, RF/microwave (e.g. wireless), photonics (e.g. opto-electronics) and sensors. It will complement recent investments in the Institute of Compound Semiconductors at Cardiff University and the Compound Semiconductor Centre (a joint venture between Cardiff University and IQE), helping to establish the world's first compound semiconductor cluster in South Wales. It will operate as an open-access facility, welcoming enquiries from start-ups and SMEs to larger companies, and will work with relevant academic departments across the UK.

More information on the CSAC can be found at https://www.catapult.org.uk/catapult-centres/compound-semiconductor-applications-catapult/.

As the CASC is not yet established, it is yet to have its evaluation framework scoped and logic model developed.