Mapping the Cognitive Landscape of Productivity in Northern Ireland: A Systems Approach to Understanding Productivity Policy

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About PIN

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1. Introduction

Key points:

- The persistent low growth of productivity since the 2008 Financial Crisis has been identified as a "puzzle" with wide-ranging implications for economic growth and wellbeing.
- Northern Ireland regularly lags UK averages on productivity performance and has also experienced stagnating productivity growth rates.
- Despite being central to both UK and Northern Ireland public policy, to date interventions have had little effect on productivity outcomes.
- Adopting a systems lens on the productivity puzzle may help identify policy bottlenecks and opportunities.

Productivity is a core concept in economics and a key determinant of economic prosperity. It measures how effectively resources and factors are utilised in the production of goods and services, including all of the interactions with, and roles played by, the market, technological, institutional and cultural setting. Boosting productivity has become a policy objective across most developed economies and is central to the UK Industrial Strategy. In the UK, the persistence of the so-called "productivity puzzle" – a condition of stagnating productivity growth even in the wake of economic recovery following the 2008 Financial Crisis – has prompted lively debate and investment in initiatives like the Productivity Insights Network (PIN) to generate a better understanding of productivity dynamics and underpin policy innovation. Northern Ireland is also experiencing productivity lags that have catalysed policy action (see Box 1).

Box 1: The UK Productivity Puzzle

Stagnating productivity growth

Across most standard measures, productivity growth has declined since the Financial Crisis. Recent data shows that UK labour productivity growth has slowed significantly – hovering at around 1% annually or lower when it had historically grown at 2% prior to the crisis (ONS 2019). This slowdown has been so significant that the Royal Statistical Society in 2019 named the 0.3% estimate of average annual UK productivity in the decade since the Financial Crisis as the UK "statistic of the decade" citing its extremely serious knock-on effects on government revenues, business competitiveness, and overall incomes (Grant 2019).

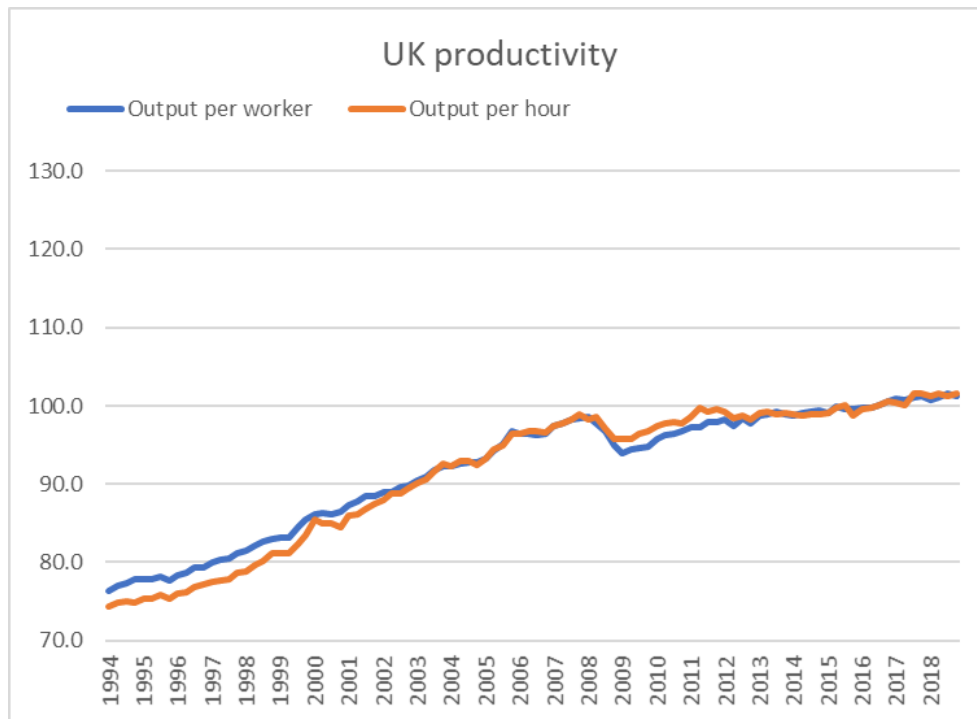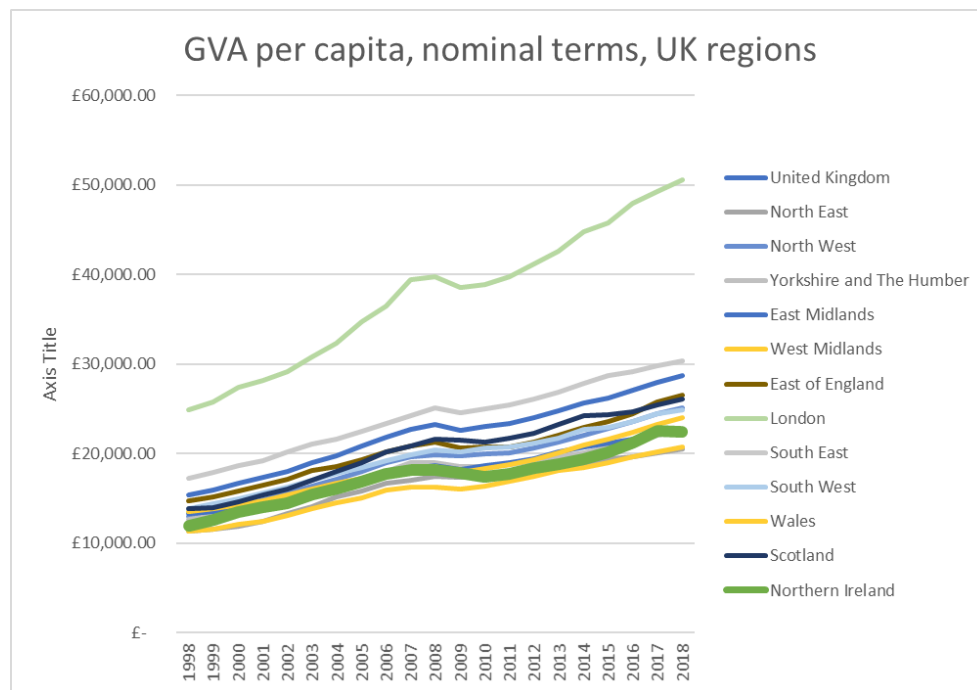*Figure 1 UK Productivity, Output per worker and output per hour, 1994-2018*

Figure 2 GVA per capita, nominal terms, by UK region, 1998-2018

Source: ONS Regional and Subregional Productivity Release (February 2019).

A Northern Ireland productivity puzzle

Northern Ireland's economy has also been affected by this overall slowdown in productivity growth. Northern Ireland has tended to lag UK averages in terms of productivity performance. Recent data shows that Northern Ireland's labour productivity has been 16-17% below the UK average.

Figure 3 Labour productivity (GVA per hour worked) by NUTS1 region

Labour producitivity (gross value added per hour worked) by NUTS1 region, unsmoothed, current prices, 2018
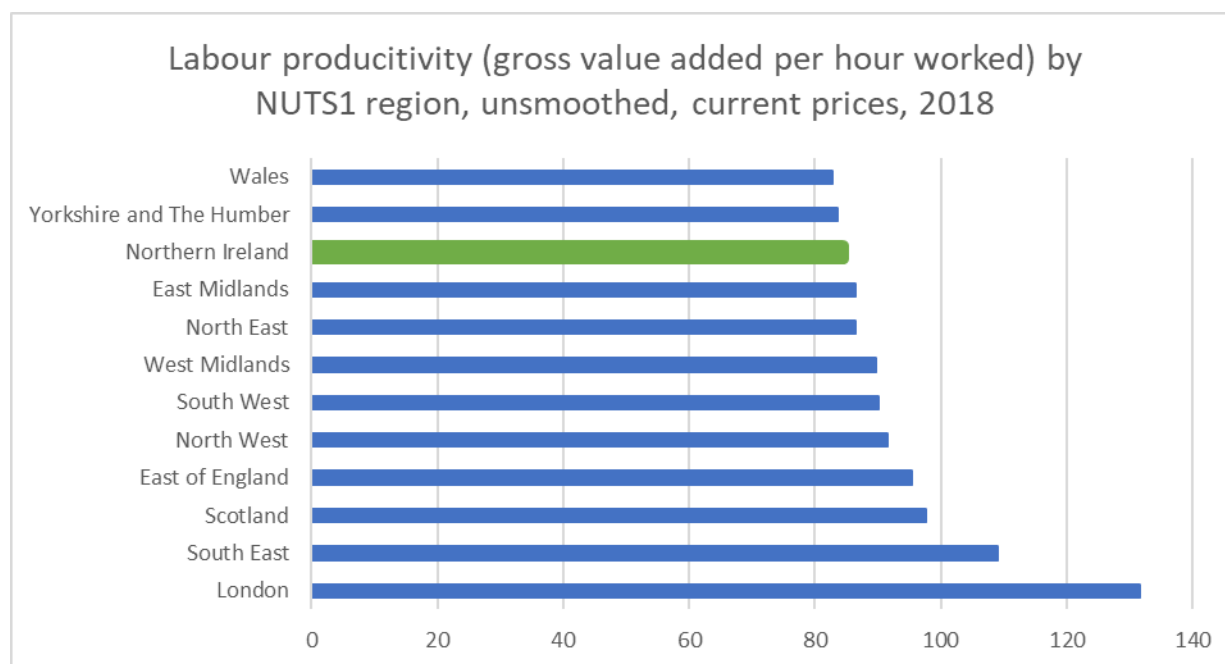
Source: ONS Regional and Subregional Productivity Release (February 2019).

The Northern Ireland Economy 2030 Industrial Strategy describes productivity as a key long-term indicator of Northern Ireland's competitive position, and a core objective of the strategy is to accelerate the pace of productivity improvements (Northern Ireland Department for the Economy 2017, 5). In this context, understanding how to effectively target Government interventions to further these aims is of paramount interest to policy makers. This joint project between DfE and PIN aimed to uncover gaps in our understanding of the factors that influence productivity outcomes and how these may be affecting policy practice.

FIVE PILLARS OF THE NORTHERN IRELAND ECONOMY 2030 INDUSTRIAL STRATEGY

VISION FOR 2030
"To be a globally competitive economy that works for everyone"

Accelerating **Innovation** and **Research**		Enhancing **Education, Skills,** and **Employability**		Driving **Inclusive, Sustainable Growth**		Succeeding in **Global Markets**		Building the Best **Economic Infrastructure**
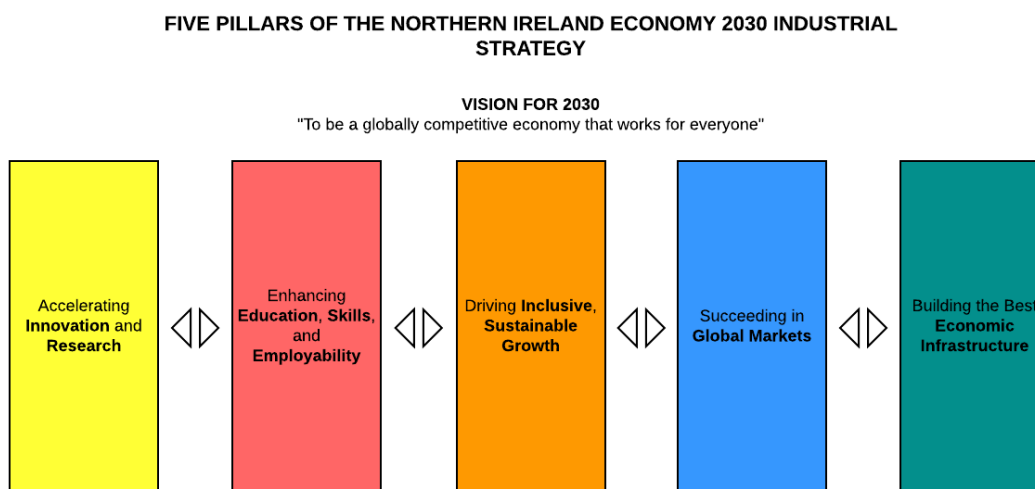
Productivity is also central to Northern Irish economic policy. The Economy 2030 Industrial Strategy describes productivity as a key long-term indicator of Northern Ireland's competitive position, and a core objective of the strategy is to accelerate the pace of productivity improvements (Northern Ireland Department for the Economy, 2017, p. 5). In this context, understanding how to effectively gear government interventions to further these aims is of paramount interest to policy makers and academics alike.

Recent research on the productivity puzzle suggests that the failure of policy to effectively influence productivity growth may stem from the fact that economic and industrial strategies tend to approach policy development in a fragmented way (Vorley and Nelles 2019). While national strategy documents recognize that a variety of policy streams influence productivity outcomes across the economy interventions often occur in a siloed manner (Cook, Hardy, and Sprackling 2020). The UK Industrial Strategy posits five foundations of productivity: ideas, infrastructure, people, place, and business environment (HM Government 2017). The Northern Ireland industrial strategy refers to five pillars of growth: innovation and research; education and skills; inclusive sustainable growth; global trade; and economic infrastructure (Northern Ireland Department for the Economy 2017). For all sorts of practical reasons, these dimensions of productivity policy tend to be discussed, and ultimately acted upon, separately.

We argue that developing policies to effectively influence productivity outcomes requires the kind of broad and multidimensional approaches advocated by both the UK and Northern Ireland industrial strategies. However, we suggest that an institutional bias towards thinking in terms of policy silos has prevented policy makers from identifying and acting upon opportunities for joined-up policy design and governance. Instead, we argue that the productivity puzzle may be more effectively addressed by conceptualising using a systems approach in which the economy, and policy space, is conceptualised as a *system* whose functioning, interactions, and interdependencies should be understood as a whole as part of the policy process. This is an enormously complex undertaking at this scale, and there are few resources to guide this exercise. This project was an exploratory attempt to apply a systems perspective in the context of Northern Ireland productivity policy to generate a map of how policy makers perceive the

economic system. Through this process we hoped to highlight gaps, biases, and potential opportunities for developing a more refined model of the system to underpin future policy interventions.

2. Working towards a solution to the productivity puzzle by understanding the economy as a complex adaptive system

Key points:

- Systems approaches have been applied in public policy to understand and address complex or "wicked" problems.
- This approach views policy outcomes as the product of non-linear interactions and interdependencies within a complex system that are difficult to predict.
- Policy to date has treated productivity as a complicated problem often addressed in silos instead of one characterized by complexity that requires a coordinated and adaptive approach.
- Adopting a systems approach understanding productivity could help illuminate missed opportunities and negative policy interactions.

"Complexity is a core feature of most policy issues today; their components are interrelated in multiple, hard-to-define ways. Yet governments are ill-equipped to deal with complex problems" (OECD 2017, 3).

Systems, or complex adaptive systems, approaches to understanding the world have emerged from and been applied across multiple disciplines from philosophy to life sciences to cybernetics. While the development and application of complexity theories across intellectual traditions differ, they share a common worldview that rejects reductionist approaches in favour of those that acknowledge that outcomes are (among other factors) the result of nonlinear interactions and interdependencies between elements. Systems approaches focus on mapping and explaining systems or processes characterised by complexity – in other words systems that lack order and stability and universal laws. A system is complex if it is difficult to "describe, explain, engineer, evolve, or predict" (Bednar and Page 2016, 450). A complex system is a system in which "large networks of components with no central control and simple rules of operation give rise to complex collective behaviour, sophisticated information processing, and adaptation via learning or evolution" (Mitchell 2009, 13). Systems-based approaches, of which complexity theory is one, aim to explain how and why system-wide behaviour emerges from the interaction between large numbers of smaller, often interdependent, components. From a policy perspective, these approaches are notable for distinguishing problems that are *complex* – and a product of systemic and synergistic effects - from those that are merely complicated (see Box 2).

Box 2. Complicated Problems vs. Complex Problems

It is important to distinguish problems that are merely complicated from those that are *complex*. Complicated problems have causes that can be easily distinguished and that can be addressed piece-by-piece and for which success is a relatively permanent solution (Poli 2013). Baking a cake is a simple problem. Building a rocket ship is a complicated problem. It can be addressed in a mechanical fashion – for instance, fuel cells can be designed and manufactured separately from guidance systems and assembled later on – and once the rocket is built and functional it will exist until it breaks (i.e. it is a permanent solution). Complex problems, by contrast, emanate from several sources, some of which can be hard to discern, and that interact with one another in hard to predict ways. Complex problems are also dynamic – there is no single permanent solution – and are therefore more accurately managed than solved. Raising a child is a complex problem (Finegood 2018).

Table 1

Problem type:	Simple	Complicated	Complex
	Bake a cake	**Send a rocket to the moon**	**Raise a child**
Problem definition	Clear	Some uncertainty	Lots of uncertainty
Rules	Same apply every time	Continuously improved until repeatable	No direct transference from context to context
Expertise	Not really required	Requires high levels in specific areas	Not needed to develop a common understanding; may be helpful
Success	Follow protocol	Experiment to develop protocol	Adaptation and continuous learning

Source: Finegood 2018

Box 3. Characteristics of Complex Systems

- Interdependence: A complex system cannot be explained merely by breaking it down into its component parts because those parts are *interdependent*: elements interact with each other, share information and combine to produce systematic behaviour.
- Non-linear dynamics: The behaviour of complex systems is difficult (or impossible) to predict. They exhibit *'non-linear' dynamics* produced by feedback loops in which some forms of energy or action are dampened (negative feedback) while others are amplified

(positive feedback). *Small actions can have large effects and large actions can have small effects.*

- Path dependence: Complex systems are particularly sensitive to initial conditions which produce a long-term momentum or 'path dependence'.
- Emergence: They exhibit emergence, or behaviour that evolves from the interaction between elements at the local level rather than central direction. *This makes the system difficult to control* (and focuses our attention on the rules of interaction and the extent to which they are adhered to).
- Strange attractors: They may contain 'strange attractors' or demonstrate extended regularities of behaviour which are 'liable to change radically' (Geyer and Rihani, 2010; 39; Bovaird, 2008, 320). They may therefore *exhibit periods of 'punctuated equilibria'* - in which long periods of stability are interrupted by short bursts of change.
- Interdisciplinarity: The various problems that complexity theory seeks to address - such as predicting climate change, earthquakes, the spread of disease among populations, the processing of DNA within the body, how the brain works, the growth of computer technology and artificial intelligence, and the behaviour of social and political systems - *can only be served by interdisciplinary scientific groups* (Mitchell, 2009: x).

Source: Cairney (2012, 384)

Policy makers inherently understand that systems, and the issues that they want to affect, are complex even if they may not think explicitly in terms of systems or complexity theory. However, decision makers are also organized within compartmentalized bureaucracies, where policy design is governed by logics of best practices, dominated by a dichotomy between evaluation and implementation, and limited by political cycles (Castelnovo and Sorrentino 2018). It is also impossible for any one person within a system to understand the full extent of a system and how it functions (see Aumann 1997, Byrne and Callaghan 2014 on bounded rationality).

These, and other, factors result in a tendency for decision makers to seek solutions – to treat and conceptualize complex problems as if they were merely complicated – rather than 'learning to dance' with complex systems[1] (Poli 2013, Rhodes et al. 2015, Burnes 2005, Eppel and Rhodes 2018). This tendency often manifests in the adoption of linear models in both policy problem definition and implementation. A such, images like Figure 3 tend to dominate policy discussions even as actors recognise that images like Figure 4 are more accurate descriptions of reality.

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[1] Where systems thinking has been incorporated into policy design tends to be limited to basic maps of policy area interactions and targeted experimental policies (Huitema et al. 2018, Greenberg and Linksz 2003).

Figure 5: Linear/Mechanical Model
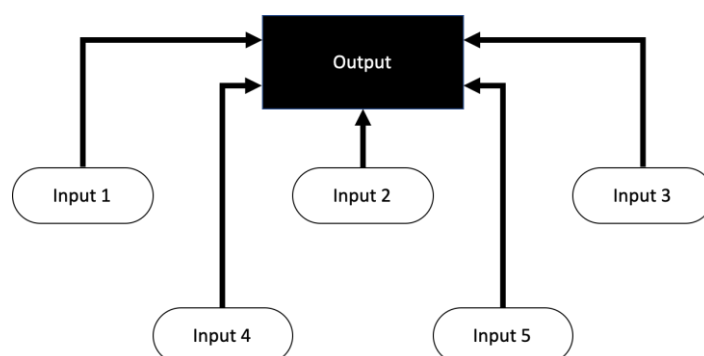
Figure 6: A (simplified) Complex System
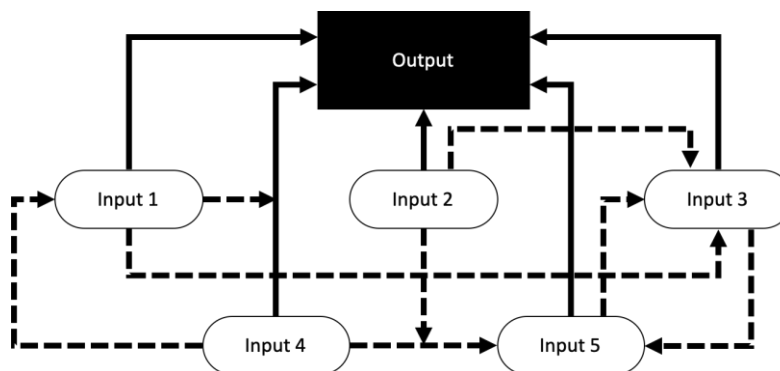
Recent productivity policy in both the UK and Northern Ireland exemplifies this tendency to reductionism. The Pillars (Northern Ireland) and Foundations (UK) that anchor the productivity narratives of the Industrial Strategy documents both evoke a sort of separateness of inputs. This is further reinforced by the accompanying imagery. Figure 5 shows how the different factor that affect productivity outcomes in the strategies are depicted as distinctive inputs that independently contribute to outcomes without interacting. This approach depicts issues like productivity as problems that can influenced by acting on individual policy areas in isolation, which implies a perception that the relationships between these policy areas is predictable, and that the results of interactions and the working whole might be understood by simply summing its parts (see Astill and Cairney 2015, Eppel and Rhodes 2018).

Figure 7: Depictions of the factors affecting productivity outcomes in the Northern Ireland Industrial Strategy (left) and UK Industrial Strategy (right)

Again, there are lots of good reasons for adopting these kinds of narratives and depictions and they should not be interpreted, in and of themselves, as evidence that policy makers are attempting to over simplify what they know to be a complex (set of) problem(s). However, doing so without qualification risks being interpreted as reductionism in policy debate and implementation.

Applying a systems approach to understanding and affecting productivity is a complicated problem. We argue that the first objective of adopting a systems approach is to develop as complete an understanding of the complexity of the problem and the system(s) of which it is a part. This understanding of the important interactions and interdependencies within this system can then serve as a foundation for policy experimentation and the development of more system sensitive tools to function as inputs to the policy process. Whatever the ultimate objective, developing this system understanding is the foundation of what follows and is the focus of this project.

Further, we argue that what is required to develop this fundamental understanding of the system is a multi- and mixed-methods research approach. In short, this involves using broad qualitative methodologies to develop a more nuanced understanding of system dynamics that can later be tested using quantitative models. This project is a crucial first step of this type of multi-methods approach. We argue that in order to define a system, identify its component parts, and explore interactions and interdependencies between those parts effectively we need to develop a cognitive map. Cognitive systems maps can be implicit or explicit and are often derived from

theory. This project proposes to develop an empirically anchored cognitive map of the elements of the Northern Irish economy related to productivity.

Crucially, this is a map of how policy makers think about priorities and interactions within the economy and the evidence that is important in informing policy – *not what it actually looks like.* However, this exercise can help uncover implicit and explicit biases in policy approaches, which will then serve as a basis for honing a systems-based approach to understanding productivity and to inform public policy intervention.

3. Applying a systems approach to better understand productivity policy in Northern Ireland

Key points:

- Cognitive maps of how actors perceive the system can help us better understand potential interactions, interdependencies, and feedback loops.
- An analysis of the Economy 2030 Industrial Strategy provides a snapshot of how policy makers perceive the economic system, while the evidence base functions as a control and helps us map how the system is perceived in the literature.
- A process of participatory mapping with stakeholders provides a more current understanding of the contours of the system.
- Comparing these three maps enables us to highlight biases, illuminate potential areas for policy synergies, and provides directions for future research.

You can create a cognitive map of almost any system or problem. Cognitive maps are qualitative models of a system, consisting of variables and the causal relationships between those variables (Özesmi and Özesmi 2004). Typically, cognitive maps are discussed in relation to how individuals perceive the systems in which they are embedded and how those systems work. However, this approach has been adapted to structure analysis of many forms of data and to make sense of accounts of a problem. When applied to document analysis is can be used to identify emergent issues, gaps, and contradictions in a cognitive landscape.

We adopt two approaches to constructing cognitive maps. First, we engage in an analysis of how the policy makers driving industrial policy perceive economic dynamics through a two-stage document analysis. Secondly, we relied on stakeholder consultations to provide perceptions from outside of the bureaucracy and an updated perspective. The ultimate aim of these phases of analysis are to understand and map:

- The aggregate economic relationships implicit in the literature used to inform the Economy 2030 strategy;
- The economic relationships implicit in the Economy 2030 strategy – and how that differs from those in the evidence base;
- How key participants in the economy perceive important economic relationships – and how those differ from the strategy and evidence base maps.

3.1 Document analysis

This project analyses the Northern Ireland Economy 2030 Industrial Strategy document and a selection of the source documents (84 total) that underpin the strategy[2]. We analysed the Economy 2030 document and the evidence base separately in order to identify contrasts or inconsistencies between how the evidence base was translated into strategy. While the Economy 2030 strategy represents the strategy, source documentation codifies the range of perceptions that informed it. The drafters of the final strategy document relied on this evidence base (alongside expert input), which was presumably selected based of relevance, quality, and the degree to which the documents reflected and confirmed the drafter's own perceptions. While an analysis of the strategy itself is illuminating, expanding the field of reference to the broader evidence base provides a richer well of data from which to construct the cognitive map.

Document analysis approaches are often combined with other methods to triangulate findings. In this study, we use document analysis as a method to explore a wide pool of sources and as a way to aggregate and analyse a variety of perceptions of how the economy functions. The advantages of this approach are that it is typically more efficient to collect documents than conduct other types of research methodologies – especially when an existing evidence base is available. It is also cost-effective and less intrusive (Bowen 2009).[3]

What we were looking for, in these documents, was *how concepts were connected to one another*. That is, we were interested in what types of concepts were invoked to understand and alongside productivity (for example) and other core themes in the strategy documents. In practice, we identified these conceptual connections by coding the documents for co-occurrence. We coded each paragraph or sentence, as appropriate, with the topics that it engaged with. Where two or more codes occurred in the same selection, we considered these conceptually linked. By summing the total of links between concept pairs we were able to establish which connections were the strongest in each of the sources – Industrial Strategy, evidence base, and stakeholder workshops – and can then compare them with one another.

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[2] What was included and what was excluded: DfE provided a summary of the evidence base used to compile the Economy 2030 Industrial Strategy (https://www.economy-ni.gov.uk/sites/default/files/publications/economy/Industrial-Strategy-Equality-Screening-Annex-A-Summary-Evidence%20Base.pdf). In total, the strategy cited 100 reports and documents. As we are primarily interested in Northern Ireland, we excluded any document that was general or focused on another country. Due to the textual analysis methodologies we employed, we also excluded documents that were predominantly statistical. We were unable to access 10 documents.

[3] The Economy 2030 strategy and the 85 documents in the evidence base provide a discrete collection of sources for this analysis. However, it is also important to acknowledge the limitations of this approach. Atkinson and Coffey (1997, 47) urge caution in the interpretation of documents: "we should not use documents as surrogates for other kinds of data. We cannot, for instance, learn through records alone an organization actually operates day-by-day, Equally, we cannot treat records – however 'official' – as firm evidence of what they report". With this in mind, we acknowledge several limitations. First, the selection criteria for this sample can be inferred but is unknown. Almost certainly, that selection reflects the biases of the industrial strategy drafters (Yin 2003). While for the purposes of this project we are mainly interested in policy maker perceptions and so bias is less of a concern, it is important to recognize that this selection limits the scope of perceptions considered in the analysis.
One other limitation worth noting here is that neither the industrial strategy document nor most of the documents in the evidence base is a productivity policy document. So, while this current project focuses on understanding the factors and interactions that influence productivity growth it does so by mapping interactions within the broader economic system, as perceived through these policy documents.

In order to facilitate coding, in the first phase we used only concepts connected to each of the five pillars of the Economy 2030 strategy. The pillars/themes included: 1) Innovation and Research; 2) Education, Skills, and Employability; 3) Inclusive and Sustainable Growth; 4) Global Markets; and 5) Infrastructure. The concepts associated with each of the pillars can be found in the findings section of the report but were drawn from the pillar descriptions themselves (see Figure 5).

In this phase, we explore the following questions:

1) *Are there conceptual links across pillar/theme/silo boundaries?*

   Links across conceptual boundaries could indicate cross-cutting themes that may be logical places to look for policy synergies and implement joined up approaches.

2) *Are there/what are unexpected and missing/weak connections between concepts across pillar/theme/silo boundaries or within these groups?*

   There may be connections that were not totally logical or that we would have expected to be there. These unexpected links and gaps might indicate areas where policy interdependencies may be being overlooked or, by contrast, overemphasised in policy discourse. These might be areas, then, where further analysis may help build deeper understanding to better inform productivity policy and economic models.

3) *Are there/what are differences between the conceptual relationships identified in the Industrial Strategy versus the broader evidence base?*

   Similarly, we can also use differences in the types of relationships, gaps, and surprises between the sources to spot potential biases and blind spots in the strategy document, which might be indicative of inaccuracies in interpreting and translating the evidence base or of political blockages.
   These results were then triangulated with the results of the second phase of analysis in which we engaged stakeholders in a process of participatory mapping.

3.2 Participatory Mapping

The second phase of this research aimed to build on the cognitive maps produced in the first phase by engaging with stakeholders in a process of participatory systems mapping. Through a series of workshops inspired by CECAN participatory modelling methodologies (CECAN 2019) we facilitated diverse groups of stakeholders as they constructed their own cognitive maps of the economic system based on their own experiences. We then compared these with the results of our document analysis and explored differences, similarities, and puzzles and their implications

In designing these workshops, we aimed to gather participants from a variety of sectors of the economy including:

- Policy makers/analysts (cross-departmental representation);
- Business/industry (large and small enterprises, different sectors);

- Associations and civic entities involved in economic policy (economic and social focuses)
- Education (colleges and universities/primary and secondary);
- Academics (working on economic policy)

Three workshops took place between November 19-21st, 2019 in Belfast. Participants from a variety of sectors of the economy were invited by DfE and assigned to workshop timeslots based on their availability (rather than a pre-determined mix of participants based on a specified research design). We opted for this model to maximise participation. Even so, there were several no-shows that diminished the number of participants in each session and that demonstrates the difficulties associated with conducting this kind of participatory research. See Table 2 for a list of actual versus expected attendees. Despite lower than anticipated turnout the participants that attended were very engaged and in all three sessions we had animated discussions for the duration of the exercise.

Table 2: Workshop participants – planned and actual attendance by primary affiliation of participant

Row Labels	academic Plan	Participants	association Plan	Participants	firm Plan	Participants	government Plan	Participants	Total Plan	Total Participants
Workshop 1	1	0	2	2	2	2	3	1	8	5
Workshop 2	1	0	4	2	0	0	6	6	11	8
Workshop 3	2	1	2	0	1	1	5	5	10	7
Grand Total	4	1	8	4	3	3	14	12	29	20

In the workshops, participants were asked to reflect on the question of what the goals of the Industrial Strategy should be. Note that this approach, which specifically avoids asking directly about the role of productivity, was deliberate. We did this in order to establish where (or if) people really think productivity fits in the Industrial Strategy. The various responses were then discussed until the group arrived at a consensus as to what should occupy the focal point of the systems map. While next phase of the event was designed to introduce the concepts used in the Phase 1 analysis based on the Economy 2030 Pillars as prompts to the mapping process, in practice many of those concepts were introduced and discussed as part of the initial debate about the map focal point. As such, the conversation evolved in a more organic fashion in which the groups began discussing the links and influences of various factors without being initially exposed to the full list of concepts used in the Phase 1 analysis. When the discussion focused on concepts used in the Phase 1 those premade sticky notes were added to the map and where other concepts were introduced the facilitator wrote and added those as needed. About twenty minutes before the end of the session the facilitator began to wrap up the mapping process by asking participants if the map looked right and whether they felt that any changes needed to be made without adding anything substantially new. In the last ten minutes the facilitator presented a quick summary of findings in Phase 1, and the experiences of previous workshops (where applicable) and offered some reflections on similarities and differences between the maps and experiences. Participants were then invited to add their own reflections and observations before the session concluded.

4. Findings

Key points:

- We find strong evidence of conceptual linkages across Pillars, which suggests that policy interdependencies where connections are strongest.
- Themes related to Education, Skills, and Employability tend to dominate all of the maps suggesting that it is likely a major cross-cutting theme and confirms the perceived importance of these concepts within the economic system.
- Productivity was most frequently connected and discussed in the evidence base, which might indicate that its significance is not being effectively translated from theory (literature) to stakeholder experience and policy practice and that it may be merely a policy buzzword under current arrangements.

Our analysis of the maps generated by the Economy 2030 document, evidence base, and the stakeholder interactions yielded some interesting overall findings. This section first queries some basic descriptive statistics before turning to the relational analysis made possible by the cognitive maps. Overall, despite being highly structured around thematic silos we find strong evidence of conceptual linkages across Pillars in the Economy 2030 document. This is evidence that the policy makers that framed the document have a cognitive map of the Northern Ireland economy that frequently links up *concepts* across policy silos even if in *practice* policies are then implemented separately. Differences between the Economy 2030 map and the evidence base and stakeholder results point to areas that might be usefully developed in future industrial strategies. A key next step from this analysis will be to figure out where and how to adopt these findings about areas of potential policy interdependencies and interaction into policy practice.

4.1 Descriptive statistics

Sources show that Education, Skills, and Employability themes are overrepresented

A simple count of how often concepts associated with each of the Pillars occur in the two sources effectively reveals patterns of potential bias and imbalance. While the models used in both the Economy 2030 and UK industrial strategies (Figure 7) visually assign each "Pillar" and "Foundation" equal weight, in reality concepts associated with the Economy 2030 pillars do not occur evenly in the document. Interestingly, these imbalances are even more pronounced in the evidence base. This may be influenced to a certain degree by the policy areas that the Department has responsibility for, which encompasses skills, further and higher education but does not include infrastructure.

Pillar 2 Education, Skills, and Employability represents the plurality of codes in both the Economy 2030 strategy and the broader evidence base (see Figure 8). Interestingly, the Economy 2030 document has a much more evenly balanced breakdown of codes across pillars with Pillar 2 only representing 38% of codes (versus 60% in the evidence base). This is perhaps reflective of the fact that the Economy 2030 strategy is an aspirational document and, as such, aims for more balance between themes. Also notable is the relatively higher incidence of codes related to Pillar 4 Global Markets in the Industrial Strategy (26% versus 12% in the evidence base). Pillar 5 Infrastructure plays a relatively minor role in both sources, which interestingly shows that the bias against engaging with infrastructure issues seems to have translated into the policy document despite allocating similar space as the other pillars. Finally, productivity

occurs a relatively significant (considering it represents only a single code) number of times in all source documents but is not a decisively dominant concept in either set of documents.

The dominance of concepts associated with Pillar 2 Education, Skills, and Employability in the Industrial Strategy and wider evidence base may speak to their greater importance in the economic development literature more generally – and may therefore reflect the significance of mechanisms associated with them in the economic system – or these may simply reflect the biases of those who selected the sources for the evidence base.[4] Whatever the case, these findings suggested (ultimately confirmed) that Pillar 2 concepts would be central to the cognitive maps generated from these sources.

Figure 8: Breakdown of codes by pillar by source

ECONOMY 2030 INDUSTRIAL STRATEGY

- Pillar 1 Innovation and Research
- Pillar 2 Education, Skills, Employability
- Pillar 3 Inclusive and Sustainable Growth
- Pillar 4 Global Markets
- Pillar 5 Infrastructure
- productivity

EVIDENCE BASE

- Pillar 1 Innovation and Research
- Pillar 2 Education, Skills, Employability
- Pillar 3 Inclusive and Sustainable Growth
- Pillar 4 Global Markets
- Pillar 5 Infrastructure
- productivity

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4 The dominance of concepts associated with Pillar 2 Education, Skills, and Employability across evidence base sources selected to feed into the other four pillars indicates that these concepts are important across thematic silos.

4.2 Document-based Cognitive Maps

The cognitive map diagrams show the frequency of connections between concepts and indicate potential interactions and interdependencies between concepts within the Industrial Strategy document and the broader evidence base. In these maps, the size of the circle reflects the total number of connections it has with other concepts while the thickness of the lines linking concepts indicates the number of links between those pairs.

Maps confirm the centrality of Education, Skills, and Employability

Across all of the maps, the concepts associated with Education, Skills, and Employability have the largest nodes and the thickest connections. This indicates that they are both among the concepts most frequently mentioned in connection with others in the study (circle size) and that they are very strongly connected with certain other concepts (where there are thick lines). This pattern indicates a relatively strong perception of the crosscutting significance of policies related to job-creation and skills development to economic outcomes. In other words, in the minds of the architects of the Industrial Strategy, and in the literature it drew upon, these concepts came up frequently across thematic silos suggesting that issues related to jobs and skills underpin (or are affected by) a wide variety of policy areas.

The maps differ somewhat on the next most central concepts. In the Economy 2030 document the concepts associated with Global Markets (Pillar 4) and Innovation and Research (Pillar 1) exhibit almost equally significant connections, and themes related to Inclusive and Sustainable Growth (Pillar 3) are also relatively well-connected. By contrast, concepts related to Global Markets (Pillar 4) and Inclusive and Sustainable Growth (Pillar 3) are relatively less well-connected and the map is most notable for the centrality of Education, Skills, and Employability (Pillar 2) and Innovation and Research (Pillar 1). These patterns should be interpreted as indictors of the policy areas that decision makers and the literature perceive to be broadly interdependent. The differences between the maps are most likely attributable to a deliberate attempt by policy makers in Northern Ireland to more evenly balance concepts and to weave themes of inclusiveness throughout the strategy.

## Significant evidence of links across thematic silos indicates strength of policy interdependencies

These cognitive maps confirm that even though each Pillar was presented separately in the Economy 2030 strategy there are nevertheless implicit conceptual links across policy silos evident in the document. While many of the strongest conceptual links were between themes in the same Pillar (for instance, between skills and talent and education – both in Pillar 2) strong links across Pillars were also common. Links between internationalisation and innovation, inclusiveness and employment, skills and innovation, and employment and innovation were among the strongest conceptual connections in the Economy 2030 document. This should be read as evidence that the architects of the strategy implicitly or explicitly perceived these policy areas to be linked and indicate areas where we might begin to seek synergies in the Northern Ireland context.

That the strongest connections in the Economy 2030 document differ from the evidence base could be an indication that decision makers in Northern Ireland have an incomplete understanding of interdependencies in the economy it could equally demonstrate that they perceive differences between their specific context and the literature. Regardless, the fact that

both sources exhibit links across thematic areas suggests that there are several areas where decision makers might begin to look more closely at policy interdependencies.

Figure 9: Comparing relationships between Pillars in the Industrial Strategy (top) and evidence base (bottom)

ECONOMY 2030
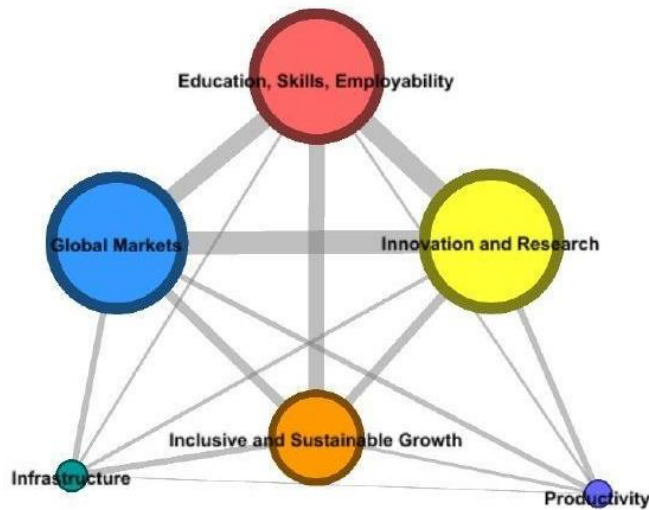
Evidence Base
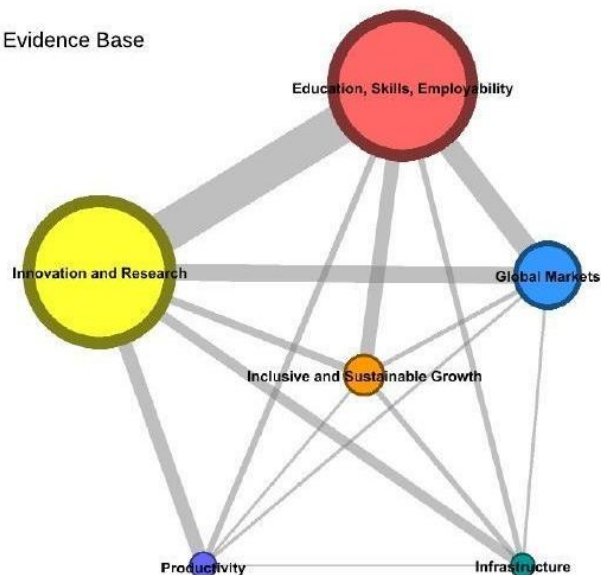
Figure 10: Links between concepts in the evidence base (colour-coded by Pillar)
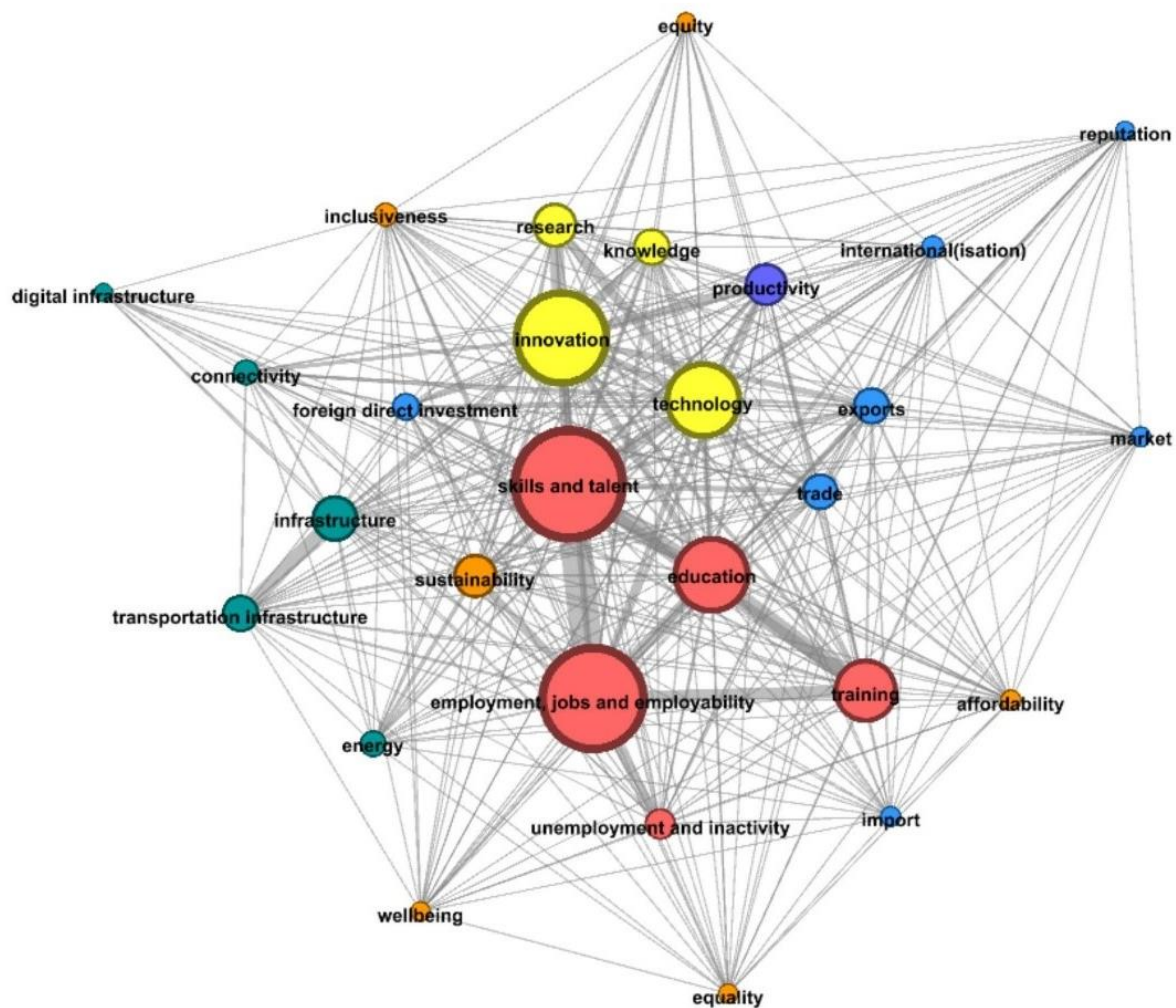
Figure 11: Links between concepts in the Economy 2030 Industrial Strategy (colour-coded by Pillar)
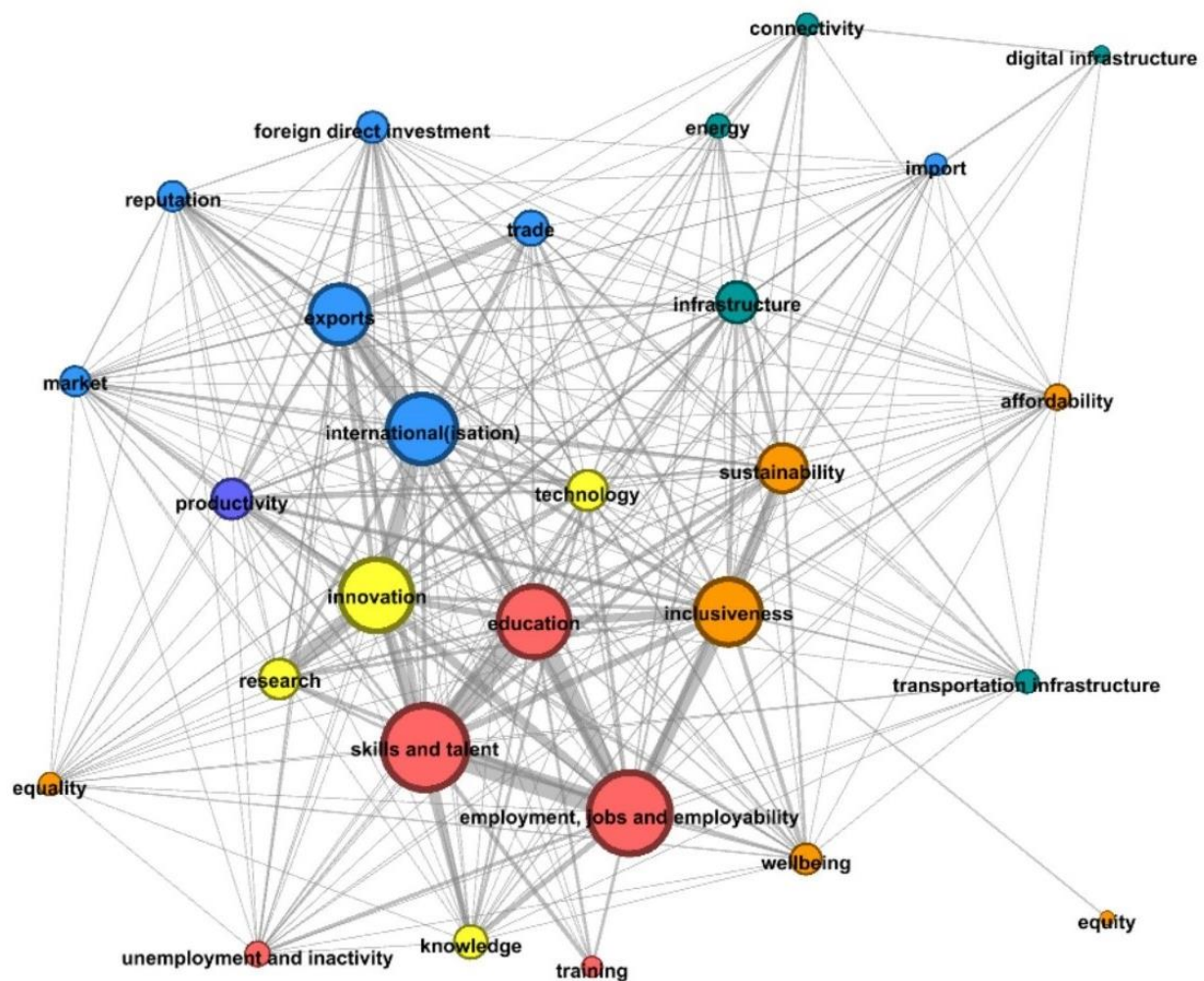
Areas of potential policy interdependencies

Cognitive maps are not exact depictions of reality but can be useful for pointing us in the right direction to better understand how systems function. We therefore spent some time unpacking some of the strongest and most surprising connections that the maps revealed. For instance, both maps show strong connections between three Pillars: Education, Skills, and Employability (Pillar 2) – Global Markets (Pillar 4) – Innovation and Research (Pillar 1). These strong conceptual connections might therefore indicate the broad areas where we might find significant policy interdependencies.

Table 3: Most connected pairs <u>across Pillars</u> in the Economy 2030 document

Node 1	Node 2	Links
international(isation)	innovation	21
Inclusiveness	employment, jobs, and employability	19
skills and talent	innovation	16
employment, jobs, and employability	innovation	12
Inclusiveness	education	12
education	innovation	10
Inclusiveness	skills and talent	10
Productivity	innovation	9
international(isation)	education	9
Exports	skills and talent	8

Table 4: Most connected pairs across Pillars in the evidence base

Concept 1	Concept 2	Links
skills and talent	technology	332
skills and talent	innovation	318
technology	research	302
productivity	innovation	301
education	innovation	220
sustainability	employment, jobs and employability	188
employment, jobs and employability	innovation	187
education	technology	182
productivity	technology	175
exports	innovation	169
employment, jobs and employability	technology	141
skills and talent	knowledge	129
productivity	employment, jobs and employability	117
energy	sustainability	106
training	innovation	99
sustainability	skills and talent	98
connectivity	innovation	97
trade	innovation	93
exports	skills and talent	89
infrastructure	technology	85
infrastructure	innovation	77
foreign direct investment	skills and talent	72
connectivity	technology	69
infrastructure	employment, jobs and employability	69
productivity	skills and talent	64
sustainability	education	60
trade	employment, jobs and employability	60
transportation infrastructure	employment, jobs and employability	58
sustainability	research	55

In addition to these broad links, several specific connections stood out as somewhat unexpected. In the Industrial Strategy the most interesting links included:

- international(isation) (Pillar 4) – innovation (Pillar 1)
- international(isation) (Pillar 4) – education (Pillar 2);
- exports (Pillar 4) – skills and talent (Pillar 2).

The international(isation) – innovation link in the Industrial Strategy stems from one of the core ambitions of the document to stimulate a globally competitive and innovative economy and to draw on international best practices and partnerships to achieve this aim. In this document, education is linked to these global ambitions to the extent that it is thought to be both an asset that enhances global reputation and a site of intervention where globally significant characteristics – such as entrepreneurship, innovation, and creativity – can be more fully

developed. The international(isation) – education link also occurs in passages comparing educational achievement in Northern Ireland with international benchmarks. The link between exports – skills and talent comes from the deliberate linking in the document of innovation, skills, and exports and an interest in strategic coherence between these goals. Investment in human capital is cited as a way to render the economy more attractive to, competitive in, and able to penetrate the global market. In short, all of these potentially interesting connections are artefacts of the framer's intention to deliberately link these concepts as part of the policy discussion. In this case, it would be interesting to explore how well those intentions are being translated into practice and the degree to which there is current (or planned) interaction between departments charges with skills, education, and international trade to establish policy priorities.

While the strong links in the Industrial Strategy are interesting, they are mainly windows into the minds of its authors. The interesting strong links in the evidence base are potentially closer to a collective perception of the shape of the system. The most interesting pairs of links emerge from the bottom half of the list:

- exports (Pillar 4) – innovation (Pillar 1);
- exports (Pillar 4) – skills and talent (Pillar 2);
- connectivity (Pillar 5) – innovation (Pillar 1);
- sustainability (Pillar 3) – skills and talent (Pillar 2);
- sustainability (Pillar 3) – education (Pillar 2);
- sustainability (Pillar 3) – research (Pillar 1).

The link between exports and innovation emerges from sources that pinpoint innovation as an important quality of firms that are most likely to engage in export activity. Sources also encourage firms to increase exports and innovation to increase productivity. Simply put, the relationship is generally thought to be innovation → exports, and in some cases innovation + exports → productivity.

The link between exports and skills and talent was largely related to developing the marketing/exporting capacity within firms to successfully navigate international markets or more generally associated with a need to develop skills to make Northern Ireland attractive and competitive abroad. Here a lack of skills in this particular area is identified as a constraint on international engagement and economic potential.

Connectivity and innovation are related along a couple of interesting vectors, not all related to the infrastructure Pillar that this concept is associated with. First, the concept of connection and connectivity comes up in relation to emerging and innovative hybrid industries such as biotech, agricultural engineering, and composite materials manufacturing. Connections are also mentioned with reference to partnerships and collaborations as key to underpinning successful innovation. Logistical, travel, and broadband connectivity linking people and businesses also facilitates innovation and productivity. This last category represents the majority of citations and the breadth of interpretations of what is moving through this connective capacity – individuals for business, goods to markets, information through digital infrastructure – is notable, as is the fairly universal conclusion that more connectivity → more innovation and productivity.

The last three interesting strong connections all involve the concept of sustainability. The breadth of factors that this is linked to indicate how broadly this concept can be defined.

Sustainability is linked to skills and talent and the related concept of education in three broad ways: skills and talent should be developed (through education in some cases) as a mechanism to achieve sustainable economic growth; 2) as a way acquire or sustain (read: maintain) economic advantage at the individual, business, or sectoral scale; and 3) to support the growth of industries connected to environmental sustainability. By contrast, the connection between sustainability and research focuses on the need to underpin the transition to an environmentally sustainable economy. Links between this pair of concepts centre on developing research capacity to drive, or researching the potential for, advancements in the science and knowledge of sustainable technologies.

A reoccurring theme among these "interesting" connections is the need to develop capacity and that many of these engage with similar ideas – education, skills, talent – suggests that there is a strong need to think about the role that these play across the economy. Here it might be worth recalling the biases towards the theme of Education, Skills, and Employability in the evidence base. These may be affecting our results here to the detriment of finding other important connections. Still, these are a place to start thinking about cross-cutting themes and evaluating existing engagement strategies.

Overlooked infrastructure

Infrastructure themes appear to be relatively overlooked in the Economy 2030 document versus the evidence base (and, later, the participatory maps). Table 4, which lists the most frequently connected pairs of concepts contains eight pairs with Infrastructure nodes, seven of which are paired with concepts outside of the Infrastructure Pillar. This suggests that concepts related to infrastructure are potentially significant cross-cutting themes and that they might be the source of important interdependencies. The relative weakness of Infrastructure themes in the Economy 2030 document may have less to do with an oversight of the architects of the policy than with some other factor that meant that devoting more attention to these topics more difficult than other policy areas. This is an important lesson for interpreting these maps – apparent gaps are not always the result of oversights but could also indicate the influence of some feature of the system itself.

Productivity is not central

The weakness of productivity across all of these cognitive maps is interesting. While it's important to reiterate that the evidence base was not specifically selected to explore how to increase productivity the Industrial Strategy does cite this as a central goal. It is therefore surprising that productivity was not more broadly connected across policy domains in the Industrial Strategy document.[5] Even though it had relatively fewer connections than other concepts, productivity was most strongly connected to innovation, technology, employment, skills and talent in both sources. Interestingly, it was also relatively well-connected to Pillar 3 themes though to different ones in each source: sustainability (evidence base) and inclusiveness (Industrial Strategy). That said, the relative weak showing of productivity – both in terms of the frequency that it was invoked and how closely it was connected with other concepts – is a significant finding of this study. That productivity was most frequently connected and

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[5] It was the ninth most central concept of 27 in the Economy 2030 document, and 10/27 in the evidence base.

discussed in the evidence base might indicate that its significance is not being effectively translated from theory (literature) to stakeholder experience and policy practice and that it may be merely a policy buzzword under current arrangements.

4.3 Participatory Cognitive Maps

In the second phase of research we connected with key stakeholders to sense check, update, and provide new insights into the research generated in the first phase. This was accomplished through a series of workshops where stakeholders engaged in a process of participatory mapping around themes related to the Industrial Strategy. The approach we used to facilitate this mapping process is described in section 3.2. Figure 12 shows the result of one of the workshop sessions. In Figures 13-15 we produced these maps to enhance legibility and colour-coded the elements that corresponded to the Pillars of the Industrial Strategy. Summaries of the individual workshops and reflections on their qualitative elements can be found in the Appendix.

Figure 12: One of the cognitive maps generated from a stakeholder workshop

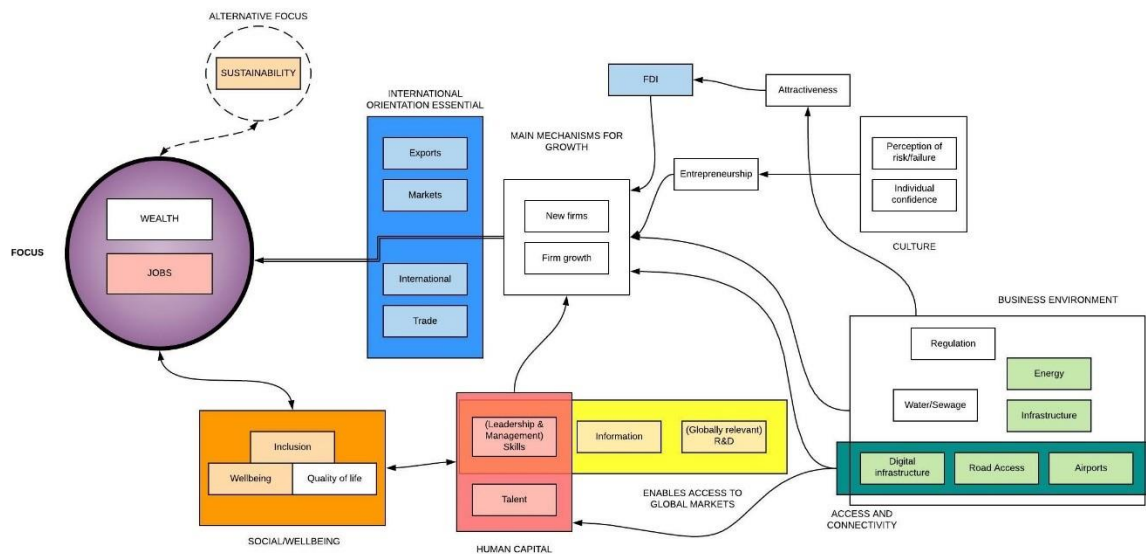*Figure 13: Workshop 1 Participatory Map*

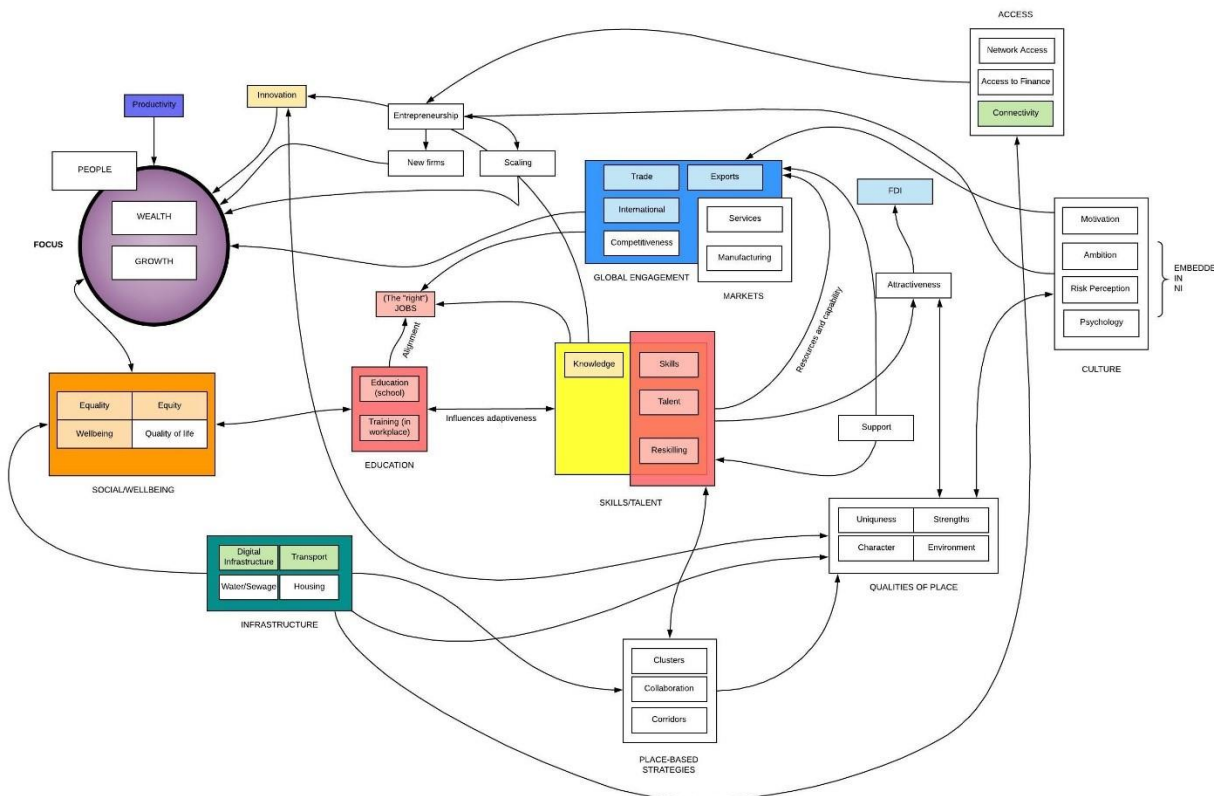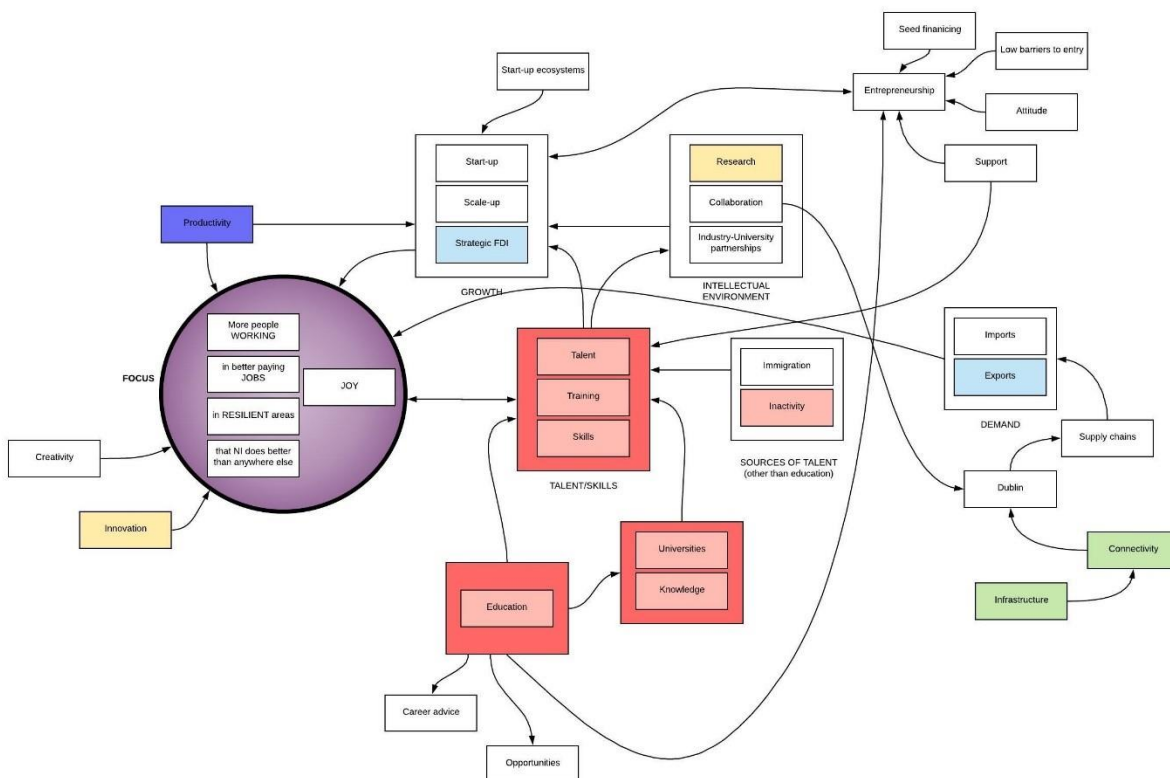*Figure 14: Workshop 2 Participatory Map*

Figure 15: Workshop 3 Participatory Map

While these maps are interesting in and of themselves one of our aims was to construct a meta-map aggregating the results from the workshop sessions that would be more directly comparable to the Phase 1 cognitive maps. The workshop sessions produced three distinctive maps – some of which include connections between concepts that are directed (i.e. point from one concept to another) and others that were more general (i.e. that simply connect two concepts). This meant that we were limited to constructing an undirected meta-map, which still suited our needs as the Phase 1 maps were also undirected.

In order to generate an aggregation of the three maps, we first harmonised the list of concepts so that related terms used multiple times across workshops were the same across maps.[6] After this harmonisation phase, we generated a list of all pairs of direct connections for each workshop map and summed them. As each pair could only have one connection per workshop the largest number of connections that a pair could have is 3. Through this process we determined that, for instance, the pair of concepts new firms-skills had connections in two of the workshops. Resilience-employment had a connection in only one of the workshops. Jobs-exports were linked in all three workshops.

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[6] For example, where one workshop used the term "new firms" and others used "start-ups" both were renamed "new firms". Similarly, in one workshop participants used the term "firm growth" while another used "scale up". These were harmonised to "firm growth/scaling".

Figure 16: Meta-map aggregating the conceptual connections highlighted in the workshops
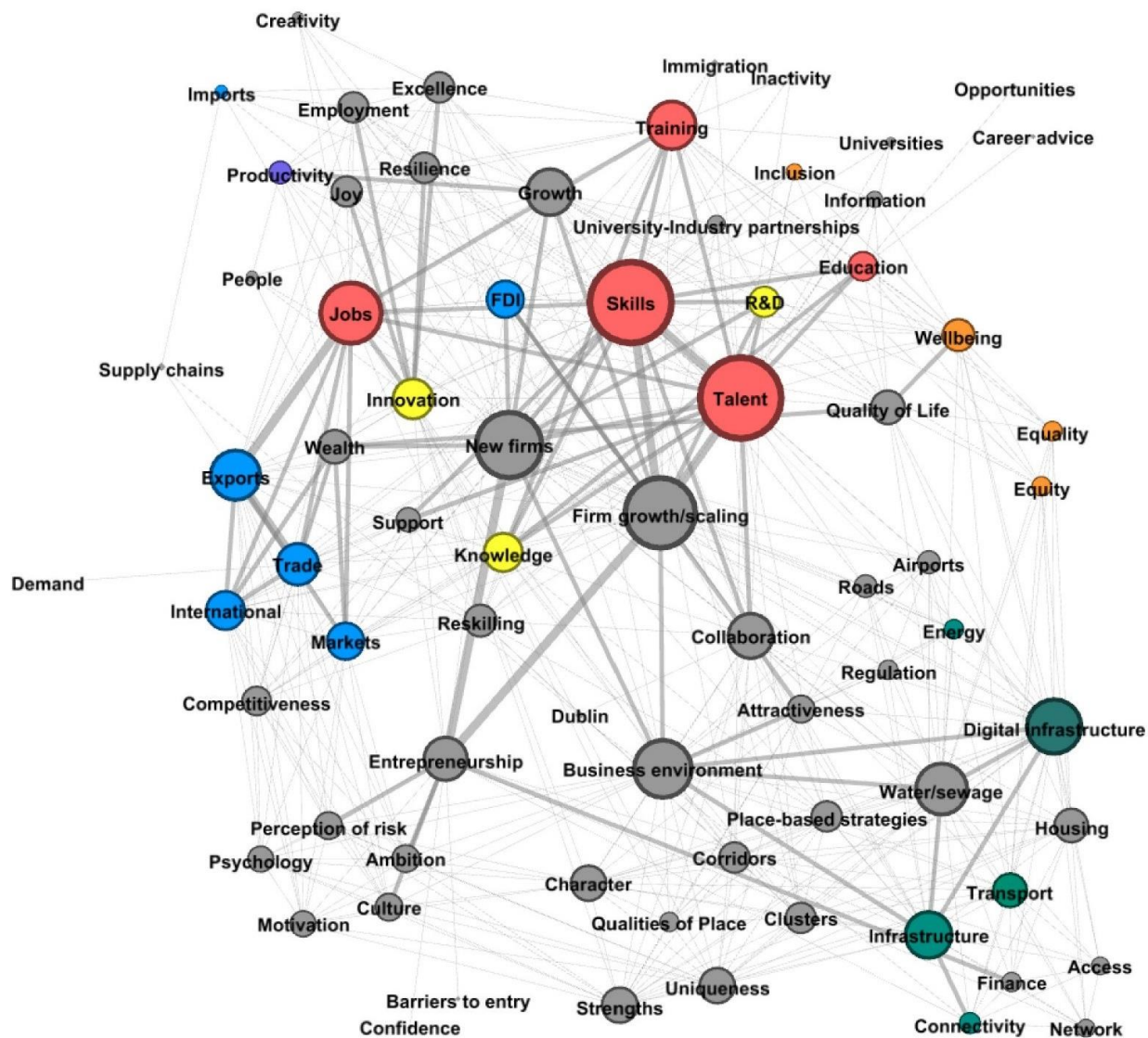
As with the previous maps, in this visualisation the size of the circles is indicative of the total number of connections that has with all other connected concepts while the thickness of the link depicts the number of connections between that pair. As with the individual workshop maps above the nodes are colour coded according to their relationship with the Pillars of the Industrial Strategy. If a term was associated with one of the Pillars in the first phase it has the corresponding colour, while terms that were not associated with any specific Pillar are grey. The following discussion teases out some important themes that emerged from comparing this map with the document-based analysis. It is, however, important to compare these maps with caution. The meta map should be considered at best as a visualisation of what participants felt was important and how ideas were connected within the unique context of their workshops. It is

still useful as an indicator of the elements and relationships with the system that might be important but *should not be interpreted as the definitive map of the system.*[7]

Stakeholders engaged with a wider range of themes

The prevalence of grey nodes indicates that workshop participants engaged with a wider group of concepts than those that were associated with the Pillars in Phase 1 of the project. This is not surprising, as participants were not limited to a pre-selected list of terms and the list of concepts associated with the Pillars was relatively short. While many of the terms in grey could easily be classified under the rubric of one of the Pillars (for instance, water/sewage could fit neatly in the infrastructure Pillar) some are relatively unique. For instance, the cluster of terms associated with entrepreneurial psychology, ambition, and risk don't have a clear home under the Pillars. Resilience is another relatively significant and unique concept as are the groupings of terms related to qualities of place and joy. One of the objectives of the stakeholder interactions was to prompt exactly this kind of expansion of conceptual scope. These additional concepts may be areas worth exploring for deepening future iterations of the Industrial Policy and can provide important clues as to intervening interactions and interdependencies within the economic system.

Employment, Skills, and Employability are still the most central concepts

A quick comparison of the maps shows interesting differences in the significance and distribution of coloured nodes. For instance, nodes associated Employment, Skills, and Employability (red) appear to be the most connected (the largest) in each of the maps. But in the meta map the nodes associated with Global Markets (blue) and Innovation and Research (yellow) while still significant are smaller relative to the skills nodes than in other maps. This suggests that these are relatively less well-connected in the meta map than in the others. Orange nodes associated with Inclusive and Sustainable Growth are slightly smaller in the meta map relative to the others. Interestingly, nodes associated with Infrastructure (green) appear to be a bit larger indicating that these elements were relatively more frequently connected in the workshop discussions than in the Industrial Strategy or evidence base. Productivity appears similarly weakly connected across maps and perhaps even more peripheral in the workshop meta map.

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[7] A comparison of these maps reveals several insights although before proceeding it's worth emphasizing that while the maps are similar, they should be compared with caution. The sizes of the nodes and thicknesses of the links are proportional to the individual data sets and to the number of data points. Because the meta map has more nodes, at this resolution they appear smaller and the links weaker than the other maps. Nodes of similar sizes across maps do not indicate that they have the same number of connections. For instance, the skills node in the meta map is similarly sized to the skills and talent node in the Economy 2030 diagram. However, these sizes are the result of very different numbers of total links. As such, the best way to approach these diagrams comparatively is to interpret size and thickness as representing the significance of the nodes and connections for that data set alone. Another point to remember is that just because a connection appears weak (or non-existent) in the meta map doesn't mean that there isn't a connection in reality. These maps depict the connections elaborated in time-limited group sessions and not every concept was given equal time or had its relationship to others as thoroughly investigated. This map, then, is at best a visualisation of what participants felt was important and how ideas were connected within the unique context of their workshops. The meta map is still useful as an indicator of the elements and relationships with the system that might be important but should not be interpreted as the definitive map of the system.

Table 5: Most connected conceptual pairs by map (colour-coded by Pillar)

Meta Map			Economy 2030			Evidence Base		
Node 1	Node 2	Links	Node 1	Node 2	Links	Node 1	Node 2	Links
Entrepreneurship	Firm growth/scaling	3	Skills and talent	Education	35	Skills and talent	Employment and jobs	1066
Entrepreneurship	New firms	3	Skills and talent	Employment and jobs	33	Skills and talent	Education	497
Jobs	Exports	3	Employment and jobs	Education	26	Training	Education	487
Skills	Firm growth/scaling	3	Exports	International(isation)	26	Research	Innovation	476
Skills	Talent	3	Research	Innovation	23	Transport infrastructure	Infrastructure	463
Talent	Firm growth/scaling	3	International(isation)	Innovation	21	Training	Employment and jobs	381

Table 5 shows the top six[8] linked pairs for each map and fairly effectively demonstrates the massive differences in numbers of links by map. Table 6 depicts the most connected concepts in each of the three sources. These reinforce what we observe in the maps – that the concepts associated with Employment, Skills, and Employability tend to figure among the most connected pairs across all three maps. Also significant is that the top six most connected nodes in the meta map tend to be fairly exclusively centred on relationships related to job creation such as entrepreneurship, new firms, and firm growth/scaling. Completely absent from the meta map's most frequently connected pair list are pairs that touch on Innovation and Research, which are the second most significant in frequency (along with Global Markets) in the other maps.

These tables are useful reference points for thinking about where to find policy synergies, interactions, and interdependencies, and where policy might consider deeper analysis into the potential for joined up approaches. However, it is worth highlighting that this is not an exact science. It is important to emphasise that while these provide different insights none of these maps is "right" nor are any of them complete. For instance, the areas of divergence of the meta map from the document-based ones does not imply that the analysis in Phase 1 was incorrect, that the document or document pool itself were somehow flawed, or that stakeholders have deeper insights. They are neither good or bad, right or wrong – they simply are. It is in comparing them, debating the implications, and testing the validity of different interpretations that these findings will most effectively contribute to our knowledge of the economic system and role of productivity in Northern Ireland. They are maps – they can point the way but they cannot get us to a destination without critical interpretation.

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[8] There are only six node pairs that have the maximum number of links in the meta map and we compare these to the top six most connected pairs for the other maps.

Table 6: Most connected concepts by source (colour-coded by Pillar)

Meta map		Economy 2030		Evidence base	
Skills	37	Employment and jobs	235	Skills and talent	3443
Talent	37	International(isation)	230	Employment and jobs	3198
Firm growth/scaling	32	Skills and talent	224	Innovation	2789
New firms	30	Education	174	Technology	2109
Digital infrastructure	29	Innovation	172	Education	2108
Business environment	28	Inclusiveness	140	Training	1638
Jobs	27	Exports	130	Infrastructure	1035
Water/sewage	27	Research	101	Research	979
Collaboration	24	Productivity	97	Sustainability	949
Growth	24	Sustainability	96	Productivity	912
Training	24	Technology	74	Exports	714
Exports	23	Trade	66	Knowledge	713
Infrastructure	23	Knowledge	64	Transport infrastructure	708
Character	20	Wellbeing	57	Trade	690
Strengths	20	FDI	51	Unemployment	505
Uniqueness	20	Reputation	51	FDI	386
Housing	19	Market	45	Energy	347
Trade	19	Energy	35	Connectivity	317
Transport infrastructure	19	Unemployment	33	Inclusiveness	256
FDI	18	Affordability	31	International(isation)	216
Innovation	18	Connectivity	30	Affordability	153
International	18	Training	29	Market	142
Knowledge	18	Equality	25	Import	140
Markets	18	Transport infrastructure	23	Wellbeing	134

5. Reflections

The central objective of this project is to extract useful policy insights from systems analysis of data from various sources. We want to stress that even though the two completed phases of this project have produced several interesting maps, none of these can or should be considered a map of the Northern Ireland system. Rather, they should be considered as points of triangulation – clues that will help develop a deeper understanding of the policy context and suggest directions for future investigations. That said, combining and comparing results from both document-based and participatory mapping processes has, we think, yielded some clues to the productivity puzzle.

First, all of the data sources suggest that productivity is not as central to policy or to economic discourse in practice as policy makers and academics would like to think. This may be because it is poorly defined, poorly understood, difficult to engage with, or seen as less (politically) important than other (more mainstream?) factors. While productivity is obviously affected by a wide variety of policies regardless of whether stakeholders care to discuss the concept or not, and regardless of whether it is central to policy agendas, if the lack of clear definition and lack of policy centrality that we observed in the course of this study has been a long term feature of economic policy in Northern Ireland (and indeed possibly the UK) then it is no surprise that a variety of uncoordinated policies have been unable to meaningfully move the productivity needle. This suggests that in order to effectively tackle the problem of productivity policy makers may benefit from a much more coordinated approach, in word as well as deed.

This last point is important. Making productivity central to economic policy and acknowledging the need for a joined-up policy approach in strategic documents is not enough to effectively achieve results. Given the broad range of factors that affect productivity, effective engagement across departmental boundaries is likely to be essential. We hope that some of the evidence that we've produced in this document and the first report help to encourage such conversations and actions.

While this analysis does not provide an incontrovertible roadmap, it does suggest a few ways forward. If productivity is to be central to future economic strategies, then the nature of cross-cutting interactions between policy areas and targets needs to be much better understood. The analysis in Tables 3-6 hint at the areas that should be explored and mapped in more detail. These are the areas that are most likely to be connected across silos and subject to inefficiencies if poorly coordinated. From an analytical point of view, these might be the areas that are most ripe for rethinking, testing, and refining models and for investigation in future rounds of research.

Finally, to end on a slightly controversial note, an alternative interpretation of all of these results is that productivity is not as important as policy makers and academics think it is or want it to be. This may again be related to poor communication and/or understanding of the term. But, perhaps what the relative weakness of productivity in all of these data sources is really telling us is that other things do (and/or should) matter more. Good jobs, fulfilling employment, wellbeing, belonging, happiness, environmental sustainability – these represent different poles around which alternative approaches to economic policy could be constructed. While this might not diminish the mathematical significance of productivity in the economy it does at least suggest

that any future discussion of economic policy should perhaps not adopt productivity as a focus uncritically or without inclusive debate.

Armed with these insights we can now turn our attention to testing these findings in the real world. Have the biases in the Industrial Strategy, in the evidence base, and in stakeholder perceptions of interactions in the economy translated into policy? Can the most frequently connected themes help us to better understand where policy may not be being optimized given economic interdependencies and identify opportunities for experimental interventions? Can pull follow threads further to produce a more accurate understanding of the economic system and the role of productivity in it? While there are several possible next steps one of the most promising is to apply these findings to existing economic models to determine if they can be refined and to explore the potential of developing systems dynamics models to more thoroughly explore the determinants and impacts of productivity in the economy.

6. Implications

These findings suggest several important implications for productivity policy and research. The following observations may be useful in any refresh of the Industrial Strategy with the return of Government in Northern Ireland in 2020.

Productivity is a challenging concept that needs to be clearly articulated and socialized to be effective: The Economy 2030 document engaged with productivity far less than expected and it came up only rarely in the stakeholder workshops. This may be because it is poorly defined, poorly understood, difficult to engage with, or seen as less (politically) important than other (more mainstream?) factors. While productivity is obviously affected by a wide variety of policies regardless of whether stakeholders care to discuss the concept or not, and regardless of whether it is central to policy agendas, if the lack of clear definition and lack of policy centrality that we observed in the course of this study has been a long term feature of economic policy in Northern Ireland (and indeed possibly the UK) then it is no surprise that a variety of uncoordinated policies have been unable to meaningfully move the productivity needle.

Productivity policy should engage more with productivity: Although the Industrial Strategy focuses on competitiveness, it cites productivity as a key long-term indicator of Northern Ireland's competitive position, and one of its stated objectives is to accelerate the pace of productivity improvements. However, an analysis of the document indicates that productivity is not frequently mentioned relative to other concepts, such as jobs and education, and it is not as well-connected or central as many other concepts. This suggests that the productivity is not the most important focus of the current Industrial Strategy. If Government intends for productivity to be a central policy focus, then strategy documents need to more effectively explore the factors that influence productivity growth and engage with them in a holistic and meaningful way across policy silos.

Adopting a systems approach to policy design requires joined up strategy, policy design, implementation, and evaluation: There is no one size fits all approach to adopting a systems lens to public policy but there are some general phases that can guide the process. First, understanding the contours of the system is a crucial initial step. Exercises such as this research project can lay the foundations for this process, but it should ultimately be complemented by broader participatory mapping and strategy sessions that aim to explore and prioritize areas for intervention and where joined up governance has the potential to make an impact. This collaboration should include representatives across departments and, if possible, stakeholders from across sectors of the economy and should be institutionalized in the strategy development and then in the translation of that strategy into policy interventions (ideally adapting experimental approaches). This research provides on guidance by suggesting potential areas to focus collaborative efforts. The most frequently connected cross-silo concepts cited in the evidence base and the meta-map stand out as particularly suitable starting points for intersectional approaches or deeper research into the nature of policy connections and effects. Finally, policy evaluation should also engage a broad base of participants who collaboratively design criteria, interpret policy feedback, and formulate policy adjustments.

This study intended to adopt systems thinking to generate actionable policy insights and pioneer and test analytical techniques that might be applied to better understand and map systems in broader contexts. As in any evolving project, however, the journey through this process has raised many questions and uncovered several interesting paths for further co-developed research. Among these:

- The concepts linked across silo boundaries are, in themselves, quite broad. More work is required to deepen our understanding of the systemic interactions and causal mechanisms that they might be signalling to underpin specific policy recommendations in those areas.
- Our analysis was limited in that it looked for connections only between concepts drawn from the five pillars of the Industrial Strategy, but what would be revealed if the scope of terms was widened? A next phase of research could expand both the number of terms considered and their specificity.
- These results only suggest that there may be biases resulting from siloed approaches to policy design – they do not confirm that they actually exist. An analysis of departmental expenditures could provide empirical evidence of whether spending follows similar patterns as those identified in this report.
- This study focused on pairs of conceptual and policy connections but in all likelihood, interactions are much more complex. Various analytical techniques, including clique analysis can identify communities of related concepts that can shed further light on multi-layered interactions within policy systems.

While this research has provided some interesting new perspectives on productivity policy it has also demonstrated the potential of applying systems approaches to understanding policy practice. There remains significant scope to build on these foundations to generate more specific policy insights and further unpack the dimensions of the productivity puzzle, in Northern Ireland and beyond.

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APPENDIX: Workshop Summaries

Workshop 1 (Nov 19)

This was the smallest group with only five participants though in some ways this streamlined the conversation and enabled us to focus on specific issues in more depth. In this group, we spent a significant amount of time debating the purpose and goals of the Industrial Strategy and establishing the focal point of the map. Specifically, the participants maintained that the strategy could be centred around very different goals with very different consequences for policy. Ultimately, they settled on a goal of full employment and maximising wealth for everyone. In part, this was selected because it provided a clear focus for Industrial Strategy policies, but participants also felt that jobs in particular were an "easier sell" to Ministers and constituents than some of the alternatives. Suggested alternatives included goals of regional equality or an exclusive focus on sustainable growth. The social themes of inclusion, wellbeing, and quality of life were also in the running to be the focal points of industrial policy but participants agreed that making those central risked diluting the focus and fall into the trap of trying to make the Industrial Strategy have "something for everybody" such that it didn't accomplish anything. This was a theme that emerged in all of the workshops. In the end, these social factors were deemed important problems that increased employment and wealth could solve (and that, in turn, affected prospects for wealth and job growth). Productivity was mentioned briefly at the beginning of the session (as was innovation) but these concepts were eventually excluded as not central.

For this group, job growth and wealth creation occurred mainly through new firm formation and firm growth. In both cases, these rely on access to international markets. Therefore, concepts like trade, exports, markets, and FDI, and how to access and encourage them, were central to the discussions. The discussion of factors influencing firm growth and entrepreneurship was fairly lean and disciplined as we spent so much time debating the function of industrial policy. Participants focused on four broad categories: skills/talent, business environment, entrepreneurship, and FDI.

Skills/talent: This discussion focused on what participants perceived as a deficit of skills and talent and information to access and succeed in global markets. These included leadership and management skills as well as expertise required to navigate complex international markets. Related to the idea of information was research (and R&D) relevant to global investors. Discussion around talent was slightly broader. It was thought to be a foundation upon which firms were formed and grew. Complex (spatial) social factors were cited as a potential drag on the development of skills and talent.
Education was implicit to this conversation as a source of skills development (and as related to spatial disparities in educational achievement and outcomes perpetuating certain social patterns) but the discussion didn't engage more deeply than that.

Business environment: This was a term that was mentioned quite early in the conversation but that we eventually used to group together a series of related ideas. Broadly, these included business support, regulation, and infrastructure. Business support came up as important for firm formation processes as well as growth (particularly export-led). Participants noted, however, that the support landscape was crowded and complicated and that firms and entrepreneurs might experience difficulties figuring out which programmes were best suited to their needs. Regulation was only mentioned briefly and with specific reference to energy prices. Participants

commented that the structure of commercial energy pricing didn't make sense given the needs of industry. Other infrastructure specifically discussed included structures that enable connectivity and access such as roads and airports. These connect talent and jobs as well as have impacts on quality of life. Digital infrastructure was key for connecting with global markets and enabling access to critical information about the international economy. The entire grouping of factors in the business environment influences jobs and wealth directly but also the overall attractiveness of the Northern Ireland economy (which in turn linked to FDI and entrepreneurship).

Entrepreneurship: This was one of the key vectors of new firm formation and was, as such, the subject of a significant amount of discussion in this group. Entrepreneurship should be supported and enabled although the discussion focused less on the practical challenge of starting a business then what were perceived as cultural and motivational barriers. Related concepts raised in this part of the discussion focused on a negative perception of risk, a lack of individual confidence, lack of ambition, and a culture that is not supportive of entrepreneurial activity. Participants also noted issues with business scale, citing an event held earlier in the week that had pinpointed scaling up as a problem for SMEs in Northern Ireland, many of whom seem content to remain small. To the group, this was a problem related to entrepreneurship because they viewed the lack of ambition of the entrepreneur to grow their firm as a major barrier to adding jobs etc.

FDI: For this group, foreign direct investment (FDI) was another vital avenue to growth. Foreign investment in establishing branches in Northern Ireland not only produces jobs but was also thought to contribute to entrepreneurship and indigenous firm growth. While we didn't go into detail about how to best encourage FDI participants did draw a link with attractiveness (and, indirectly, business environment).

Some other notable points that emerged from the discussion but that weren't incorporated into the map itself included:

- An observation that there is a culture within government as well to deliver information but not engagement. This participant felt that government should focus less on telling businesses what they need to do and more policy co-production.
- The question of spatial variations within Belfast, and across Northern Ireland, came up at several points in the discussion. Spatial inequalities were viewed as drags on growth and as major policy issues, though were not necessarily central to their version of the Industrial Strategy. Rather, it was thought that the Industrial Strategy should focus on growing the pie for all, which would then facilitate redistribution to achieve spatial goals.
- In the realm of unintended consequences, one participant noted that Northern Ireland relies heavily on subventions and that there is an incentive to remain where they are on the deprivation ranks. If funding is tied to having a problem, then there is little incentive to fix the problem.
- The topic of firm death also came up on several occasions. The members of this group felt that supporting failing firms and industries was not a winning strategy and that particularly that increased exposure to international markets would enable competition to disrupt business as usual and help to eliminate uncompetitive enterprises.

Workshop 2 (Nov 20)

The second workshop hosted the largest group and yielded both more, more detailed, and different connections than the first map. As in the first group, we spent a significant amount of time discussing the appropriate goals of a refreshed Industrial Strategy contemplating several alternatives before settling on growth and wealth creation. This group struggled with whether the focus should be on a relatively abstract idea, such as growth, versus a more specifically on outcomes for *people*. In the end, the group decided on the more abstract focus on growth but kept coming back to the idea of people, suggesting that Industrial Strategy should care about encouraging the "right" kind of growth. The "right" kind of growth means focusing on high-quality, high-paying jobs and investment and not just chasing growth for growth's sake. In other words, growth that holds positive outcomes for people and not just for bottom lines. Like the first group, this group debated the role and importance of social factors – such as wellbeing and quality of life etc. They eventually decided that these factors were something that an Industrial Strategy would impact indirectly but should not seek to affect directly. The idea that making growth central would enable more effective redistributive policies developed elsewhere also dominated this discussion. There was also a strong movement in this group to simplify the Industrial Strategy around one disciplined purpose. Productivity was mentioned early on as a critical part of the growth equation but aside from a few isolated mentions largely receded in importance.

Growth and wealth creation – and an increase in the "right" jobs – were primarily linked to innovation, global demand and market orientation, and entrepreneurship and most of the other concepts discussed fed into one or more of these.

Innovation: Participants connected a lot of other concepts to this idea but did not go into great detail about how, exactly, it influenced the focal goals of growth and wealth creation other than it was thought to have a positive impact on both. Similarly, innovation was positively linked to productivity. Participants identified a reciprocal relationship between the suite of concepts related to skills/talent/knowledge/reskilling. For instance, noting that innovation contributes to skills development and talent/knowledge underpin innovation. This group was interested in discussing factors connected to the character of the Northern Ireland economy. In this case, the focus was more on local strengths and what makes Northern Ireland unique. The factors were linked to attractiveness and other groups of factors such as the social/quality of life grouping but was also connected to innovation. The argument here was that the unique local characteristics influence the types of innovation generated, while that innovation trajectory is part of what makes Northern Ireland unique. Throughout the discussion there was a strong focus on identifying and building on strengths rather than seeking to increase innovation in completely new sectors.

Global demand and market orientation: As in the previous session, this group felt strongly that an international orientation was an essential prerequisite for growth and wealth creation. Specifically, generating and maintaining global demand for what Northern Ireland does – in manufacturing and services was seen as crucial, particularly in growing a pool of the "right" jobs. While what the focus of these promotion efforts should be was not rigorously discussed some areas, such as AI and Industry 4.0, were mentioned as potential "winners". The issue of how well firms in Northern Ireland are able to access global markets was also raised along with concerns that the resources and capabilities to do so might be lacking. This was indirectly linked with the support environment and more closely related to the pool of skills/talent/knowledge required to effectively access and navigate these markets. The propensity for firms to engage

globally was also connected to the ambitions of firm leadership. This group also pointed to cultural factors that might influence individual psychology towards risk and that could be posing barriers to international growth.

Entrepreneurship: Entrepreneurship was identified as a source of growth principally through new firm formation, although it was also linked with firm growth strategies (see the previous paragraph on engagement in global markets). Entrepreneurship generally was seen to be a function of individual characteristics, government policy, business environment/ecosystem, and skills/talent/knowledge. Again, a risk averse culture was identified as a potential constraint on entrepreneurial motivation, whether to start a company, grow it (scale), or trade internationally. Participants speculated that entrepreneurs possibly felt disconnected from the economy – like their firms were personal projects versus important contributors to a collective endeavour (i.e. growing Northern Ireland). Consequently, they felt that increasing the feeling of embeddedness, of belonging, would encourage entrepreneurs to grow their firms beyond what would satisfy their own material needs and personal ambitions. This was also connected to the "uniqueness" of Northern Ireland, something that participants thought could be leveraged by policy to increase the embeddedness of indigenous as well as foreign firms. The group touched briefly on the role of government support for entrepreneurship but did not focus specifically on any group of policies. Factors such as access to finance, access to (global) networks, and connectivity came together into a grouping that was ultimately dubbed the "ecosystem". The availability of start-up capital, for instance, was described as fundamental, while differential access to social, business, and trade networks was thought to be partly a function of individual skills and partly of the types and density of extant networks. Connectivity – defined physically and digitally – was linked to infrastructure investment. Finally, participants linked entrepreneurship to the development of skills/talent/knowledge and particularly highlighted the importance of managerial and leadership skills as well as access to knowledge about markets, opportunities, and support programmes to firm growth.

Education and skills: While not directly linked to the central goals of economic growth and wealth creation, the clusters of concepts related to education and skills seemed to underpin many of those that were directly linked. This group distinguished between education, which occurs in schools, and training, which occurs in workplaces, and argued that both were important for attracting and retaining the "right" kinds of jobs. Both concepts were linked to economic adaptiveness and resilience. In particular, this group called for a better alignment between the skills produced by public investment with the actual demands of the economy and argued that educational success should be judged not just on completion rates but actual job readiness of graduates. Participants emphasised that government policies should focus on learning as an ongoing process and encourage private investment in workforce training and reskilling. Crucially, they thought that while curriculums and the skills produced by the education system in Northern Ireland could be much better aligned firms should also be more willing to invest in training their workers and not expect the task of developing talent to be a solely public affair. Adopting a combination of better aligned education and workforce policies was thought to be one key to addressing some of the social and wellbeing issues discussed at the beginning of the session.

Some other notable points that emerged from the discussion but that weren't incorporated into the map itself included:

- A note that economic inactivity rates are not even in Northern Ireland – they tend to be higher in the population aged over 40 years and among women (more of whom are opting to stay home with family). In the pursuit of the right kind of jobs policy makers needs to be cognizant of the capacity of and gaps within the labour market and ensure that these populations are not being left behind.
- One participant identified a boundary between college and industry in Northern Ireland. This connects two ideas previously discussed above – that students are emerging from secondary and tertiary education programmes without the necessary skills to go to work (both a supply and alignment issue) and the fact that there is not enough engagement between firms and their sources of talent (for alignment and ongoing education purposes).
- There was some disagreement about whether government should be "picking winners" in terms of targeting sectors for policy intervention and promotion or whether interventions should be more generalised. Those that thought interventions should be targeted wanted to make Industry 4.0 (as well as reindustrialisation) and AI central to any refreshed strategy. Those that were less enthusiastic about this approach argued that the major growth areas of the future might not even exist yet.

Workshop 3 (Nov 21)

The last session of the week differed meaningfully from the first two sessions in terms of the focus of discussions. The conversation was quite polarised between two themes of education and strategic FDI and the central objective of a refreshed Industrial Strategy for Northern Ireland was articulated in much more detail. These differences were possibly attributable to the fact that two individuals dominated the discussion – one from the Ministry of Education and the other from the private sector – and so the group spent the most time on their pet agendas.

The group chose to craft a mission statement as the core focus of the mapping process. They thought that a refreshed Northern Ireland Industrial Strategy should focus on getting more people working in better paying jobs in sectors that we can reasonably expect to be resilient and in areas of the economy where Northern Ireland can perform better than anywhere else. This discussion had some parallels with the previous session where the group emphasised the "right" jobs (here defined as "better paying") and the value of leveraging the Northern Ireland's uniqueness and strengths (here described as areas in which Northern Ireland can perform better than anywhere else). One participant argued that this mission statement could be summarised as a more productive job sector, although the consensus was ultimately that the mission statement approach was more appropriate. This group also thought the strategy should raise incomes overall. Finally, this group also wanted people to experience more joy. While there was some debate about whether that should be a real strategic focus or not, the group opted to keep it in on the grounds that we should not lose sight that the outcomes impact people and not just ledgers. What exactly constituted joy was never definitively established although it was linked with fulfilment, job satisfaction, and work-life balance. Interestingly and in contrast with other groups, other than this exchange about joy, social and wellbeing themes were not specifically mentioned or included in the map.

As mentioned above, the discussion about how to achieve the agreed central goals followed two dominant (but ultimately interrelated) themes centred on strategic FDI and education. Generally, the core goals were thought to be the product of economic growth through start-up, scale-up, and new (strategic) FDI activity. The concepts of creativity and innovation were directly linked to the core goals early on but remained orphans on the map. That is, aside from their connections to the core goals they were not linked explicitly in the discussion to any other concepts on the map. Productivity was discussed more in this session than in any other but was still quite weakly linked with other concepts. In this group, in addition to being reciprocally linked to the core goals productivity was connected with the sources of economic growth cluster (start-up/scale-up/FDI) as well as the group of concepts related to markets and demand (both indigenous and external). For the most part, the conversation focused on the drivers of economic growth through start-up/scale-up/FDI, though this was almost totally dominated by the latter. The two major themes (strategic FDI and education) intersected in their relationship between the skills/talent/training cluster.

Strategic FDI: While other session identified FDI as among the important elements of growth it was the core topic of conversation for a significant part of the third workshop. One participant emphasised, and others agreed, that the search for new sources and retention of FDI were a crucial source of growth for Northern Ireland but that it was important to be *strategic* about it. Strategic FDI involves targeting sectors and firms for FDI rather than seeking investment from any source. This topic was discussed in detail and so linked to a number of factors such as a group of foundational factors related to the knowledge pool and research capacity,

entrepreneurship, and talent/skills/training. First, strategic FDI is attracted to and helps develop a vibrant and supportive knowledge economy. This environment is a function of the research and knowledge generated by firms and research institutions (such as universities and labs) and is enhanced, nurtured, and leveraged through collaborative interactions between higher education and firms or between firms. This knowledge and these collaborations, and the talent that operationalises it, is one of the region's key competitive advantages. Ensuring the vibrance of this intellectual environment is what makes a place "sticky" in this era of footloose capital. Embedding foreign firms in this environment through the mechanism of collaborative relationships and by creating a steady pipeline of talent to enable them to scale their investments increases the likelihood of investment growth and retention. The concept was reciprocally linked to the intellectual environment and to FDI to the extent that as rich environment will produce spin offs from higher education, university-industry collaborations, from foreign entities, and that this entrepreneurial activity might be an attractor to new FDI and foreign investment growth. Talent and skills are important to sustaining knowledge creation and effectively commercialising it and, as a result, to attracting and retaining FDI. This grouping of concepts proved central to this map and was an important link between other core concepts.

Education: The prominence of education on this map is not surprising given the presence of a member from the Ministry of Education. While it was not, ultimately, explicitly connected to many other concepts various aspects of the education system in Northern Ireland was one of the dominant topics during the session. In the course of those discussions, it was strongly connected with the talent/skills, higher education/knowledge generation, and entrepreneurship groupings. The link between education and talent/skills and higher education/knowledge generation is intuitive – the education system contributes to both the quality of the labour pool directly or through the vector of higher education. As with the previous group, this group identified the alignment of educational outputs with the skills demanded by firms as an important lacuna. Participants suggested that there was an opportunity for education policy to be more closely coordinated (and potentially integrated) with local businesses. The education system was identified as an important area to influence cultures, attitudes, and skills required for entrepreneurship. Participants noted that there had been some successful programmes but that there was an opportunity for deeper collaboration between government and education to boost entrepreneurial attitudes amongst students. While the strengths of the education system were often acknowledged critiques were levelled at the suitability of its curriculum for the current demands of the workplace (e.g. mention was made about how students still learn about dot matrix printers), the lack of (resources for) career advice, the institutional fragmentation and duplication of the system, and a persistent long tail of underachievement.

Talent, skills, and training: This grouping of concepts ties together a lot of the themes discussed above. It is one of the foundations of the knowledge economy and is the pool of people to occupy the "better paying jobs" that are one of the central goals of this group's strategy. The group identified some important facets of the skills/talent/training nexus not mentioned in other groups, namely that the talent pool is (and can be) fuelled from different sources. Talent emerges most obviously from indigenous educational programmes. Here the group highlighted that Northern Ireland may be producing an impressive number of graduates, but that retention is an issue. This was partly associated with a misalignment of skills being produced relative to the jobs available that forces highly skilled graduates to seek work outside of Northern Ireland. This group also pointed out that immigration was also a source of talent and that there was potential to provide better support to those that are inactive to get them back into the labour pool. This

group also drew the distinction between education and training and argued that there was scope to invest more in this aspect of skills development outside of the educational system.

Other points that emerged from the discussion included:

- The opportunity for cross departmental policy for entrepreneurship. One participant noted that a recent OECD report recommended collaborative approaches to entrepreneurship policy.
- Trade with Ireland, or all island supply chains, may offer an opportunity to improve firm productivity. One participant observed that firms that trade internationally tend to be more competitive and productive. But, they argued, that trade does not have to be over massively long distances. They cited figures that showed that firms from Northern Ireland that trade in Ireland also tend to reap productivity gains. Given proximity and the relative ease of building cross-border networks, encouraging trade in Ireland might be an effective way to boost productivity.
- Productivity came back into the discussion right at the end where participants mentioned the Australian and New Zealand Productivity Commissions and wondered whether that was a model that Northern Ireland should consider.