Cluster Policy in Northern Ireland

Best practice and findings from consultation across three sectors

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Table of Contents

Executive Summary

Introduction

1. The idea of clusters as an economic development tool was popularised by Michael Porter in 1990. Porter's definition of clusters was as follows:

   Clusters are geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate (Porter, 1990).

2. Porter was most interested in the inter-linking of firms and institutions and in the 30 years since there has been further refinement of his arguments over what happens within clusters, their contribution to wider economic growth and how their development might be supported by policy. Equally there has been significant focus on geographic concentrations of businesses and how these contribute to regional and national economies.

3. These geographic concentrations can lead to economies of scale and scope, greater access to specialised resources or larger pools of labour and consequent reductions in transaction costs and risks associated with investment or innovation. These factors and others associated with clusters of firms can contribute to increased productivity, economic growth, employment growth and wage growth. Given this, governments have become over time understandably keen to be involved in cluster promotion and development (Wilson, 2019). A balance needs to be struck, however, with any risks of increasing costs for participants (e.g. congestion costs pushing up input prices) and thus consideration be given as to how government might be most appropriately involved in order to maximise benefits and minimise potential downsides.

4. At present, Northern Ireland (NI) has no formal cluster policy in place. However, there is a growing body of work where collaborative activity between industry, education / research bodies and government in NI is supported through a range of programmes. These include Invest NI's Collaborative Growth Programme – which began in 2007 – and a number of Competence Centres. The MATRIX panel, which began its work in 2008, has adopted a sectoral approach from the start and identified five priority sectors in NI (Advanced Manufacturing, Agri-Food, ICT Digital, Advanced Materials and Life & Health Sciences), to which MATRIX has applied capability analysis and foresight research.

5. The report reviews best practice from policy and academic research in the formation, management and development of clusters. It then discusses the findings of a recent report into the levels and nature of collaboration between organisations in three specific sectors and offers evidence on the reasons why collaboration is not much more widespread and productive in the NI economy. It concludes with some remarks on the factors which a cluster policy needs to take into account in NI, and recommendations to assist a successful implementation.

Lessons from best practice

6. The purpose of public policy – in the context of clusters – is to address key market failures including information asymmetries, coordination and network failures, and to encourage positive externalities around investment. The types of information

asymmetries might include a lack of knowledge about firms in similar or related industries - creating a potential role for a cluster policy in matchmaking / coordination activities, specific collaboration projects or in developing an appropriate incentive structure for knowledge sharing.

7. The lessons from elsewhere point to some conditions being necessary for cluster policy to work best. The obvious ones include an enterprise-focused macroeconomic environment where innovation is prioritised and markets function well (especially flows of knowledge, labour, capital and trade). Crucially, however, there is a need for both a critical mass of firms who can (sometimes simultaneously) combine competition and cooperation, and strong, strategic leadership for the clusters which emerge.

8. In general, the experience across countries implementing cluster policy has identified several necessary stages in the introduction of cluster policy, including analysis of local strengths and opportunities, reviews of cluster tools and good practice, implementation alongside monitoring, evaluation and policy learning. Cluster policy requires an approach which combines top-down (government-led) and bottom-up (meaning an element of co-design with diverse stakeholders) elements, and a clear decision about the resource which is being made available to the initiative. Above all, in policy design, there is a need for cluster policy to be complementary to wider business-related policy, rather than implemented as a stand-alone intervention. Mirroring the ideas of triple and quadruple helix in innovation policy, an inclusive approach should be employed, given the significant degree of overlap with other policy areas.

9. The other aspects of policy design – the sectors to be selected and the objectives to be set – also need to be clearly thought through. In terms of sector selection, the literature suggests that any policy must reflect the stage of maturity of sectors and existing clusters that are identified for support. In other words, as the experience of Innovation Norway shows, room needs to be made for support for both emerging sectors as well as supporting more mature sectors and clusters to become world leaders in their field (Wise et al, 2017). There are also lessons here about any cluster policy addressing real market failures and opportunities, as opposed to being an end in itself.

10. When it comes to the implementation of a cluster policy best practice emphasises the role of Cluster Management Organisations (CMOs). CMOs often originate in trade or sectoral bodies and have a particular sectoral or technology expertise, which can be critical in initial trust and credibility-building work. However, over time successful CMOs tend to develop into specialists in cluster management, technology/innovation management, internationalisation, etc. The typical activities offered by the more than 300 CMOs in Europe include match-making services for firms in the cluster, knowledge exchange, promotion of the cluster and region to international bodies, acquisition of funding for participants and accessing HR/skills development services. In terms of 'managing' the CMOs, the best practice is that funders or economic development agencies need to balance regular reporting of progress against objectives and how cluster participants are performing, with support by the agency for the CMOs to excel at their work (through access to training programmes, international events, etc.).

11. Evaluation of cluster policy is an area undergoing development. A key difficulty for the evaluation of cluster policy and initiatives is how to disentangle the effects of clustering, in terms of impacts on firm performance and on regional economies, from the effects of other policy inputs and individual firm interventions. A working group on evaluation, led by the TCI Network, has been developing thinking on how best to evaluate clusters and different methods are emerging in the Nordic countries and the Basque Country which is detailed in the report (Aranguren et al, 2014). To sum up on evaluation of policy a recent review of cluster evaluation research suggests the following results:

    - Significant evidence of a positive impact on firm-level innovation, influenced by connectivity to other actors within and beyond the cluster;
    - Less significant evidence of a positive impact on firm productivity, most particularly for newer and smaller businesses;
    - No significant evidence of a positive impact on firm-level employment; and
    - Evidence of positive impacts on regional competitiveness, including levels of entrepreneurship, rates of GDP/GVA growth (Wise et al, 2017).

Some findings from the consultations: Collaboration and its catalysts and barriers

12. For the purposes of the report a total of 72 business consultations were carried out across three sectors or business/technology areas in order to better understand the clustering and collaboration landscape in NI. The three sectors are as follows:

    - High-Tech Creative Industries;
    - Immersive Technologies; and
    - Materials Handling and Quarrying Equipment.

13. A sectoral approach is useful for the analysis of the themes identified by sector but raises questions about the fluidity across some emerging sectors, particularly between High-Tech Creative and Immersive Technology, as firms increasingly self-identify in ways that make the traditional sectoral boundaries less relevant. This is important for clusters which can benefit from 'related variety' or coming together around technological or innovation capabilities as opposed to belonging to any one sectoral definition (Hartog et al, 2012).

14. More than 80% of the businesses consulted collaborated with other partners, with a focus on business activities such as innovation, purchasing, pooling of skills, etc. Consultees highlighted specific supports provided by Invest NI and NI Screen to develop collaboration and encourage enhanced clustering activity. However, in general the consultations reflect a point in time where firms across the three sectors are still working out not only who to collaborate with, but also to what end.

15. Table I shows that a majority of the firms, across all three sectors, collaborate vertically (i.e. with customers and, to a lesser extent, within their supply chain). A key exception to this vertical collaboration is that with higher/further education (HE/FE) institutions. A majority of the businesses consulted have some connection with these institutions, though the proportion is much higher in High-Tech Creative and Immersive Tech than in Materials Handling. From the education provider perspective, it is telling that this collaboration often centres more on the potential for

skills development and placements, rather than technology or knowledge transfer. Materials Handling is an exception as both elements are seen as equally important.

Table I: Collaboration partners by sector

Collaboration Partner	High-Tech Creative Industries (N=25)	Immersive Technologies (N=22)	Materials Handling & Quarrying Eq (N=25)	Total (N=72)
Own supply chain	8	6	5	19
Own customer	13	15	11	39
FE / HE institutions	18	14	10	42
Competitors	10	7	3	20
Related industries	12	10	4	26
Other /not specified	5	6	3	14
No collaboration	2	0	10	12

Note: Consultees often had more than 1 partner.

16. Among the businesses consulted, 'horizontal' collaboration (i.e. with competitors and/or related industries that develop complementary products and services) was more limited. Consultees in emerging sectors felt that horizontal collaboration is more important (in theory, if not fully realised) than those in a more mature sector like Materials Handling. When asked about the location of collaborative partners, customers (and to a lesser extent suppliers) can often be located outside NI, especially in the case of Materials Handling and parts of High Tech Creative (animation and film & TV). HE/FE partners and those in related industries or competitor firms tend to be located locally. Interestingly, the all-island economy is much less present when it comes to collaboration. A small number of consultees – usually successful and keen to gain access to scaled-up businesses – are collaborating on a cross-border basis, notably in animation and gaming, but this is not the norm.

17. When the idea of a 'cluster' or 'clustering' was raised with consultees, it is clear that to many this meant that their business was one of a number operating in the same sector and/or in the same general location. This is particularly the case for consultees in the Materials Handling and High Tech Creative sectors. The idea of a 'sectoral concentration' being the same as a cluster is related in the minds of consultees across all three sectors with the existence of critical mass. This could arise from the existence of global firms among consultees, such as Powerscreen and Terex for Materials Handling, or the ability to attract significant levels of FDI in a particular technology stream, such as in Dublin where IDA Ireland have been successful in the case of gaming and animation.

18. Consultees expressed general support for collaboration and an understanding of its benefits for their firm, but they also identify significant barriers to beginning and extending collaborative relationships. Figure I provides a 'word cloud' illustration of the key barriers.

Figure I: Summary of barriers to clusters

19. However, it is important to note that there are differences in the barriers identified between the three sectors and this is further detailed in the report. These highlight differences between a mature sector and the barriers identified by emerging sectors. For example, critical mass is much less an issue for Materials Handling, while resource requirement is a key barrier for the small firms engaged in High-Tech Creative or Immersive Technology.

20. A key barrier identified by consultees across all three sectors is the **lack of trust**. Sometimes a fear of losing intellectual property tends to lead to lower levels of innovation collaboration, or it is a concern about losing highly skilled staff to competitors. The lack of social networks to get to know other actors is connected to one other notable barrier identified by consultees: **Information Gaps**. Specifics can include an absence of profiles of potential partners and their capabilities, something which was raised in particular by smaller enterprises (Roper, Lover and Bonner, 2017). This suggests that creating knowledge networks and trust may go hand in hand.

21. Figure II illustrates the catalysts identified by consultees as being important to assist new or further collaboration. In general, the need to **articulate the benefits** of collaboration and clustering is seen as critical. Consultees regularly returned to the idea of risk vs reward. For those not currently engaged in collaboration, they spoke of a need for a clear demonstration of "what would be in it for me", and a need to be convinced that "free rider" risks would be addressed. Even among consultees who had gained from collaborative projects (in terms of turnover or innovations brought to market), there remained a desire to see how improving the sector might benefit their firm. Interestingly, among the more suspicious, improving the "place" rather than the "industry" appeared to be more persuasive.

Figure II: Summary of catalysts for clusters

22. Although **creating trust** was identified by consultees as necessary to underpin any collaboration, there was little consensus around what initiatives might best achieve this. In some countries (e.g. the Basque Country), building trust has been attached to the (pre)existence of strong social networks or bonded social capital (Aragon et al, 2014). The extent to which social networks are part of the context for a cluster policy or something which emerge as a result of it, remains an open and important question. Related to the question of trust is the emphasis placed on a dedicated resource or **Cluster Management Organisation (CMO)** as a catalyst for collaboration. There was a difference of perspective depending on whether the consultee was keen on sparking off a new collaboration – in this case regarded as useful, but not critical – or were looking to deepen existing collaboration. In the latter case, consultees regarded this resource as essential, with sectoral knowledge, impartiality and independence all raised as key success factors.

23. Within mature, competitive sectors, consultees pointed to potential distrust between incumbents and new entrants and the need to create a strategic vision for the sector into which participants can buy. The consultations show how in the emerging sectors there may be more scope to engage in collaborative activities, as there is less direct competition with other market participants. Allied to the issue of dealing with competitors, another catalyst for collaboration – identified across all three sectors – was the opportunity to work outside their specific industry. This shows a sense that there may be less competition involved in this type of collaboration, as well as a realisation about the potential to work with other complementary areas or skillsets.

24. The consultations also deal with what the impacts are from collaboration and provide further detail on how this works at the level of the three individual sectors. Given that the terms 'collaboration' and 'clustering' tend to be used inter-changeably (including by many consultees), the report offers a working definition which might be applied. As the research progressed it became clear that a 'collaboration–clustering spectrum' exists.

25. Table II provides an illustration of the spectrum in which, for example, the range of collaboration may be narrow or project-based at one end of the spectrum but can be expected to be much broader and strategic in a cluster. The consultations suggest

that in NI most activity is closer to the 'collaboration' end of the spectrum. What might be described as 'deep clustering' activity remains at an early stage of development, especially horizontal collaboration between businesses. However, this is a dynamic situation and the consultations show how the extent of collaboration differs across individual firms, as much as across sectors.

Table 2: Attributes/activities in the collaboration-clustering spectrum

Attribute / activity	Collaboration	Deep Clustering
Vertical collaboration	✓	✓
Horizontal collaboration	✗ Limited / none	✓
Other collaboration e.g. with FE/ HEIs	✗ Limited / none	✓
Recognition that broader sectoral competitiveness is challenged	✗ Limited / none	✓
Part of sector strategy or action plan	✗	✓
Range of collaboration	Narrow focus, single-project based	Wide-ranging, strategic undertakings
Timescale of collaboration	Finite, project-based	Ongoing, not time-bound
Perspective of participants	Project / Company-focussed	Company / Sector-focussed

26. A key theme emerging from the consultations was that the degree to which strategic direction underpinning collaborative activity exists **within a business** was crucial to understanding where an individual firm placed itself (and others within their sector) along the collaboration-clustering spectrum. Across all three sectors, in general, collaboration is pursued on a project-by-project basis, often with a specific end or ends in mind. There are only a few exceptions to this rule, where collaboration is a strategic pursuit by businesses, a means to increasing value across the sector as well as within individual firms.

27. In sectors such as Hi-Tech Creative, business activity tends to be highly collaborative by nature, where a large number of small firms collaborate on individual projects on a freelance basis. In these instances, the project drives the collaborative activity and at the end of the project, individual firms then go in search of the next project – sometimes jointly, sometimes not. **The point being the project is larger than the individual firms that make-up the project.**

28. Contrast that, with sectors (or firms) operating towards the clustering end of the spectrum which tend to have multiple projects ongoing with a variety of participants at any given time. These projects tend to span a range of industry-relevant activities,

rather than a focus on product improvement within a single supply chain. **In these instances, the firm is bigger than the individual project.**

29. One final remark, which should be important to policy makers, is that a number of consultees saw collaboration as potentially bringing benefits to them, but they did not necessarily see moving along the spectrum towards deeper clustering as a benefit. This can be the case, even if it might be useful to their sector or technology area. This could have an impact on the amount of time and resource that any individual business is prepared to allocate to deeper clustering activity.

Recommendations

30. Although there can be difficulties in identifying or defining clusters, policy-makers are keen to promote cluster emergence, development and evolution. The report includes a series of policy recommendations aimed at supporting the emergence and consolidation of clusters in Northern Ireland. The recommendations – listed below - cover a range of suggested policy actions and are grouped under three headings of 'laying the groundwork' for clusters, cluster policy development and cluster policy implementation.

R01: Maintain progress in achieving draft PfG outcomes to ensure necessary conditions for growth are in place for NI; further embed the collaborative working culture.

R02: Ensure skills and innovation policies remain up to date and appropriate for business needs through updating of evidence bases, and close working with businesses and FE / HE institutions.

R03: Continue scenario planning for EU exit and continue to work closely with GB counterparts and Westminster.

R04: In terms of data captured via industry/firm mapping, investigate feasibility of including (if available) data on:

- Participation of firms in government initiatives;
- Receipt of funding or other support from government;
- Exporter status of firms;
- Inter-firm linkages; and
- Inter-industry linkages.

R05: Support for emerging and established clusters should be targeted across NI using a competitive bid process with clear eligibility, selection processes and scoring criteria.

R06: Broaden the evaluation of existing programmes – especially in trying to understand specific barriers to innovation, growth and export development – in order to assess where it may be appropriate to use available cluster supports to address these barriers and further attract participants to collaborate in these areas.

R07: Government should lever existing initiatives and networks to increase industry knowledge about collaboration opportunities and potential partners.

R08: Ensure policy has a long term window and is flexible across a variety of industry/priority sectors and adaptable according to cluster maturity.

R09: Ensure full integration of cluster policy (and collaborative approaches) with wider, traditional policy and programmes. Ensure consistency with policy in GB and Ireland.

R10: Structure support in a way to maximise additionality. Consideration should be given to building in "fast fail" mechanisms within longer term strategies.

R11: Intended outcomes of policy should be clearly identified with milestone objectives, SMART targets and embedded data gathering, monitoring and evaluation.

R12: Policy staff may find it helpful to work with statisticians and economists to ensure appropriate and robust data are available for use in monitoring / evaluation work; and to identify appropriate methodologies for such work. The communication of results should be considered in relation to assessing the benefits for participants.

R13: Government should encourage the establishment of a CMO, particularly where a lack of strategic focus exists and firms are predominantly micro-enterprises with limited resources for coordination.

R14: Consideration to be given for the need (over time) for a CMO to reflect both sectoral expertise and expertise in the management of clusters and the support services for these.

R15: The priorities of a CMO are likely to depend on the nature of the sector involved; though it may be appropriate to require the building of a strategic vision and the creating of trust-building initiatives to be part of any initiation plan for the CMO.

R16: The CMOs should be regarded as a wider policy resource in this area, in particular in driving cross-sectoral and international policy learning and connections.

R17: Consideration should be given to how public sector and other actors can use particular tools (such as SBRI in the innovation space or 'global sourcing' missions for export development) as stimulants for collaboration and wider cluster development.

1 Introduction

1. The Ulster University Economic Policy Centre (UUEPC) has developed a research paper on the **levels and nature of collaboration between organisations in specified sectors**, and produced an evidence base on the reasons why collaboration is not more widespread and productive for the Department for the Economy (DfE). From this research, UUEPC has developed **policy recommendations to improve collaboration, towards the development of clusters in Northern Ireland** (NI).

2. The specified sectors are *Immersive Technology*, *High-Tech Creative Industries*, and *Materials Handling and Quarrying*. The research specifically aims to provide:

   - An assessment of levels of collaboration (within the consultee group);
   - Understanding of types of organisations with which firms collaborate;
   - A better understanding of the purpose for collaboration and its impact;
   - An assessment of reasons for non-collaboration;
   - A comparative analysis of the specified sectors with respect to collaboration; and
   - Recommendations of interventions to support and create clusters including changes to existing programmes or introduction of new programmes.

3. This research will be used to inform the *Leveraging Cluster Policies for Successful Implementation of RIS3* (CLUSTERS3) project and will support delivery of action points 1 (cluster mapping of smart specialisation projects) and 6 (examination of pragmatic ways to support the growth of clusters in key priority areas) of this project.

4. This report includes:

   - A literature / policy review of clusters & barriers to their successful development;
   - Findings from consultations (providing an overview and an analysis of existing collaboration within each sector, case studies of successful collaborations and reasons for non-collaboration within sectors); and
   - Recommendations, based on international best practice, for changes to existing policy programmes or introduction of new programmes to address non-collaboration.

2 Literature review

1. This section of the paper provides detail on what is meant by clusters, the current policy landscape in NI, and identifies best practice from academic and policy literature in the formation, management and development of clusters.

2. It is important to note that the purpose of this paper is **not to examine whether cluster policy is an appropriate pursuit, nor to identify appropriate sectors for intervention** in NI, as this work has been previously undertaken by, and remains ongoing in, DfE. As such, **this literature review focuses on best practice**, in order to maximise benefits and minimise risks of such policy intervention.

2.1 Conceptual issues: Defining and identifying clusters

3. The term *clusters* is open to interpretation but has traditionally referred to an inter-connected network of businesses and other actors (Lämmer-Gamp *et al*., 2012). In recent years the thinking on clusters has evolved to reflect the diversity of clusters – in terms of their size, the nature of their activity and the structure (Wilson, 2019). There is also an ongoing debate over the 'mapping' of clusters and how these might be identified (Delgado et al, 2016; van Egeraat, 2018).

4. The goal for clusters and policies to support them is the development of networks of firms and other organisations that reach a critical mass, at which point increased productivity and competitiveness, theoretically begins to be realised by those participant firms (DASTI, 2015).

5. The definition of clusters utilised by DfE is derived from Porter's work as follows:

   "Clusters are geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate."

6. Cooperation is emphasised as being feasible, either vertically or across related industries rather than with direct competitors (Porter, 1998). However, the boundaries of clusters should be defined by linkages and complementarities that are important for effective competition. Therefore, it is not unusual for clusters to cross international boundaries, something which has important implications for considering what constitutes a cluster in the NI setting, given the land border with the Republic of Ireland.

7. However, given the variety noted above, to identify clusters (or potential clusters) in practice is not straightforward (Kiese, 2017). First, the term "geographically concentrated" does not specify an appropriate level of geography or appropriate measure of concentration (van Egeraat and Doyle, 2018). Clusters can be found in all geographical units, from (for example) official areas (e.g. NUTS) to organically generated units based on the specific data under investigation, to cross-border geographies (Wilson, 2019). Further, there is no clear threshold at which the degree of concentration or specialisation becomes "high" (van Egeraat, 2018).

8. Secondly, there are issues in defining the specific sector or industries under consideration. Defining a cluster based on a single industry tends to perform poorly

in capturing industry inter-dependencies (van Egeraat, 2018); but must be sufficiently specific to avoid non-impactful activities (Maxwell Stamp, 2013).

9. Consequently, policy makers and researchers often find setting appropriate cluster boundaries a challenge. Best practice policy approaches in cluster identification and resource targeting are examined in Section 2.3.2.

2.2 Cluster policies: Why the interest?

10. Despite the difficulties associated with identifying clusters in practice, policy-makers are often keen to promote cluster emergence, development and evolution. Successful examples of clusters – software in Silicon Valley, environmental technologies in Austria or games development in Dundee – demonstrate the benefits theorised to result from clustering.

11. Porter (1990) identified that the headline benefits of clusters would be improved productivity, increased innovation and the formation of new businesses. Such benefits are typically as a result of realising economies of scale and scope, in addition to positive externalities associated with closer working relationships.

12. A number of authors note that a high degree of geographic concentration in an industry with close interlinkages increases access to specialised resources (Giuliani *et al*., 2013; Polozhentseva and Klevtsova, 2015). This may be in the form of access to larger pools of skilled labour, or close linkages with educational and research institutions (Delgado *et al*., 2016), or may relate to access to other specialised factors of production (Schmiedeberg, 2010).

13. This access to specialised factors of production may help to reduce transaction costs that would otherwise be associated with sourcing such inputs (Delgado *et al*., 2016). Alternatively, it may be that as part of a cluster, participants hold a stronger bargaining position when negotiating on supplier prices (Giuliani *et al*., 2013). This lowering of cost can represent a decrease in barriers to entry or expansion, thereby enabling an increase in entrepreneurship within the industry (Delgado *et al*., 2016). The pooling principle also applies when considering the sharing of innovation or investment risk (Roper *et al*, 2017). While the overall risks may increase due to larger project size, the risk faced by each individual participant will decline, thereby increasing their incentive to engage in innovation or investment activity.

14. Cluster policy is therefore one method of identifying and tackling barriers to improving regional innovation, growth and employment (Kiese, 2013). It builds on various input factors to address systemic or network failures, the risk of regions being left behind in the industrial restructuring associated with globalisation and automation (Polozhentseva and Klevtsova, 2015), and continued under-investment in innovation and R&D. The policies come with the intention of fostering long term and sustainable improvements in economic outcomes (Uyarra and Ramlogan, 2012; Wise *et al*., 2017).

15. Porter (1998) emphasised the importance of competition in successful clusters to drive forward development and innovation. Increased entrepreneurship within the industry and via attraction of business from other regions serves to drive forward this increase in competitive forces. Innovation may further increase thanks to

improved relationships and collaboration between industry and research institutions, and knowledge spillovers (Konstantynova, 2017; Magennis and Gough, 2015).

16. Clusters may also serve as a signalling device to the markets – the existence of a cluster indicates a strong regional industry. This signalling may help to reduce uncertainty and thereby increase investment in the industry (Kergel *et al*., 2014).

17. Participant firms in clusters may be better placed to access finance from private sources through pooled risk; further, they may also receive increased funding from government e.g. due to increased capacity to deliver on contracts (Kergel, 2018).

18. The factors noted above all contribute to increased productivity, economic growth, employment growth and wage growth. As such, governments have become over time understandably keen to be involved in cluster promotion and development (Wilson, 2019). However, if market failures and bottlenecks exist in the markets, clustering may result in increased costs for participants e.g. congestion costs pushing up input prices. As such, it is important to consider how the government might be most appropriately involved in order to maximise benefits and minimise potential downsides.

2.3 Cluster policies: Common themes & illustrative case studies

19. Ultimately, the purpose of government intervention is to reduce or remove market failures in order to pave the way for economic growth and improvements in living standards for the population as a whole.

20. In the context of clusters, key market failures addressed include information asymmetries, coordination and network failures, and positive externalities around investment (European Commission, 2016; Giuliani *et al*., 2013).

21. Information asymmetries may result where competitor firms are unwilling to share information about products or services under development, or may arise due to a lack of knowledge about firms in similar or related industries (Roper *et al*, 2017). As such, a role for cluster policy exists in matchmaking / coordination activities, specific collaboration projects or in developing an appropriate incentive structure for knowledge sharing, noted in Case 1 below.

Case 1: Plugging the information gap

We will work with local partners to develop a portfolio of High Potential Opportunities around strategic supply chain gaps, places and clusters that are attractive to investors and have economic potential, ***but which are not widely understood by businesses as they do not have sufficient market information***.

- UK Industrial Strategy, 2017 (emphasis added)

The UK Industrial Strategy (2017) highlights the importance of clusters to both regional and national economic growth and commits to strengthening, in particular, emerging clusters.

In doing so, the UK Government recognises that market information is imperfect, leading profitable opportunities for firms to go unnoticed. Policy has therefore committed to highlighting such opportunities and therefore reducing the extent of information asymmetry.

22. The remainder of this section reviews necessary conditions for successful cluster policy implementation, identifies common policy approaches elsewhere and associated challenges in implementation, drawing out best practice in clusters and cluster development policy.

2.3.1 Necessary conditions for clusters

23. In summary, literature highlights seven key elements as necessary conditions for the development of successful clusters and successful implementation of cluster policy. These are as follows:

- A macroeconomic environment conducive to business growth;
- A strongly competitive environment;
- A critical mass of firms;
- Willingness of firms to collaborate with external organisations;
- Sufficient capacity in the local economy;
- Strong coordination of industry / cluster management; and
- Responsiveness to mega trends.

24. Dynamically developing clusters often emerge in a macroeconomic environment where research, science and innovation are strongly supported (Burger *et al*., 2015) and with well-functioning markets, in particular ease of movement of labour, capital, products and knowledge (European Commission, 2016; Lämmer-Gamp *et al*., 2012; Porter, 1990).

25. Much of the dynamism associated with clusters is also as a result of economies of scope, or the extent to which there are co-located related industries present in the region (European Commission, 2016). In NI, this mapping work has been initiated by the Department for the Economy.

26. A competitive environment is crucial, and to be encouraged alongside cooperation. This is not to say that businesses should collaborate with their competitors in areas of intense competition; rather, competition and cooperation can occur on different dimensions and across different actors. Porter (1998) emphasises the role of competition in the product market – "*without vigorous competition, a cluster will fail*" – and notes that much of the cluster's cooperation occurs vertically and or with related industries.

27. Not only should the business environment be competitive, a critical mass of firms is often required in a given industry (and related areas); ideally with many operating at least at a European level of competitiveness. The greater the potential for knowledge spillovers, the greater the impact of any clustering activity; as such, if industry in a region is dominated by a small number of large firms, cluster policy may not be the most appropriate policy tool (Maxwell Stamp, 2013).

28. Furthermore, there needs to be critical mass in firms that are willing to actively participate in a cluster and engage in collaborative activities (Lämmer-Gamp *et al*., 2012). The Gold Standard for cluster management organisations (CMOs) requires a minimum of 15 active participants (with at least 50% drawn from businesses) and evidence highlights that at least 30-40 active participants is beneficial (Kergel *et al*.,

2018). However, these numbers are not prescriptive as the ideal numbers of participants will vary across regions and sectors.

29. Clustering activity may be viewed as the next step in teamwork that is already in place through informal networks, via formalisation of that collaboration into a strategic framework. This requires regular contact, consensus on key issues, collaboration at multiple levels and involvement of all parties in forging strong linkages (Maxwell Stamp, 2013). Consequently, successful cluster development depends on its participants and their degree of willingness to collaborate with external parties.

Case 2: Cluster participation and performance across the European Union

Between March 2016 and March 2018, benchmarking data were gathered for 316 cluster organisations across Europe. This included 82 from the Danube Region (covering 10 countries and two German regions) and 234 from the remaining EU member states and Norway (referred to subsequently as "EU").

Within EU clusters, 50% have between 40 and 130 participants, and a median of 70.

Cluster initiatives in the Danube region are relatively small, with an average of 35 participants.

One area of study was the number of participants who were committed to the cluster – i.e. not just subscribing to a newsletter or engaging in one-off collaboration, but rather active, regular participation or ongoing financial support. This is important in developing critical mass for sufficient interaction between participants and resultant impactful activity.

Clusters in the Danube Region tend to be relatively small for several reasons, including more challenging framework conditions (given, historically, a lack of stable cluster support) and a relatively lower industrial density. While the number of cluster participants is lower in the Danube Region than their EU counterparts, the composition is consistent – both are dominated by SMEs and other industry representatives, and their concerns dominate the cluster agenda to similar extents.

Given the scale of industry in Northern Ireland, it may be more likely that clusters similar in size to those in the Danube Region are a more achievable target for the majority of sectors. Given their relatively small size, it is therefore of particular importance to: (a) ensure regular, productive interaction between participants; and (b) ensure that industry representation takes a lead role & comprises at least 50% of active participants.

- Kergel *et al.*, 2018; UUEPC insights

30. A key motive for agglomeration or spatial concentration is labour market pooling, as noted in Section 2.2. It signals to labour that skills in a particular specialism have a good chance of generating future employment and, simultaneously, that firms have a better chance of finding workers with necessary skills. In other words, matching between firms and workers is improved (Saha et al, 2018).

31. However, firms with similar labour requirements, operating in close proximity, risk staff being poached by rival firms – this is particularly the case where supply of skilled labour is limited and employees have access to crucial knowledge about their own firms (Combes and Duranton, 2001). In such fiercely competitive environments, it

may be expected that competition for skilled labour will increase and incentives for collaboration will therefore decrease.

32. Consequently, a necessary condition for the successful implementation of cluster policy is a responsive labour market. Government may therefore have a role in facilitating or improving labour mobility across regions, or in ensuring responsiveness of Further and Higher Education Institutions to the requirements of key industries.

33. Finally, where the fundamental conditions are in place and a cluster or significant / repeated instances of collaboration begin to emerge, it is important to have strong leadership to help propel such groups forward into long-term, strategic dimensions (Lämmer-Gamp *et al*., 2012). Best practice in development and activities of cluster management organisations (CMOs) is further examined in Section 2.3.3.

2.3.2 Best practice in the policy approach

34. Experience across countries implementing cluster policy has identified several necessary stages in the introduction of cluster policy (see for example Konstantynova, 2017; Maxwell Stamp, 2013), which include analysis of local strengths and opportunities, reviews of cluster tools and good practice, implementation alongside monitoring, evaluation and policy learning.

35. European Commission (2016) provides a useful summary table of policy "dos and don'ts" – much of this section is drawn from this comprehensive research and the summary table is included for reference as Appendix D.

36. As noted in Section 2.3.1, the landscape needs to be understood, which normally involves a cluster mapping exercise and encompasses a wider policy review. In the latter, policy makers can identify if changes are required in the wider business environment, to ensure it is broadly conducive to growth.

Best practice in policy design

37. Given that government resources limit how far support can be provided to all existing or potential clusters, policymakers sometimes choose to take a top-down approach, where specific sectors or locations are targeted for support (Kiese, 2017; Maxwell Stamp, 2013; Ontario Government, 2017). In this case, the key is to identify areas of existing comparative advantage with the potential for continued growth. This can mean mapping of sectoral concentrations (in terms of both number of firms and industry employment), and of existing networks (Delgado *et al*., 2012; European Commission, 2016). However, as noted in Section 2.1, the identification of appropriate levels of geography and what constitutes specialisation is not clear-cut.

38. Consequently, combining this top-down, targeting approach with a business-led, bottom-up approach tends to generate the best results. In a bottom-up approach, criteria are set to qualify for support and open competition determines the most suitable candidates. Lock-in or path dependency can be avoided through inclusion of an entrepreneurial discovery component in the policy (Delgado *et al*., 2012; European Commission, 2016; Havierniková *et al*., 2016; Maxwell Stamp, 2013).

39. If policymakers choose to target specific sectors for intervention or need to prioritise a limited number of sectors for support, account should be taken of the sectors'

competitiveness, growth potential, absorptive and coordination capacity, and existing infrastructure that could be utilised. Government should understand how the industry has evolved in order to assess its and the cluster's expected growth trajectory (Delgado *et al*., 2012; Hospers, 2005; Maffioli *et al*., Eds. 2016; Maxwell Stamp, 2013).

Case 3: Clustering policy design in Germany and the role of government

A key policy objective for Germany has for many years been equality across the regions, but unification in 1990 increased spatial disparities in productivity and innovation capability. The German economy consists primarily of SMEs and the innovation system is focussed on incremental innovation and diffusion, but lacks strength in radical and breakthrough innovation. Promotion of cluster policy was therefore viewed as a means of improving regional equality, economic growth and internationalisation across Länder.

***BioRegio**: In the mid-1990s, Germany's biotech sector lagged significantly behind the US & UK. BioRegio launched in 1995 to identify & promote the most promising biotech clusters in the new Länder. Three winners each received €25m over 5 years and privileged access to R&D funding from a Federal programme. Significant growth in the subsequent five years, even with other assistive factors, saw BioRegio regarded as a key jumpstart to the domestic industry.*

***InnoRegio**: Adapted from BioRegio in 1999 with a purpose of closing the gap between eastern & western states, InnoRegio was open to all Länder, industries & technology. The initial call generated 444 applications and 23 projects ultimately received support. This competition was judged a success and spawned a range of programmes, called Entrepreneurial Regions.*

***Go-Cluster**: Cluster excellence programme launched in 2012 to support CMOs in development activity. Currently, 87 members make use of the programme services, including professionalisation, visibility and closer relations with other clusters.*

The policy environment comprises a federal government and 16 federal states (Länder), each of which has its own constitution, legislation, etc. Cluster policy may also be developed by towns and municipalities to complement the federal and Länder policies, while also addressing specific local needs.

Federal Government usually establishes the general framework and desired direction of cluster policy; the majority of practical measures are via the Länder. Federal focus is typically focussed on increasing innovation and facilitating the clusters' efforts to internationalise. Support across the Länder varies based on requirements present in each state but is particularly focussed on improving cluster management, innovation and education. All policy levels focus on SMEs & development of networks, both domestically and internationally.

Typically, German clusters are co-financed from several sources (on average 41% public funds, 28% membership fees and 22% chargeable services). This mix encourages a proactive approach in development of new activities and projects, and in raising further funding. This approach is helpful in ensuring cluster sustainability.

Clusters policy is closely integrated with more general regional development policy and innovation strategies, and is perceived positively by both the government and entrepreneurial sectors. The German government has therefore put in place a range of specific, targeting measures; however, a market-driven element of cluster establishment has been retained. Potential clusters have been required to self-identify and, rather than government taking an active role in bringing parties together, the German government has adopted a facilitative role.

- Adapted from Burger *et al*. (2015) and Kiese (2013)

40. In terms of location-specific policy in a small country, national-level cluster policies are generally sufficient to benefit many areas. Indeed, local / regional policies are only appropriate where there is very high concentration of firms, particularly those involved in research (van Egeraat and Doyle, 2018).

41. In summary, the literature suggests cluster policy should be developed that reflects: (a) the maturity of sectors and existing clusters identified for support; (b) the local context (via inclusion of diverse stakeholders in policy development); and (c) the resource available to the initiative.

Case 4: Norwegian Innovation Clusters: assisting maturity

Cluster policy began in Norway in 1995 with RUSH – an experimental cluster programme that focussed on network-building. It was followed by REGINN in 1997, which focussed on development of collaborative projects. This was the pre-cursor to Arena.

Arena was developed in 2002 with **a focus on emerging clusters**. It aims to promote innovation through collaboration between business, education / research institutions and public sector and targets regional business communities with a high industry concentration. Funding is available for 3-year development projects, subject to satisfactory evaluation on an annual basis. While there are no thresholds for participant numbers, on average there are 12-15 industry participants per funded cluster.

Policy targets clusters across 3 levels of maturity, all regions and all industries in Norway.

*Receiving support are **22 emerging** clusters, **14 established** clusters and **3 mature** clusters with international status.*

*Support comprises access to **finance**, provision of **advice**, **networking** services, **profiling** services & **administrative** support.*

In 2006, the cluster policy concept was extended to **support established clusters** via Norwegian Centres of Expertise (NCEs). This aims to increase innovation and internationalisation activity to accelerate ongoing development processes. This provides up to 10-year funding for development projects in 3-year funding cycles, subject to satisfactory performance in an annual evaluation.

In 2014, the Norwegian Innovation Clusters programme was established, bringing Arena and NCEs under the same policy heading and extending NCEs to Global Centres of Expertise (GCEs). Where Arena and NCEs target emerging and established clusters respectively, GCEs **assist mature clusters** in becoming world-leaders, or which are seeking to identify new action areas with which they can engage. **There has been a change in focus over time to make room for emerging clusters.** GCEs can access funding for up to 10 years if eligible – mature clusters with potential for domestic and internal growth, that already have systematic cooperation in strategic areas (both within and external to the cluster), and with companies already part of the global value chain.

Innovation Norway **allocates funds and practical support based on a competitive bid process**, without setting targets for specific industries or regions that may be preferred and the onus is therefore on industry to take the lead in cluster establishment. As such, the government takes an entirely bottom-up approach but tailors its support according to cluster maturity levels.

- Adapted from Burger *et al*. (2015), Wise *et al*. (2017) and Innovation Norway presentation, Belfast, July 2019.

42. Best practice would emphasise the role of the private sector in driving forward clusters. As such, cluster policy should specifically aim to address a real problem, as identified by private sector, rather than promoting clusters as being generally

beneficial for business (Havierniková *et al*., 2016; Konstantynova, 2017; Maffioli *et al*., Eds., 2016).

43. One key element of clustering is innovation collaboration and the support for knowledge spillovers between firms, research institutions and educational institutions. Successful cluster development programmes should support knowledge sharing and transfer within the cluster, between clusters and regions, and across national and international borders (Havierniková *et al*., 2016; Kiese, 2017; van Egeraat and Doyle, 2018).

44. Consequently, in fostering true collaboration, cluster policy should remove any barriers to connectivity, wherever possible, and funding should be provided for specific, new and collaborative innovative activities, which might otherwise not occur (European Commission, 2016; Havierniková *et al*., 2016; Kiese, 2017; Lämmer-Gamp *et al*., 2012; van Egeraat and Doyle, 2018).

45. This points to cluster policy needing to be complementary to wider business-related policy, rather than implemented as a separate silo. A whole-of-government approach should be employed, given the significant degree of overlap between cluster policy and e.g. innovation or infrastructure policy (see for example Skilling, 2017; Delgado *et al*., 2012).

46. To ensure this, it may be helpful to limit the number of objectives, in order to reduce duplication, conflict across policy areas, or spreading resources too thinly and missing significant impacts (Hospers, 2005; Trippl et al, 2015). Thus it may be helpful to incorporate cluster policy into wider policies as a mechanism for delivery or implementation (Kiese, 2013; van Egeraat and Doyle, 2018).

47. Attention needs to be played to the role of government as a facilitator or perhaps partner in cluster policy. Developments in innovation policy – notably the quadruple helix model (where government, academia, business and end users interact) and the idea of 'mission oriented' innovation – point to a larger role for the state (McAdam & Debackere, 2017; Mazzucato, 2017). Cluster policy may be another area where the necessity of a whole-of-government approach needs more than a policy design and evaluation role. Best practice from elsewhere, such as Belgium (see Case 5) may provide some pointers to achieving this in implementation.

Best practice in policy implementation

48. Following the identification of sectors to be targeted and the development of SMART policy objectives for clusters, policy ordinarily moves to a practical implementation phase via cluster management organisations (CMOs). These CMOs should ultimately work towards a level of self-funding and each work to develop and implement strategy tailored to their specific cluster requirements (Havierniková *et al*., 2016; Maxwell Stamp, 2013).

49. Where policy is implemented via CMOs, it may remain relatively more flexible and responsive to changing requirements or context. Further, the flexibility required to apply cluster policy to new or emerging industries is important in avoiding lock-in or path-dependency where the loss of a cluster would potentially devastate a region (Havierniková *et al*., 2016; Maxwell Stamp, 2013). CMOs are considered in further detail in Section 2.3.3.

50. Further, cluster policy should aim to harness complementarities across related activity and jurisdictions, for example via support for infrastructure, by facilitating access to demand, etc. (Delgado *et al*., 2012). As such, policy in NI should consider not just the region as a whole but also linkages with clusters and customer bases in Ireland and GB, as well as operation across multiple geographic levels (European Commission, 2016; Havierniková *et al*., 2016; Kiese, 2013; Ontario Government, 2017; van Egeraat and Doyle, 2018).

Case 5: Balancing geographic levels in Belgium

Belgium comprises 3 regions: the Flemish Region in the north, the Walloon Region in the south and the Brussels-Capital Region. There are no national cluster programmes; however, the regions each have programmes to promote cluster development, which attempt the difficult balance between regional and national policy objectives while also remaining relevant to their members. This has led to top-down and bottom-up efforts in all three regions, raising questions about an efficient use of resources.

For example, Flemish policy differentiates between two types of cluster: the bottom-up Innovative Business Networks (IBNs) and the top-down Spearhead Clusters. Both groupings have access to the Flanders Innovation and Enterprise (FIE) network, which brings together a range of sectors and organisations in the promotion of knowledge sharing across the economy.

*The Flemish Region supports **20** Innovative Business Networks and **6** Spearhead Clusters*

*The Walloon Region supports **6** Business Clusters and **6** Competitive Clusters*

*The Brussels-Capital Region supports **4** clusters and **2** networks*

IBNs are bottom-up (i.e. business-led), small-scale initiatives, with a support period of 3 years, to develop collaborative dynamic between organisations to result in intensive collaboration. Participants in these networks are expected to implement action plans designed to generate benefits for each organisation.

Spearhead clusters are much larger in scale and more ambitious than IBNs, involving cooperation between companies, knowledge centres and government. Further, they are longer-term initiatives, providing funding for up to 10 years, with demonstrable results expected in the short to medium term (2-3 years). The aim is for Spearhead Clusters to be an integral part of the Belgian innovation system and achieve a leverage effect of European Funds.

- Invest NI (2017); www.clusterobservatory.eu; www.clusters.wallonie.be; www.abe-bao.be

51. While the CMO should be responsible for monitoring and evaluating the cluster's individual strategy and progress against those objectives with some external input and challenge function. Government will need to monitor progress against its own targets and objectives to ensure value for money. Data gathering, monitoring and evaluation should therefore be an integral part of the policy development process and consideration should be given to feedback channels via CMOs (European Commission, 2016; Konstantynova, 2017; Maffioli *et al*., 2016).

2.3.3 Government funding and cluster management organisations

52. In public sector decisions on funding, consideration should always be given to market needs and failures (such as information asymmetry or externalities warranting government intervention). Government should, however exercise caution and not rely solely on needs identified by those who stand to gain from funding provision.

53. In prioritising and allocating public sector funding, government should ensure spend on cluster policy would align with wider policy objectives, such as encouraging higher levels of innovation and exporting, and that appropriate structures and processes are in place to ensure efficient and effective use of such funds by the cluster or CMO (Havierniková *et al*., 2016; Lämmer-Gamp *et al*., 2012).

54. A key element of government support in cluster policy is the provision of funding. Public sector funding can be highly beneficial in the initial stages of cluster development (and in the establishment of a CMO) and this effect, as in the Innovation Norway approach, can continue over a number of years. However, there remain dangers of funding continuing past its usefulness due to the normal risks of 'capture'. For example, a 2015 examination of cluster initiatives across both Europe and North America found that the majority source of funding tended to be the public sector, irrespective of cluster age / maturity or effectiveness (Burger *et al*., 2015).

55. This points to the need for government to have in place a clear exit plan to avoid crowding out private sector and generating deadweight loss as best practice would indicate that clusters perform better when they are predominantly private-sector-funded and have a broad mix of funding sources to ensure funding stability (Kergel *et al*., 2018; Kiese, 2017; Lämmer-Gamp *et al*., 2012).

Case 6: Questions over opportunism and additionality raised in the UK and Finland

Additionality refers to whether or not an action or event would have happened without government intervention. Deadweight represents the value lost to non-productive, or in this case non-additional, interventions to promote cluster activity.

*Deadweight was found to be **27%** in Yorkshire and **44%** in West Midlands under the older RDA structures*

In Finland, the nature of actors & relatively small participation of private and not-for-profit organisations led to concerns that opportunistic partnerships may have been set up to attract funding for projects that would have been pursued anyway, in the absence of cluster policy.

Deadweight loss was quantitatively estimated for two cluster initiatives in England; this found relatively high levels of non-additionality in both. In Yorkshire, deadweight was estimated at 27% of the cluster support, while in West Midlands, it was estimated at 44% of gross attributable sales.

This shows the potential risks associated with any intervention and the need for government to ensure policy is designed in such a way that opportunistic collaboration is minimised from the outset, to ensure value for money is attained from public funds.

- Uyarra and Ramlogan, 2012; UUEPC insights

56. Evaluation of a number of cluster development programmes has identified that successful implementation requires a dedicated cluster management team or CMO, the most important function of which is facilitation (Uyarra and Ramlogan, 2012).

57. Personal characteristics of the facilitator are consequently of paramount importance; the facilitator should also thoroughly understand private sector operation and have good understanding of the industry itself. In addition, cluster management should be independent but aim to align cluster activities with regional and national strategic priorities. Professionalisation of cluster management, and in particular facilitation, is consequently an important action for government (Havierniková *et al*., 2016; Uyarra and Ramlogan, 2012; Wise *et al*., 2017).

58. Private sector involvement and leadership from an early stage is a lynchpin in ensuring successful clusters, and those firms who engage deeply in a cluster over a long period of time reap the greatest benefits. The role of the facilitator is therefore to generate enthusiasm for the cluster and its potential, and to channel that into commitment of the private sector (and other participants) to specific actions (Havierniková *et al*., 2016; Uyarra and Ramlogan, 2012; Wise *et al*., 2017).

Case 7: CMOs and their role

The instruments to support cluster policies are as varied as the sectors they aim to help and can include R&D funding, networking programmes and/or competence centres. The establishment of intermediaries to manage the clusters or CMOs.

More than 320 CMOs in the EU28 plus Norway (2016-2028) with most of these located in Norway, Denmark, Germany, Italy and Spain.

Average (median) of 70 participants in each initiative managed by a CMO with these having a minimum 4 year lifespan.

Average of 3 FTEs in a CMO in Europe or 1 per 20 participants.

CMOs often have their roots in trade or sectoral bodies and typically begin with a particular need for or stress on sectoral or technology expertise. This can be critical for the initial trust and credibility-building part of any cluster initiative.

However, over time the strength of any CMO is based upon it developing into a specialist in cluster management and the provision of successful services such as technology/innovation management, internationalisation, etc. The expertise acquired by CMOs in Europe and their typical activities include match-making services for participants, knowledge exchange, promotion of the cluster and region to international bodies, acquisition of funding for participants and accessing HR/skills development services. R&D, developing entrepreneurship and internationalisation are less areas of focus.

Best practice in how funders or development agencies deal with intermediaries suggests the need to balance regular (annual) reporting by the CMO of progress against programme objectives and how cluster participants are performing, with support by the agency for the CMOs to excel at their work (through access to training programmes, international events, etc.). The importance of the second part of this work has been recognised more clearly since 2013-2014 onwards

- Kergal, 2014; Kergel, 2018; Uyarra and Ramlogan, 2017; Wise *et al*, 2017

59. Therefore, in order to ensure ongoing commitment and maintain momentum, the CMO should be set up to become self-funding in time and encourage acquisition of private sector investment in cluster activities (Kergel *et al*., 2018). This expectation of longer-term funding sustainability should be balanced with avoiding short-termism in 'money-chasing', whereby this becomes a sole focus of the CMO.

2.3.4 Individual cluster strategy and success

60. On establishment of a CMO, one of its first tasks should be to work collaboratively with participants in the development of a strategy for the cluster. Such strategy should be formalised, include specific actions with measurable goals and contain a portfolio of initiatives, with cross-sectoral learning and collaboration embedded (DASTI, 2015; Maxwell Stamp, 2013; Ontario Government, 2017).

61. Cluster policy is a long-term undertaking, usually at least 5-10 years, and so government should endeavour to ensure as much stability as possible in the policy environment over that horizon. Policy makers should also work regularly with CMOs to ensure expectations are and remain accurate for the life of the programme.

62. In deciding the projects with which to initiate implementation of the cluster strategy, it may be helpful to select projects based on participants' strongest interests or those projects expected to generate "quick wins" in order to establish momentum.

63. Further, the appropriateness of the strategic objectives should be formally reviewed regularly, to ensure continued appropriateness for the cluster and the local environment in which it operates (DASTI, 2015; Kergel *et al*., 2018; Maxwell Stamp, 2013; Ontario Government, 2017)

Case 8: Funding for the long term in Austria

Cluster policy initially emerged in Austria during the 1990s and clusters were often the outcome of state initiatives to integrate SMEs into networks. The *National Cluster Platform* was established in 2008 with the aim of creating a structured working level in Austria, at which federal and regional stakeholders across government, industry and research could initiate and work on common topics relating to clusters.

Austria aims to reinforce positive trends in R&D by increasing and intensifying cooperation between industry and research institutions. One way in which this is actioned is via Competence Centres, of which there are currently 47 funded by ABA (the equivalent body to Invest NI). Activity is organised around six working groups under the National Cluster Platform managed by a CMO:

The Austrian economy is characterised by a ***large share of SMEs***

In 2017, ***R&D amounted to 3.1%*** *of Austria's GDP*

Cluster participants ***employ around 1 in 8*** *people*

Clusters identified through a combined ***top-down and bottom-up*** *approach*

(1) clusters in the national innovation system, which focus on linkages between regional and national policy;
(2) clusters in research, innovation and qualification, aiming to stimulate a culture of cooperation in and between clusters;
(3) ensuring learning and knowledge-sharing from cluster-relevant developments at EU level;
(4) clusters and internationalisation, aiming to strengthen expertise on strategy, relevant markets, instruments, etc;
(5) clusters and KIBS, to consider in particular the role of service innovations in connection with industry 4.0; and
(6) environmental & energy research clusters, which focus on development of the sustainable energy technology.

Clusters are identified for the provision of support via a top-down and bottom-up approach. All clusters are managed within a single organisation, initiated by the government, while the agenda for the cluster organisation is entirely business-led.

Clusters attract c. ***€6m per year*** *in government funding*

Although the Austrian government aims for approximately 50% of cluster funding to be self-financed, there is recognition that a higher level of government support is required in the cluster initiation and development phase, typically lasting around 10 years. Funding amounts to approximately €6m per year.

- Burger *et al*. (2015); https://investinaustria.at; https://www.bmdw.gv.at

64. Improved internationalisation is noted extensively in the literature as a potential benefit of clustering. However, this should only be included as part of a given cluster's strategy if there is resource capacity and a clear competitive rationale for it (such as the cluster being unable to avail of relevant supports as a group). If major participants are already acting internationally, the process for the cluster as a whole will be smoothed, only if it complements, as opposed to competes with, the individual strategies of participants (Kergel *et al*., 2014; Maxwell Stamp, 2013).

65. In building and developing successful clusters, the importance of establishing strong formal and informal networks between participants is paramount. These can also have a role in attracting new cluster participants, thereby contributing to the long-term sustainability of the cluster as it matures and the operating environment evolves. An area that is particularly amenable to collaboration is around business support services – availability of such services in clusters generally has positive effects and is well-received by firms (Kiese, 2017; Uyarra and Ramlogan, 2012).

66. That said, the benefits of competition should not be overlooked in driving efficiency, productivity and the incentive to innovate. As such, it is important for each CMO to find the appropriate balance between cooperation (strong networks) and competition for its participants (Kiese, 2017; Maxwell Stamp, 2013).

2.3.5 Evaluations of cluster policy

67. There is clear emphasis in the literature of the importance of ongoing impact measurement, monitoring and evaluation of clusters. However, this is not straightforward since cluster development programmes typically involve a range of policy interventions, there can be significant time lags before impact realisation, as knowledge spillovers beyond the cluster become significant and material (Maffioli *et al*., 2016).

68. Consequently, government must build in monitoring and evaluation mechanisms by design of the policy. The key to this is clarifying the purpose of policy and carrying out a needs assessment for intervention that is explicitly based around correction of market failure. Data gathering is also crucial both before implementation of policy and on its introduction to ensure a robust basis for the assessment of policy impact.

69. There are a range of evaluation types – some may be focussed on end results, some on intermediate results, some with an eye to both monetary and non-monetary benefits, and others may be centred on the efficiency / effectiveness of processes – and there are a variety of underpinning methodologies to do so. The key short- to

medium-term aspects of cluster evaluations include cluster management and governance (from selection criteria through to excellence in facilitation), leveraging of other funding, and the behaviour around propensity to collaborate (Uyarra and Ramlogan, 2012)

70. The key longer-term aspects of cluster evaluations centre on the impacts on innovation, entrepreneurship and more general performance at the firm level (Polozhentseva and Klevtsova, 2015; Uyarra and Ramlogan, 2012). Evaluations into innovation tend to focus on the usual indicators such as patent applications/ completions (not always applicable to software or business services firms), R&D projects completed, though other elements such as changes in business models and processes is increasingly taken into account. Entrepreneurship is usually tied to new ventures in particular, or targeted, sectors or geographies.

71. Firm-level performance rarely, if ever, moves away from the standard growth in turnover, productivity, employment and trends in wages and profits.

72. The key difficulty for cluster evaluations is the disentangling of the effects of the clustering initiative, in terms of impacts on firm performance and regional economies, from other policy inputs and interventions to other individual firms. The TCI working group on evaluation has been developing a programme of work since 2014 to support the work of CMOs and funders in evaluating clusters. And, in the Nordic countries, a number of initiatives have been undertaken around development of evaluation frameworks and methodologies[1] which can disentangle these effects.

Case 9: Evaluating cluster performance in Denmark

There has been a tradition of support for cluster development in Denmark since the early 1990s. Regional Centres of Technology (RCTs) were operational prior to this, since the 1990s, providing support to 13 groups to develop cooperation between industry, education, research institutions and other relevant areas within specifically defined regions.

The first official national cluster programme in Denmark was initiated in 2008. At a regional level significant structural reform took place in 2006/07, creating five regional growth forums, all of whom made cluster development a key area of their work.

*The Danish economy is characterised by **its openness and the export orientation of its SMEs***

*In 2017, **R&D amounted to 3.0%** of Denmark's GDP but is concentrated in a few leading firms*

*Clusters identified through a **bottom-up** approach*

Cluster Excellence Network has the task of evaluating the impacts of cluster policy in Denmark, as an independent body funded by government. This is done through annual performance reviews of the current 30+ clusters or innovation networks (completed by the CMOs themselves) and a biennial survey of 4,000+ firms engaged in these clusters.

The firm-level evaluations, which are published, look at both behavioural change (e.g. probability to be innovative or engage in collaboration) and economic impacts (with a focus on turnover and % of this exported).

[1] Recent research into cluster evaluation in the Basque Country suggests the use of both nested methodologies and participatory forms of evaluation, largely to account for the various contexts in which clusters can operate; see Aranguren et al (2014).

Clusters attract c. ***€10m per year*** *in government funding*

In terms of learning from the Danish method of evaluation, they show that behavioural changes and economic impacts work on very different timescales. And while firms find it difficult to disentangle the effects of participation in a cluster from other programme supports, over time they believe that participation becomes increasingly important to performance improvements.

- Wise et al, 2017; www.clusterexcellencedenmark.dk

73. Evaluations that are publicly available paint a mixed picture in terms of cluster and cluster policy performance. The best summary of evaluation research (Wise et al, 2017) suggests the following points:

- Significant evidence of a positive impact on firm-level innovation, influenced by connectivity to other actors within and beyond the cluster;
- Evidence (less significant) of a positive impact on firm productivity, most particularly for newer and smaller businesses;
- No significant evidence of a positive impact on firm-level employment, which is in line with the theory; and
- Evidence of positive impacts on regional competitiveness, including levels of entrepreneurship, rates of GDP/GVA growth.

2.4 Cluster policies: The landscape in NI

74. This section considers both the business landscape in NI and current policies in place to support collaboration and clustering-type activities.

2.4.1 The NI business landscape

75. Although NI has typically lagged behind the rest of the UK in terms of entrepreneurship, activity has been on an upward trend and compares favourably to France and Germany (DfE, 2018). NI firms exhibit strong growth towards the first £1m in turnover, but lower levels of scale-up thereafter. However, other growth indicators are more positive with a higher incidence of high-growth firms in NI (17.4%) than in the UK as a whole (15%) and a higher-than-average proportion of firms achieving productivity growth (Bonner, 2018).

76. The NI business landscape is dominated by SMEs (99% of total businesses) with micro-businesses (i.e. the 88% of NI firms employing between 1 and 9 people) an important cohort. These firms employ around 19.7% of the workforce and generate £10.4bn in sales (17.2% of NI total). A recent survey of this cohort found that business owners want to keep their business operating in a similar way to its present state and less than 20% place importance on building a national or international

business (Hewitt-Dundas and Roper, 2018). Consequently, policymakers aiming to increase growth through scaling up of existing business face a number of challenges to overcome.

77. Businesses that innovate and collaborate tend to be more productive, more inclined to export and tend to employ more highly-qualified staff (DfE, 2018). However, the level of innovative activity in NI in 2014-16 (39%) was the lowest of any UK region, and significantly below the UK average (49%). Analysis of the levels of collaboration by active innovators show that the 51% level also lags those in the rest of the UK, with much of this being with suppliers, customers or within the same enterprise group (NISRA, 2019).

78. Given that the NI economy is dominated by SMEs and micro-businesses, and that DfE have identified the need to encourage more businesses to scale up, to accelerate innovation and R&D, and to encourage increased collaboration, clustering is regarded as one of a number of vehicles towards attaining economies of scale. DfE has thus committed to the introduction and development of clusters in NI, and is participating (alongside partners including Invest NI) in the *Leveraging Cluster Policies for Successful Implementation of RIS3* Interreg Europe project. This project runs to March 2020 and there are questions marks, in light of Brexit, about NI involvement in EU-funded projects after the end of 2020.

2.4.2 The NI policy landscape

79. NI has a devolved administration with responsibility across a number of policy areas, including economic development. However, Westminster retains responsibility for reserved matters, including fiscal policy.

80. The policy agenda for NI is framed by the draft Programme for Government 2016-21 (PfG), with a number of measures being taken forward under Permanent Secretary authority. The draft PfG takes an outcomes-based approach to "*improving wellbeing for all by tackling disadvantage and driving economic growth*". This approach is underpinned by a range of commitments, in areas such as Innovation, Infrastructure, Education & Employability and Entrepreneurship.

81. Behind the draft PfG commitments are a raft of strategies, each of which focusses on an aspect of economic growth and improvements in living standards. These include the following: *Economy 2030: An industrial strategy for Northern Ireland*; *Further Education means success: The NI strategy for Further Education*; and *innovateNI: The innovation strategy for Northern Ireland 2014-25*.

82. As such, the NI Executive has taken a number of steps to ensure the necessary conditions for business growth generally are in place.

2.4.3 NI cluster policy[2]

83. At present, NI has no formal cluster policy in place. However, collaborative activity between industry, education / research bodies and government in NI is supported

[2] Findings in this section centre on the DfE / Invest NI peer review document for NI under the RIS3 programme, unless otherwise specified.

through a range of programmes including the Collaborative Growth Programme (CGP) and Competence Centres. The first report of the MATRIX panel, beginning in 2008, also identified five sectoral clusters in NI (Advanced Manufacturing, Agri-Food, ICT Digital, Advanced Materials and Life & Health Sciences.[3]

84. The CGP, then named the Collaborative Network Programme, was established in 2007 as a pilot to support development of business-led networks, where participants had an interest in undertaking time-limited collaborative initiatives with potential to stimulate their growth and competitiveness. The CGP supports provision of independent facilitation support for collaboration, in order to realise the critical mass to overcome barriers of scale that typically prevent / limit innovation and export activity.

85. The CGP was mainstreamed in 2011 and has performed well in evaluations to date (Cogent, 2016). However, by its nature, networks formed under the CGP can be focussed on an individual project, although there is now scope in Phase 2 to develop workstreams tackling a range of issues. The difference between this programme and a clustering initiative may therefore be considered as the depth of the collaboration (the extent to which it is on-going and developing) and the range of issues brought to the table.

86. Competence Centres bring together universities, research institutes and groups of (typically) 15 or more businesses to develop a long-term research strategy and facilitation of knowledge transfer. Generally the Centres focus on initiating smaller projects with a subset of participants, building to larger projects over time. Although Competence Centres exhibit some attributes associated with clusters, their focus is quite specific, to bridge the gap between industry research needs and academic output.

87. The intent to develop clusters has been set out in both the draft PfG (to support three clusters in new and emerging technology) and the draft industrial strategy for NI. To achieve this, DfE (in close collaboration with Invest NI) have identified a number of workstreams, which are being progressed at present, including:

- An exercise to map industry concentrations across a number of sectors;
- Research – contained here - to focus on best practice in policy implementation and consultation in three sectors;
- An examination of the role of Competence Centres within clusters; and
- An investigation by InterTradeIreland on what support might be required for a pilot all-island scheme where clusters operate collaboratively across the two jurisdictions.

[3] For more see https://matrixni.org/challenges/clusters-2/

3 Findings from consultations

1. Consultations were carried out across three sectors or business/technology areas in order to better understand the clustering and collaboration landscape in NI. These were:
   - High-Tech Creative Industries;
   - Immersive Technologies; and
   - Materials Handling and Quarrying Equipment.

2. These cluster groupings were identified by DfE, who requested that approximately 25 interviews should be carried out within each area. A total of 78 interviews were conducted and the breakdown is shown in Table 1.

3. To protect confidentiality and encourage the highest levels of openness in the feedback, a list of consultees has not been made publicly available. Only senior staff (including firm owners) were consulted and, in addition to the business voices, a small number of academic staff (3) and those involved in cluster policy (3) formed part of the consultation group.

4. A number of consultation contacts were obtained from Invest NI (18 of 78), particularly for the Immersive Technologies businesses, with others provided by DfE (8 of 78). The remaining 52 consultees were identified through academic and professional networks.[4]

Table 1: Consultations by sector or area

Sector/Area	Consultations
High-Tech Creative Industries	24
Immersive Technologies	22
Materials Handling and Quarrying Equipment	24
Other	8

"Other" includes consultees from firms in the areas of Advanced Materials and Data Analytics, individuals with an overview of specific sectors and academic representatives.

5. The "Other" group was useful in pointing to the existence of "related variety" in the NI landscape. This refers to the idea that there are sectors – e.g. Advanced Materials and Materials Handling – which can relate to one another in complementary ways, rather than a solely competitive relationship. The presence of "related variety" in regional economies can have a positive effect on levels of collaboration, especially in businesses with high levels of technological intensity.[5]

6. One of the challenges the research team encountered when identifying consultees was that it was not always appropriate to consider cluster participants in a traditional sector sense and a cluster can include businesses from various, related sectors. This

[4] Professor Frank Lyons (Ulster University) of the *Future Screens* AHRC cluster initiative and contacts within Mid Ulster District Council were especially helpful. The reliance on personal networks highlight some of the difficulties that the agencies and Departments can have in identifying firms in these sectors.

[5] See Frenken, Van Oort & Verberg, 2007; Hartog, Boschma and Sotarouta, 2012

could become more important as clusters form around "technologies" rather than selected sectors.

7. The consultation process indicated that businesses and others self-identify as operating in a "High Tech Creative" space, although they might be listed as "Immersive Technology". This fluidity across sectors, in particular in what is increasingly called the Creative Industries, is important in any future understanding.

8. This section provides an overview of common themes that emerged from the consultations, followed by findings by sector, each organised by the structure of the Terms of Reference. Where case studies have been presented, permission has been sought for their inclusion from the companies / organisations involved.

9. Throughout this section, reference will be made to emerging themes and findings within sectors. The reader should note, however, **that findings and themes apply only to those organisations consulted and caution should therefore be exercised in applying findings from this sample more widely across each sector and across sectors not consulted**.

3.1 General themes identified

3.1.1 The level and nature of collaboration

10. A majority of firms (60 of 72 responses) across the three cluster groupings said that they collaborated with other outside businesses and actors. This collaboration focussed on a variety of business activities: innovation, purchasing, pooling of skills, etc. Table 2 provides a summary of collaboration partners by sector.

Table 2: Collaboration partners by sector

Collaboration Partner	High-Tech Creative Industries (N=24)	Immersive Technologies (N=22)	Materials Handling & Quarrying Eq (N=24)	Total (N=72)
Own supply chain	8	6	5	19
Own customer	13	15	11	39
FE / HE institutions	18	14	10	42
Competitors	10	7	3	20
Related industries	12	10	4	26
Other /not specified	5	6	3	14
No collaboration	2	0	10	12

Note: Consultees often had more than 1 partner. The N=72 figure equates to the consultees in the three sectors and excludes 'Others'.

11. Whilst the majority of firms identify that they engage in collaboration, this tends towards 'vertical' collaboration (i.e. with their supply chain and/ or customers).

12. One exception to this vertical collaboration is the links with HE/FE institutions, with a majority of the businesses consulted having some connection. From the education provider perspective, it is telling that this collaboration centres more on the potential for skills development and placements, rather than technology transfer. Materials Handling is an exception as both elements are seen as equally important.

13. Of the businesses consulted, 'horizontal' collaboration (i.e. with competitors and/ or related industries that develop complementary products and services) was more limited. One observation from this research is that horizontal collaboration appears more important (in theory, if not fully realised) for emerging cluster groupings than for a more mature sector like Materials Handling.

14. Interestingly, a significant number of consultees raised the idea of being in a "cluster", with the meaning that their business was one of a number operating in the same sector and in the same general location. This is particularly the case for consultees in the Materials Handling and High Tech Creative sectors who identify with specific geographical areas as a location for a number of firms operating in the same sector.

15. There was a strong belief that a 'cluster' was the same as a 'sectoral concentration'. Consultees in Materials Handling referred to the role of Powerscreen and Terex as bringing critical mass to the sector, something which Game of Thrones was seen as doing for film and TV. However, a number of consultees from the other two sectors looked enviously at how Dublin had attracted significant FDI in gaming and animation to create critical mass and the sense of a competitive location for businesses in a particular technology stream.[6]

16. As this research has an NI-wide focus, less of an emphasis was placed on geographic location as a characteristic of a cluster. That said, Materials Handling firms were predominantly located in Mid-Ulster and the Hi-Tech Creative and Immersive Tech firms were predominantly located in Belfast.

17. Connected to this was the issue of the location of collaborative partners. If the partners are customers (and to a lesser extent suppliers), they can often be located outside NI, especially in the case of Materials Handling and parts of High Tech Creative (animation and film & TV). HE/FE partners and those in related industries or competitor firms tend to be more local. Interestingly, in terms of collaboration the all-island economy is much less present. There were a small number of consultees – usually successful and pleased to have gained access to scaled-up businesses – who are collaborating on a cross-border basis, notably in animation and gaming.

18. The consultations highlighted the support among businesses for the work being undertaken by Invest NI and NI Screen to develop collaborative networks and encourage enhanced clustering activity. And, given the relatively nascent nature of many Immersive Tech and Hi-Tech Creative companies operating in this space in NI, Government support is likely to remain vital at this stage in their development. The consultations reflect a point in time where firms are working out not only who to collaborate with, but also to what end.

Defining collaboration and clustering

19. Given that the terms 'collaboration' and 'clustering' tend to be used inter-changeably, it is important that some form of working definitions are applied. As the research progressed it became clear that a "collaboration – clustering spectrum" exists and

[6] The emphasis in Ireland and other small economies on coordinated efforts to integrate skills and innovation policy has been emphasised in recent research (Skilling, 2019).

this is described in more detail in Table 3 further below. This must be recognised as a dynamic situation with the extent of collaboration differing across organisations, as much as across sectors or areas.

20. Overall, most activity occurs closer to the 'collaboration' end of the spectrum and what might be described as 'deep clustering' activity remains at an early stage of development. In particular, business-led strategic collaboration at the sectoral level was limited, and horizontal collaboration between businesses still quite nascent.

Table 3: The presence of attributes/activities in the collaboration-clustering spectrum

Attribute / activity	Collaboration	Deep Clustering
Vertical collaboration	✓	✓
Horizontal collaboration	✗ Limited / none	✓
Other collaboration e.g. with FE/ HEIs	✗ Limited / none	✓
Recognition that broader sectoral competitiveness is challenged	✗ Limited / none	✓
Part of sector strategy or action plan	✗	✓
Range of collaboration	Narrow focus, single-project based	Wide-ranging, strategic undertakings
Timescale of collaboration	Finite, project-based	Ongoing, not time-bound
Perspective of participants	Project/ Company-focussed	Company/ Sector-focussed

21. A key theme emerging from the consultations was that the degree to which strategic direction underpinning collaborative activity exists within a business was crucial to understanding where an individual firm placed itself (and others within their sector) along the collaboration-clustering spectrum. Across all three sectors, in general, collaboration is pursued on a project-by-project basis, often with a specific end or ends in mind. There are exceptions to this where collaboration is a strategic pursuit by businesses, a means to increasing value across the sector as well as within individual firms.

22. It is also recognised that sectors such as Hi-Tech Creative are highly collaborative by nature, where a large number of small firms collaborate on individual projects on a freelance basis. In these instances, the project drives the collaborative activity and at the end of the project, individual firms then go in search of the next project – sometimes jointly, sometimes not. **The point being the project is larger than the individual firms that make-up the project.**

23. Contrast that, with sectors (or firms) operating towards the clustering end of the spectrum which tend to have multiple projects ongoing with a variety of participants at any given time. These projects tend to span a range of industry-relevant activities, rather than a focus on product improvement within a single supply chain. **In these instances, the firm is bigger than the individual project.**

24. Another general theme which should be important to policy makers is that many consultees saw collaboration as potentially bringing benefits to them, but they did not necessarily see moving along the spectrum towards deeper clustering as a benefit to them. This can be the case, even if it might be useful to their sector or technology area. This could have an impact on the amount of time and resource that any individual business is prepared to allocate to deeper clustering activity.

3.1.2 Barriers and catalysts to new or deeper clustering

25. Although the consultees expressed general support for collaboration and an understanding of its benefits, there are some significant barriers to beginning and extending collaborative relationships. Figure 1 provides an illustration with the key barriers as follows:

- A lack of trust between firms and potential collaboration partners;
- A lack of perceived benefit from new or deepened collaboration;
- Insufficient critical mass;
- Significant resource requirement (time and financial resource); and
- Sectoral structure may be prohibitive where complementarities are limited.

Figure 1: Summary of barriers to clusters

26. As the following sub-sections show, there are differences in the barriers identified by mature sector from those identified by emerging sectors. Critical mass is much less

an issue for Materials Handling, while resource requirement is a key barrier for the small firms engaged in High-Tech Creative or Immersive Technology.

27. A key barrier identified by consultees across the three sectors is the **lack of trust**. Sometimes the fear of firms losing their intellectual property tends to lead to lower levels of innovation collaboration. This also extended to concerns about losing highly skilled staff to competitors and a lack of social networks to know other actors.

28. This is connected to one other notable barrier identified by consultees: "**Information Gaps**". Consultees tended to be specific about the absence of profiles of potential partners and their capabilities, often accompanied by a lack of personal networks through which information can pass. This barrier was emphasised most strongly in Immersive Technology, where there was a strong appetite for an engagement with other local actors in order to acquire knowledge, something which can be strong in particular for smaller enterprises (Roper, Love & Bonner, 2017). This might suggest that building knowledge networks and trust go hand in hand.

29. Moving to catalysts for new or further collaboration, consultees viewed the following, captured illustratively in Figure 2, as being crucial to the development of a successful cluster:

- Ensure clear benefits in plans for initiatives;
- Trust enablers between sector participants and potential collaboration partners;
- Development of collaborative actions with related industries rather than just in-sector competitors;
- Dedicated cluster management / development resource; and
- Strategic vision for the sector, to which all participants are committed and agree.

Figure 2: Summary of catalysts for clusters

30. In terms of **articulating the benefits** attached to collaboration and clustering, the consultees returned to the concept of risk vs reward on a regular basis. The thinking varied from consultee to consultee, for those not engaged in any collaboration, they were looking for a clear demonstration of "what would be in it for me", a sense of need to be convinced that "free rider" and other risks were addressed by those promoting such initiatives.

31. However, even among consultees, who had gained from collaborative projects (in terms of turnover or innovations brought to market), there remained a desire to see how improving the sector might benefit their firm. Interestingly, among the more suspicious, improving the "place" rather than the "industry" appeared to be more persuasive.

32. **Creating trust** is clearly seen by consultees as a necessary underpinning for any collaboration, not surprisingly given its absence was cited as a barrier. That said, it is useful to note that there was little consensus around what initiatives might best achieve this. In other countries (e.g. the Basque Country), building trust has been attached to the (pre)existence of strong social networks or bonded social capital (Aragón *et al*, 2012). However, the extent to which this is something which is part of the context for the cluster policy or something which emerges as a result of it, remains an open and important question.

33. Related to this question of trust as a catalyst is the importance placed on a **dedicated resource or Cluster Management Organisation (CMO)**. This differs depending on whether consultees were looking to spark off new collaboration – in this case regarded as useful, but not critical – or were looking to deepen existing collaboration. In the latter case, consultees regarded this resource as essential, though issues around sector knowledge, impartiality and independence were all raised as criteria for success.

34. Within mature, competitive sectors, consultation would indicate that one company's gain can translate directly into another's loss. Some distrust was expressed about collaboration between incumbents and new entrants (see Cozzolino & Rothaermel, 2018, for similar picture in cases of technology change). **Creating a strategic vision** for the sector can allow a way out of this potential stalemate. A key example of this in the NI economy exists in the Aerospace industry, where ADS NI was originally established as a trade body with leverage of UK-wide resources and has brought together companies seeking to expand their share in the growing international market. This raises a question of whether access to a greater level of resources, either UK-wide or all-island, may offer a greater incentive for firms to collaborate (given an emphasis on necessary critical mass). It also points to how the potential for international networking and access to international buyers and suppliers can prove attractive to participating firms.

Case 11: ADS NI and the *Partnering for Growth* Strategy

ADS was established as a trade body in 2010 for companies operating in the aerospace, defence, security and space sectors with the aim of growing the sector as a whole. It has 90 member organisations in NI, part of a wider UK group with approx.. 1,100 member companies. The UK group is managed by approximately 100 staff to develop the group's strategy, assess progress towards agreed actions, provide business development support, run industry events, provide a single point of representation for the industry and engage in other activities of benefit to the Group's members.

***All key players** in the NI industry are members of ADS Group*

*It took **four years** from the establishment of ADS for the group to agree its strategy for growth*

*ADS aim to **grow the NI sector** from 0.5% to 1% (£1bn to 2bn) of global revenue over 10 years*

*ADS is **fully funded by member subscriptions***

Although the Group was established in NI in 2010, it took four years to develop and launch a strategy which had sector buy-in to implement and achieve that strategy collaboratively.

The Partnering for Growth strategy has six working groups to address key issues for the sector: skills, supply chain excellence, R&D, sales and exporting, defence, and space. These groups meet three times per year to oversee actions and monitor achievement.

The Group is instrumental in the gathering and provision of market intelligence for its members, including a daily list of tender opportunities. It provides access to buyer events, prepares members for trade missions, and undertakes strategic research to inform government lobbying activity in Westminster.

Key reasons underpinning the success of ADS hinge around commitment of its members. The Group has national reach, meaning NI firms have access to a wider set of opportunities. Members are committed and active participants, controlling the agenda and shaping the Group's strategy and goals. The Group is committed to providing a service that is highly valued by its members; given the scale of the sector and its ability to speak with one voice, it can have greater influence when lobbying the UK Government.

In addition, the commitment to growing the sector as a whole is such that members bring project opportunities to other members with assistance from ADS in identification of relevant partners.

35. Emerging sectors may have more scope to engage in collaborative activities, as they are in less direct competition with other market participants. From the consultations undertaken, technology-driven sectors, in particular, have demonstrated a culture of collaboration.

36. One final catalyst for collaboration, identified across all three sectors, was the opportunity to work outside their specific industry. This shows a realisation about the potential to work with other complementary areas or skillsets, as much as a sense that there may be less competition involved in this type of collaboration.

3.2 Themes from *High-Tech Creative Industries* consultations

37. This sector was selected by DfE, and may be described as a technology grouping within the broader Creative Industries sector (this may also include Immersive Technology which is considered separately in this research). Creative Industries are defined by the UK Department for Digital, Culture, Media and Sport (DCMS) as "*those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property*".

38. DCMS provide annual estimates of the size of the Creative Industries using data gathered for the SIC groups, including IT & software, film & tv, music & performing arts, publishing, museums & libraries, design, architecture, advertising & marketing, and crafts.

39. Relevant statistical estimates of the Creative Industries sector are also provided for NI and, although a little dated, the most recent data (2015) estimates employment of 26,000 and GVA of almost £800 million, effectively around 3% of the total NI economy. Although the statistical estimates show NI have a smaller share of the whole economy than is the case in other UK regions, other surveys of the UK Creative Industries (eg: NESTA's *Creative* Nation) do identify areas where NI (and Belfast in particular) have strengths.

40. Each of these indices or benchmarks highlight Belfast as central to the NI story. The consultations support this with many of the firms spoken to being based in the city. Importantly though, a second, smaller centre for consultees was Derry/ Londonderry.

41. For the purposes of this research 24 firms were consulted, mainly from three areas (animation, gaming and film & television), with a small additional sample of businesses from the music and publishing industries. Although Immersive Technology is normally included in the Creative Industries estimates and research, for the purposes of this report a separate sample of businesses who are developing or using that technology were also consulted and the findings from those consultations can be found in Section 3.3 below.

42. The consultees reflect a mix of the more established elements of the sector, typically those involved in film and television, alongside relatively new firms, many of which have been in business for less than five years.

43. A number of consultees made the point that they did not agree with the definition of Creative Industries, but there was no agreement on what might make a better sectoral definition. Some consultees suggested a focus on the 'commercial' end of creativity whilst others favoured an approach which looked to a 'creative ecosystem', which could include businesses as well as museums, libraries and performing artists.

44. Other consultees were keen to see any sector defined by the commercial use of emerging, digital technologies 'in a creative way' (and this could include software firms as developers or consumers). This approach follows one taken by the NI MATRIX panel in their 2017 Creative Technologies[7] report, which offered estimates of employment, GVA, exports and business demography for Creative Technologies in NI. It also described, by way of a business survey and focus groups, the current

[7] See https://matrixni.org/documents/the-2018-creative-technologies-report/

state of growth areas within Creative Technologies – gaming, animation, film & TV, immersive technology, and user experience.

45. Some consultees also made the point that the different strands (be it gaming or animation) had begun to create their own identity – with the development of informal networks – which may need policies and supports specific to their needs.

3.2.1 The level and nature of collaboration

46. Allowing for some selection bias in the sample (ie: that those consulted would have an interest in collaboration), the vast majority (with the exception of two consultees) were engaged in some form of collaboration. Companies tended to partner with their own customers and HE/FE institutions. This was the only sector (of the three in this research) where the top partner came from outside the supply chain, something which is unusual in most sectors.

47. Consultees found **much to praise about the involvement of HE/FE** staff and students in the sector, especially in "meet up" activities for gaming and animation. Indeed these tend to operate very much around the academic year with numbers dipping across the summer months. The role of the two universities and Belfast Met as producers of graduates was also commented on positively, albeit with the usual caveats around employability skills needing to be improved.

48. Related to this point and the desire of courses to "place" students with firms for short or longer internships, the size of firms and their focus on ongoing projects was commented on as a potential barrier to this type of collaboration. A number of consultees bemoaned the fact that if they were regarded as leaders within the sector and had to take on roles associated with this, there was a danger that they might be taken away from pursuing core business objectives.

49. The **role of the customer** as a key collaboration partner is no surprise. Many projects are initiated by current, repeat or potential customers – the process often being a resource-intensive one of developing an idea for market and then pitching this to potential buyers, sometimes on the basis of past success. The pressures around the "D" of R&D were highlighted by a number of consultees with NI Screen and other investors/partners necessary for seed funding. In addition, there is also pressure to have strong project development personnel in place in businesses.

50. Although there was a good level of collaboration with competitors – stronger than in the other two sectors consulted – this varied across the different strands. Based solely on the consultations, one element of the industry which appears to lean more towards competitive rather than collaborative relationships with other, similar firms, is the film and TV sub-sector. As noted above this is a relatively mature sector with a balance to be struck between the need to collaborate with firms offering complementary products or services, and also recognising that commissions are relatively small and those will only be shared with other firms when necessary.

51. High Tech Creative also sees a desire to have a stronger element of collaboration with related industries or sectors, specifically with IT and software businesses. This is most apparent among consultees in gaming and animation, with the aim of working with or moving beyond the interest in the developing markets among leading technology firms.

52. This desire to engage with related industries may reflect the need expressed by a number of consultees for what one called an "**anchor client**" who could help develop the sector. Several referred to the story of Keywords, which began in Dublin as a localisation partner for Microsoft and now employs more than 5,000 people across the world, through internal growth and acquisition of other firms in the gaming sector.

53. The desire for collaboration was strong among the consultees involved in gaming, which has been supported by the Invest NI Collaborative Growth Network (CGN). Those consultees involved in these were positive about the assistance provided by Invest NI but expressed a belief of the need that Games NI needed to go further in accessing a greater level of resources to facilitate collaboration.

54. The sector also appears likely to benefit from an initiative, supported by the Arts & Humanities Research Council (AHRC). It invited applications in 2018 to become part of the Creative Industries Clusters Programme across the UK (as part of the Industrial Policy), which led to a successful joint bid between Ulster University and Queen's University, Belfast for a cluster to be located in NI. The *Future Screens* initiative is now one of the nine clusters which aims to bring together educational and commercial partners to tackle unique R&D challenges identified by a specific area of the industry.

55. *Future Screens*, run by the two universities and a business-led advisory committee, may be seen as a developmental catalyst for the sector or a Cluster Management Organisation (CMO). It identifies four pillars across the industry along the lines of the MATRIX report referred above and will be running open calls and challenge calls for R&D funding available to companies working with researchers, and building programmes to increase talent growth.

56. Given the existing (narrow) strength of collaboration between academic partners and businesses in the sector, *Future Screens* may be a good place from which to start to deepen the levels of collaboration within the sector.

3.2.2 Impact of the collaboration

57. The objective of collaboration in the High Tech Creative sector is very much around "project completion", most often product/service innovation. Allied to this is the comments made by consultees that they often cooperate in order to harness complementary skills or capabilities from other businesses or from HE/FE.

58. When asked about the impact of this collaboration it became clear the extent to which many parts of the High Tech Creative sector are still very nascent, to the extent that a number of firms only generating very low levels of revenue. Consequently, consultees often referred to the financial impacts being relatively limited, but there was optimism about future prospects and potential.

59. In the more mature parts of the sector – notably film & TV – the results were different, collaboration tends to be within the supply chain, largely the use of sub-contracting services not available or too expensive to maintain in-house. Here, the financial impacts of successful projects were significant (sometimes >50% of turnover), although there were different views on how much collaboration had contributed to the overall total. In the small number of cases in film & TV where collaboration was with competitors, the results might be encouraging but the

experience could be a gruelling one, highlighting difficulties which can arise when different creative views come together.

60. Elsewhere in the sector, the general feedback from consultees was that the impacts were positive, many referred to collaboration as being "essential", sometimes leading to market access beyond NI.

61. Many also referred to the huge potential of the sector, which has yet to be realised. When explored further, this unrealised potential was a reflection of the nascent nature of the Hi-Tech Creative sector as a whole rather than any specific weakness in interventions (this is discussed in more detail below).

3.2.3 Barriers and catalysts to new or deeper collaboration

62. In terms of barriers, consultees had much to say, only a small number (N=4) were unable to identify any barriers to collaboration. There was a particular focus on two related barriers: **resources required** and a **lack of critical mass** (both within firms and within the sector more generally).

63. This sector primarily consists of start-ups, micro-businesses and small firms (<50 employees) and, given the industry's nascent status, many of these firms' resources are fully committed. Consequently, a number of consultees highlighted that they were not able to become fully involved in the work of *Future Screens* (or similar initiatives), as they could not meet the match funding requirements or spare the time away from project delivery.

64. Further, there was a recognition among consultees that clustering could require a long-term, strategic investment of time and other resources, which is a barrier to small businesses that require quick or short-term project returns. Several consultees referred to the sector being small and once sub-divided into gaming, animation, etc. there was a danger that the same people would be expected to take the lead.

65. Where consultees referred to a "siloing" of policy, they tended to refer to not being clear who had responsibility for developing the sector.[8] One consultee went on to say "*there may be too many agencies involved in the sector and a need for one, well-informed body to take the lead and be resourced to do exactly that*". At the same time, NI Screen, in particular, are "*doing a great job*", according to several consultees.

66. Consultees in the film & TV area indicated other issues with collaboration particularly around **finance** and **staffing**. In particular, there is a high degree of competition between firms in bidding for relatively limited commissions. One consultee said that "*cooperation would be a zero-sum game for us, a way to lose ground rather than gain it*". Another stated that firms "*jealously protect their creative talent*" and avoid collaborative relationships to mitigate the risk of staff being poached. These quotes reflected the general sense from the wider group.

67. Consultees highlighted a number of potential ways in which collaborative relationships could be fostered:

[8] The Department for Communities, Department for the Economy, NI Screen, Invest NI all have different roles in the sector.

- Identification of a sectoral lead;
- Further support for trade missions or a presence at international expos/festivals;
- A unifying common cause; and
- Reduction of the knowledge gap in the market.

68. Given that most of the sector consists of nascent technologies and new market entrants, the approach to sector development may be considered relatively fragmented. This probably underestimates the strategic development undertaken by NI Screen in recent years, both at the broader level of market development and engagement with emerging technologies, as well as the specific supports for gaming start-ups built around the Pixel Mill incubator. Of course, this may be as much a case of, as one consultee said, "*not getting the message out there loud enough*".

69. Research supports the idea that bottom-up clustering initiatives work best when they have as an objective closing the "innovation gap" (Parrilli, Aranguen & Larrea, 2010). When this creates the opportunity for interactive learning between firms themselves and between firms and HEIs (often prompted by specific actions around researching new processes or products), this can lead to more intensive innovation within businesses. This seems to be a role that *Future Screens* is seeking to fill.

70. A small minority of consultees expressed concerns about what they see as a focus on increasing levels of R&D and innovation by *Future Screens*, but there is an acceptance among most that innovation is absolutely central to the development of creative industries. Several firms referred to the "gap" which they see as in existence between businesses and HE expertise – at least from a research perspective – and how this might be a "common cause" for any clustering initiative. As one consultee put it, "*if we are not innovating we are dead in the water*".

71. It was striking among consultees that there was a debate as to who might be the appropriate sectoral lead to drive the industry forward. Invest NI currently have a facilitative role, and some within the consultee group felt it was appropriately placed to drive collaboration and growth-focussed activities. However, other consultees regarded the universities, NI Screen or other intermediaries as more appropriate sector leads.

72. This debate has not concluded, given the key element that trust-building forms in deepening levels of collaboration. Two issues raised by a number of consultees – the perceptions of cliques operating in the sector and the need for transparency about the value derived by intermediaries[9] – need to be resolved to ensure collaboration goes on smoothly and indeed deepens.

73. Trade missions were highlighted by consultees as not just a good way to gain entry to non-domestic markets, but also a good way to bring together firms operating in NI and develop those domestic linkages. This point highlights how a traditional industrial policy tool may be leveraged within cluster policy – something found across all three sectors.

74. Finally, given its relative newness in NI, consultees highlighted a lack of awareness of potential collaboration partners. They identified that the provision of market

[9] For relevant research on this question and the extent to which intermediaries do derive financial and non-financial benefits from collaboration, see De Silva, Howell & Meyer (2018).

intelligence, a map of all companies working in the sector (in GB and NI), and strategic insight into growth opportunities would be of particular benefit.

Table 4: The collaboration-clustering spectrum in High Tech Creative

Attribute / activity	Conclusion
Vertical collaboration: firms work with a supplier or customer on product or service development	✓
Horizontal collaboration: firms engage with rivals, or with firms in related industries	Limited
Collaboration with other organisations, e.g. Further Education, Higher Education, other sectors, etc.	✓
Recognition that broader sectoral competitiveness is challenged	Limited
Collaboration is formalised as part of a sector strategy or action plan	Developing
Range of collaboration	Broad focus, mainly on product/service development
Timescale for collaborative relationships	Short-term and based on project lifespan/funding
Perspective of participants undertaking collaboration	Bottom-up, largely self-facilitated

3.3 Themes from *Immersive Technologies* consultations

75. Immersive Technology belongs to what economists call 'general purpose technologies' such as ICT (ie: technologies that can be applied across sectors). Virtual reality (VR), augmented reality (AR) and mixed reality are changing the ways in which we access and indeed interact with digital information and are being applied to various purposes, from training simulations to experiencing tourism, retail or construction solutions.

76. The global market for this technology is growing quickly, with some forecasts of growth to €100 billion plus by 2020. Education and healthcare are seen as key sectors where growth is likely to see greatest growth in terms of VR and AR content.

77. Another growing segment of the market for Immersive Technologies is gaming, where the technology can create the experience of immersive worlds. This highlights the point that Immersive Technology is less a 'sector', and more likely to become all-pervasive across many sectors, a new way in which we shop, travel, treat illnesses or build.

78. Digital Catapult NI was launched in 2017 with the aim of showing how the adoption of digital technologies can increase innovation and improve productivity levels in NI's businesses. Immersive technology is one of the priority digital technology areas and the new Immersive Lab, now sited in the Ormeau Baths, Belfast, is there to showcase the potential of these new technologies, as well as providing a space for their further research and development.

3.3.1 The level and nature of collaboration

79. All consultees from the Immersive Technology sector indicated that they had engaged in collaboration with at least one other actor in the past three years[10]. It was observed that the level and type of collaboration amongst the consultees depended on their role within the sector. The first group may be considered as developers of immersive technology and a second group could be referred to as early users/ adopters of immersive technologies developed by others.

80. The developers were engaged mainly in networking with other similar, but complementary, firms and tended to be associated with Immersive Tech NI (an Invest NI CGN) an/ or *Future Screens*. Among these developers of technology there was also a strong strand of industry/academia cooperation, with a number of consultees being located within universities and spin-outs simultaneously.

81. Within this group the drivers for collaboration vary. Those at an early start-up stage or still in the process of research see collaboration as potentially leading to commercial leads ("*it's all about the opportunities to meet possible customers and who they might lead to*"). For those with a fully commercial business model and revenue streams most collaborations are opportunity or project led. A smaller number have made collaboration with others increasingly a core part of the business model, a form of resilience against skills shortages (in particular for software engineers).

82. The early adopters engaged with their customers, seeing the potential advantages to be derived from adopting Immersive Technologies but they did not regard themselves as part of an Immersive Tech 'sector'. These consultees tended to identify as being within industries which could use Immersive Technologies, such as design, architecture and construction. This may speak to the wider Creative Industries sector in which at least some of these consultees would sit.

83. As noted above, many of the consultees were aware of potential supports, actual initiatives and market opportunities that might drive collaboration in this area. The Invest NI CGNs programme, *Future Screens* and technology transfer initiative (KTP, etc) were mentioned most.

84. The Invest NI CGNs were highlighted as particularly useful frameworks for networking and administrative support. Scope for development was identified as introducing more value-added activities, such as strategic insight, through these networks. One consultee, involved in one of these networks targeting the use of VR for tourism, praised the flexibility of the support which could be mobilised for responding to Small Business Research Initiative (SBRI) challenges, but argued also that "*we'd like to see a next step beyond the immediate project and into tourism development more generally*".

85. As noted above, Invest NI has supported Immersive Tech NI, best described as a "meet up" initiative. This has operated since 2017 as a "*clearing house for VR and AR ideas*" according to one consultee. It also brought together the two groups described above – firms keen to pick up opportunities to use immersive technologies with some of those developing or retailing it – along with some start-ups keen to

[10] The issue of selection bias may be strong in this sector, given that many of the consultees were currently or recently part of different CGNs supported by Invest NI.

identify opportunities and potential collaborators. One consultee made the point that the networking had not automatically led to collaborative activity. This is not a surprise and perhaps highlights unrealistic expectations of some consultees.

86. One important note from the consultations is that the majority of collaboration emerging centred on entry or access to new markets (whether new to the firm or new to the NI sector). There was little or no evidence to suggest that companies were choosing to focus their collaborative activities on research.

87. *Future Screens* aims to redress this balance and provide an enterprise pipeline that enhanced infrastructure can service, with its support for R&D and capability development in those firms actually developing immersive technologies as part of the wider Creative Industries. This initiative may form a potential focal point for collaborative innovation among this growing group of businesses.

88. Another potential spur to collaboration in this sector may be what is referred to as the Experience Economy, one based on the increasing value placed by consumers on paying for an experience rather than tangible, material products (Pine & Gilmore, 1998). A group of firms led by the Deluxe Group, again with Invest NI CGN support, has collaborated to develop improved project offerings to access larger contracts in the global market. This group is relatively nascent and expects to grow and deepen linkages in the future but also has a strong commercial foundation.

89. In conclusion, for Immersive Technology collaboration is project driven. This can (and often does) lead to repeated collaboration with the same partners, one consultee summed it up as "*this is very much collaboration for a pre-defined and revenue-based reason and not for its own sake or for broader goals*".

Case 12: The Deluxe Group and the Experience Economy

The Deluxe Group is a Portadown-based bespoke joiners and interiors refurbishment contractor for a range of business types including hotels, theme parks and the marine industry. Established in 1969, it employs 150 staff and has experienced rapid growth in recent years; Deluxe Group expects further rapid growth within the 'experience economy' over the coming years as consumer preferences evolve.

Approximately 18 months ago, The Deluxe Group set up a one-stop-shop to enhance their offering when bidding for large experience economy projects. Their aim is now to take this forward through the development of a cluster.

Story-telling
+
Architecture & design
+
Creative technology

= *Experience*

Participant firms are drawn from across creative industries (including virtual / augmented reality and visual content) and also more traditional industries (such as plastics and composite manufacturing), where skillsets and products could be adapted or used in novel ways to enhance the service offering for the experience economy. The group also engages with Ulster University and well-established service providers within the experience economy.

The purpose of the group is to: (a) facilitate group bids for large, international projects; (b) harness synergies to create a turn-key package for export; and (c) leverage NI's creative industries potential and established brand to create a non-price-based value proposition. Working in collaboration has been essential to meet that goal.

Although this cluster grouping is still described by its founder as nascent, it already makes a significant contribution to the company's turnover, and other tangible benefits across participants.

3.3.2 Impact of the collaboration

90. The key impact of collaboration, which was highlighted by a number of consultees, centres on the beneficial support provided to each other through membership of the Collaborative Networks. In part, this involves the sharing of solutions to problems which others had experienced. In addition, some of the start-ups in this area also see opportunities to showcase their technology to potential users as a means to entering larger markets. For one consultee, "*this is all about showing what we can do, finding potential partners who can act as a channel into the very markets we want to be in*".

91. Almost all are developers of content, rather than developers of VR and AR hardware. "*We are agnostic about the hardware we use and concentrate on ensuring we get known for the quality of the training content we can offer*".

92. Although this area is still relatively new and a number of the consultees engaged in developing content are not yet revenue-generating, a significant share of revenue comes from collaborative efforts. "*Collaborative projects are our business model at the current time*", reported one consultee.

93. With regard to the work by the experience economy group, it has been 18 months in development, meaning it is still in its relative infancy. However, it points the way with encouraging early results for significant revenue generation. Given the initial success, participants unsurprisingly remain committed to collaboration and work is underway in the sub-sector to develop leadership and facilitation in order to propel the group's growth forward.

94. Other users of Immersive Technology – in areas such as architecture, construction and manufacturing – speak of similar shares of revenue (10% - 20%) being realised by adding this technology stream to their business. They were clear, however, that they did not see themselves becoming more than partners with Immersive Technology developers. As one consultee put it, "*that expertise lies elsewhere and the priority is in building strong partnerships as this technology is not only something that everyone will be using but it will also be changing quickly so keeping up to date will be equally important*".

3.3.3 Barriers and catalysts to new or deeper collaboration

95. Consultation participants highlighted that collaboration was generally welcomed as each company tends to have its own specialism or market niche. Therefore, products and services are typically complementary across firms and networking may open opportunities to find customers in other areas.

96. However, **firms tended not to collaborate on research** projects due to concerns over **IP** and **project budgets** tend to be too small to share with other partners. Further, many businesses are so small that they do not have **sufficient resource** to participate in collaborative calls, such as completion of research calls, etc.

97. Several firms indicated that they were too busy or did not have sufficient resource to dedicate to collaboration or cluster development. There was a division among consultees, between those who found limited value in attending sector meetings or meet-ups ("*too often talking shops*"), and those who regard this as essential in a market still without a critical mass of customers.

98. The majority of firms highlighted that **market requirements tend to be the most compelling driver of collaboration**. Some suggested that it may be helpful for government to commission a large project that would require several firms in the sector to work together on deliver. The SBRI model – competitive calls around public sector challenges – was highlighted by some consultees as a positive one and something which de-risks some development work.

99. One sector that has been very active in commissioning Immersive Technology, including some SBRIs for AR, is tourism. Tourism NI has now run at least two competitive calls to bring together businesses working in AR with tourism partners to develop projects, and also has a capital programme inviting tourism providers to apply for funding.

100. Another is the recent competitive call for training solutions using VR to meet different training challenges for three key NI manufacturers (Thales, Bombardier and Denroy Plastics working through the Northern Ireland Advanced Engineering Competence Centre). Common to all three challenges is the need for the solution to demonstrate how the adoption of VR can not only improve productivity within the business, but also increase their offering to customers.

101. However, a small minority of consultees identified some problems with the SBRI or competitive calls as being potentially rigid in terms of accepting partnerships. In one case, a consultee argued that the SBRI or 'technology push' by government that they had been involved in could "*have a process that is more geared towards enabling collaboration, rather than a beauty contest for companies*".

Table 5: The collaboration-clustering spectrum in Immersive Technology

Attribute / activity	Conclusion
Vertical collaboration: firms work with a supplier or customer on product or service development	✓
Horizontal collaboration: firms engage with rivals, or with firms in related industries	✓
Collaboration with other organisations, e.g. Further Education, Higher Education, other sectors, etc.	Limited
Recognition that broader competitiveness is challenged	Limited
Collaboration is formalised as part of a sector strategy or action plan	Developing
Range of collaboration	Project-led focus, with market development at the core
Timescale for collaborative relationships	Short-term and based on project lifespan/funding
Perspective of participants undertaking collaboration	Agency-led and facilitated

3.4 Themes from *Materials Handling & Quarrying Equipment* consultations

102. This sector is much more established and mature than Hi-Tech Creative and Immersive Tech. The origins of the sector in Northern Ireland lie in the 1966 establishment of Ulster Plant, later called Powerscreen in the 1970s, in County Tyrone.

103. Invest NI estimates that the Materials Handling equipment sector currently employs around 4,000 people in more than 100 companies. The research for this report supports these estimates as they are likely to include businesses manufacturing agriculture equipment, machinery for waste handling and recycling, as well as the core of the sector: the manufacture of machinery and equipment for mining, quarrying, crushing, screening and roadworks.[11]

104. This core, using ONS 3 digit BRES figures, employed more than 2,500 people in 2017, an increase of 1,100 (78%) since 2009. This growth has been export-led as industry sources report that the Materials Handling sector in NI now manufactures around 40% of the global supply of mobile crushing and screening equipment. A significant number of consultees reported sales to 50+ countries often through global distribution forces.

105. Mid-Ulster continues to form the core of the industry with 45% of workplace employment in the wider Machinery & Equipment sector in that one local government district. The other significant concentration is in the neighbouring Armagh City, Banbridge and Craigavon Borough Council area.

106. The consultations ranged across the entire sector, including Agri Equipment and Recycling Equipment businesses as well as the 'crushers' and 'screeners'. Consultees were keen to be met on site and showcase the industry, modern manufacturing centres situated in industrial parks and other sites on the outskirts of towns like Dungannon and rural areas of NI.

3.4.1 The level and nature of collaboration

107. The consultee group differed significantly on the extent to which firms were currently (or in the past) engaged in collaboration. This was the one sector where a significant number (10 out of the 24 firms consulted) had never engaged in any collaboration, vertical or horizontal.

108. When this group of 10 were probed further, on whether this was an active decision or not, a minority confirmed it was a conscious decision that would not change and was due to "trust issues". Other businesses had a belief that they did not need to collaborate in order to grow.

109. Those who were open to collaboration were not optimistic that their 'non-collaborative' peers would change their mind. However, there was a view that the

[11] The industry falls within the SIC 28 division of Manufacture of Machinery and Equipment nec which covers a range of industry groups including 289 (Other Special Purpose Machinery), including the manufacture of crushing and screening equipment.

general economic climate (skills and Brexit both being mentioned) might be a factor in bringing about change.

110. This picture of limited levels of collaboration is not a unique phenomenon to this sector. Emerging research into collaboration and innovation in SMEs in case study Metal Forming & Foundry sector suggests similar findings with trust being a key factor alongside knowledge about capabilities (Akenremi & Roper, 2019).

111. For the other 14 consultees, they were either currently and, in many cases, continuously collaborating. However, most of this activity is taking place within the firms' own supply chains and individually with FE / HE institutions.

112. Vertical collaboration tends to be either: (a) initiated by the customer seeking to improve supply chain efficiency or quality improvement; or (b) large companies only wanting to work with a collaborative group, rather than individual companies. The consultees found this useful for incremental innovation and the updating of product lines, though there is also a sense of frustration from businesses about how this might lead to a potential for stagnation in the sector.

113. The need for process innovation and incremental product innovation has led to relatively strong collaboration between firms in this sector and FE / HE institutions. Much of this collaboration has been project-led technology transfer (Innovation Vouchers and programmes such as KTPs and InterTradeIreland's Fusion were all mentioned).

114. In addition, some of the larger firms are now looking at potential for further automation, use of robotics and how data analytics might assist in servitisation (or the addition of services to products) in this sector. There is a business view that the proposed City and Growth Deals – in particular various ideas for Advanced Manufacturing centres – are likely to add further impetus to this collaboration as the Materials Handling firms will be key to successful business engagement.

115. There was an awareness among several consultees of Invest NI's Collaborative Growth Networks programme. This is, in part, because of several initiatives by the agency to see if there would be interest in developing a network for the sector, something which was appreciated but had not yet delivered a proposal.

116. A new initiative, which has the support of Invest NI and Mid Ulster District Council, is MEGA (Manufacturing & Engineering Growth & Advancement). Some Materials Handling firms, who have been involved in the Council's Skills Forum, are supporting the initiative as a way of ensuring a skills pipeline for the broader manufacturing sector and enabling the businesses to explore new business model opportunities aligned to Industry 4.0. Success in these efforts can act as a demonstration of the benefits of wider collaboration on a firm-to-firm basis.

3.4.2 Impact of the collaboration

117. Collaboration in this sector is predominantly **market-driven**, where the **customer demands** improvement to existing products or provision of a new product. Alternatively, the customer may wish to work only with one entity (rather than establish multiple small contracts), which would then function in a project management or contractor role to act as a single point of liaison and deliver a finished

product to the customer. A collaborative effort is then required within the supply chain to meet customer needs or specifications.

118. Consequently, this kind of collaboration enables each firm within the supply chain to attract business, thereby contributing significantly to turnover. Collaborative activity could account for 20% to 25% of total turnover that otherwise would not have been generated.

119. A question which consultees found difficult to answer was whether this was truly collaboration or good innovative responses to customer needs. As one consultee put it, "*Anyone who wants to be successful in businesses will naturally work with their customers to win business, and will invest time and effort to get the product right which fulfils the customer's need*." The growth in market share by the NI Materials Handling sector, as well as employment growth, reflects the success to which these new orders are being accepted by customers in global markets.

120. That said, it may be important (albeit difficult) to distinguish between: (a) vertical collaboration that will have a singular impact on a particular customer relationship; and (b) vertical collaboration that will have a long-lasting impact on productivity, product quality or market access within an industry. Of which, the latter is likely to be more useful in maximising value for public money.

121. A further driver of collaboration is emergence of **new technology**, which creates a need to work with firms and researchers producing complementary outputs. Two aspects that were mentioned in consultations centred on advanced materials (with some firms collaborating with the NI Advanced Composites and Engineering Centre (NIACE)) and using technology to analyse faults and even allow servicing of equipment along the lines that cars have introduced in recent years.

3.4.3 Barriers and catalysts to new or deeper collaboration

122. A telling phrase used by a number of consultees was the need to "*keep your cards close to your chest*". In other words, **collaboration is seen** by many businesses (even those engaged in it) **as a risky endeavour**, with upsides limited and downside risks high. Thus, barriers to collaboration in this sector centre around the risk versus reward trade-off resulting from collaboration.

123. Among the risks highlighted by consultees in this sector, concerns around **Intellectual Property** (IP) or **protection of firm knowledge**, were one of the strongest, given the closeness with which several firms compete. As collaboration necessitates knowledge sharing, the risk of losing valuable commercial information to a competitor is high and there was a fear of opportunism being a factor behind collaboration.

124. Unless the benefits of collaboration are clear, relatively certain and outweigh the potential IP loss, the incentive for firms can be to avoid collaborative activity (Padula & Dagnino, 2007). This is borne out in practice, with consultees highlighting that their businesses would be likely to withdraw from any collaborative activity where there is a risk to their IP.

125. **Benefits from collaboration can be distributed unevenly** within clustering, and this can also be a cause of withdrawal from activity. For collaboration to be and remain successful, firms should be able to understand a clear path from their

resource commitment to benefits received. However, in practice, a number of the (collaborating) firms consulted in this sector highlighted that they do not always see the benefit resulting from collaboration and this therefore reduced their incentive to be further involved.

126. Connected to this lack of clarity around benefits, the consultation highlighted that a **lack of clarity around goals** for collaboration can also act as a barrier. Some consultees went further and noted that there may be a hidden agenda that, due to a lack of disclosure, does not get incorporated in the plan for collaboration. This leads to a negative view of collaborative activity among a majority of consultees in the Materials Handling sector, and a reduced willingness to participate in future collaboration.

127. Consultees therefore highlighted **the importance of the scoping stage** in any collaborative projects, which, in the words of one, could act as a "*screening-out phase*" to identify any and all agendas.

128. Consequently, it may be helpful to foster a more collaborative culture, which would form part of a normal scoping study approach, through:

- Support for development of legally-binding non-disclosure agreements (NDAs);
- A focus on collaborative activity within neutral territory (either conceptually or physically through a shared space for meetings or research, etc.); and
- Facilitation at the outset of collaborative undertakings of (1) transparency of aims and (2) agreement by all parties of objectives with (3) a roadmap to benefits realisation.

129. Another strong indication given by the consultees was that **geographic proximity**, in this case, can act as a barrier to working together as competitors know one another too well. This highlights the "proximity paradox" (Boschma & Martin, 2010), which suggests collaboration needs to follow the "Goldilocks principle", of "not too near and not too far" (Fitjar, Huber & Rodríguez-Pose, 2016).

130. In other words, geographic proximity needs to be accompanied by other forms of closeness – social, cognitive, institutional and clarity of purpose – which can create the conditions for successful collaboration. The consultations in this sector support the idea that geographic proximity is not enough to act as an enabler of trust. Indeed **inter-firm and interpersonal rivalries** can act as a disabler to any sustainable collaboration.

131. Therefore any local rivalries, arising from poor social networks or the fierceness of past competition, could act as constraints that would severely limit any collaboration/ clustering potential. The willingness of consultees to act in collaboration with potential global partners (albeit within constraints of customer/supplier relations) acts as a reminder of distance sometimes being an enabler of cooperation. Trust can be built where competition is not such a clear factor (Ben Letaifa & Rabeau, 2013).

132. The idea of further collaboration and even clustering structures does have some appeal to consultees. A number of those consulted were keen to explore how they might look again at the Invest NI Collaborative Growth Networks programme. However, this may be a sector where the groundwork and preparation will take time and will be crucial to foster a collaborative outlook amongst businesses. It is also sometimes the case that informal networks are the furthest extent of firm linkages

(Gordon & McCann, 2005). In the case of the Materials Handling sector, the benefits of formalised clustering in terms of future success have yet to convince the businesses.

Table 6: The collaboration-clustering spectrum in Materials Handling

Attribute / activity	Conclusion
Vertical collaboration: firms work with a supplier or customer on product or service development	✓
Horizontal collaboration: firms engage with rivals, or with firms in related industries	✗
Collaboration with other organisations, e.g. Further Education, Higher Education, other sectors, etc.	Limited
Recognition that broader competitiveness is challenged	✓
Collaboration is formalised as part of a sector strategy or action plan	✗
Range of collaboration	Narrow focus currently on skills
Timescale for collaborative relationships	Finite, project lifespan
Perspective of participants undertaking collaboration	Facilitated by others, with some bottom-up impetus

4 Policy Recommendations

1. The policy recommendations in this section have been drawn from a combination of the key findings from the consultations (both general and sector-specific), and the good practice identified in the literature review, which might be applied to the NI-specific landscape.

2. It is recognised that Government is currently providing a wide range of support to collaborative networks in NI – such as facilitative support (e.g. provision of appropriate accommodation (eg Pixel Mill) and management training) and administrative support (e.g. organisation of trade missions). These findings and recommendations are intended to support this work and how best to move it into a new stage.

4.1 Laying the groundwork for clustering

3. Successful cluster policies and initiatives tend to work best as part of a broader set of economic policies, in particular those which support collaboration in areas such as innovation. NI has at its disposal a range of policy measures with which to influence economic performance, often in developing the supply side. Therefore, to maintain momentum set out in the outcomes-focussed draft PfG and any opportunity to increase levels of collaboration as part of this should be seized.

4. Particular emphasis is placed on economic policy in NI on the improvement of productivity, innovation and export performance in firms and in the economy more generally. Assuming that improvement in these areas will remain the focus of policy, then, where possible, collaboration and clustering should be embedded into policies and supports for these areas of growth.

5. The best practice and consultations also support the alignment of any cluster policy in NI with wider policy objectives/measures in GB and Ireland. This is particularly the case where clusters are or aspire to operate across national and international borders. Knowledge of and potential to become congruent with any cluster policies in GB and Ireland will be necessary in order to maximise opportunity and minimise duplication of effort.

6. The attraction/ retention of appropriately skilled labour is key to economic development and the skills profile of the NI labour market should be kept under constant review in order to minimise skills mismatches. Utilisation of research and forecasting (such as the UUEPC's Skills Barometer) is important to appropriately inform policy around student number caps and incentives to study. Government should continue to work closely with businesses and FE / HE institutions to ensure labour market supply challenges are met, including in-migration, particularly associated with sector expansion or development of new industries.

7. Although the UK's exit from the European Union poses the greatest short to medium-term risk to economic stability, it is not possible to recommend mitigating actions without knowing the terms of exit. Consequently, the NI public sector should continue to plan for different scenarios of exit to minimise instability for the region. Senior

officials in NI should also continue to work closely with GB counterparts and Westminster to understand how NI may be affected as the exit plans unfold.

R01: Maintain progress in achieving draft PfG outcomes to ensure necessary conditions for growth are in place for NI; further embed the collaborative working culture.

R02: Ensure skills and innovation policies remain up to date and appropriate for business needs through updating of evidence bases, and close working with businesses and FE / HE institutions.

R03: Continue scenario planning for EU exit and continue to work closely with GB counterparts and Westminster.

4.2 Cluster policy development

8. In developing cluster policy, the literature recognises that a thorough understanding of the landscape is important. The current work on the development of a dashboard collating company registration information by sector and maps of spatial concentration in NI is seen as a contributor to this. It is intended that a next step for this workstream is to layer in further datasets, e.g. from Invest NI and Innovate UK open datasets.

9. This work is critical in developing sectoral concentrations. However, to assist in cluster policy development, consideration could be given to taking the mapping exercise even further. For example, it would be beneficial to investigate feasibility of incorporating further quantitative information (such as government funding received), participation status in CGNs, whether firms are active in international markets (and to what intensity), and the potential for inclusion of other qualitative information on inter-firm and inter-industry linkages.

10. The warning is normally sounded that government should exercise caution in "picking winners", in identifying how to best target cluster policy. This is supported by previous experience and the findings from consultees, which would indicate that clusters are most likely to be successful when driven by industry, rather than via attempts by government. This risks attempting to create a cluster where none is likely to develop or being driven by the agenda of an established cluster.

11. The key is to mix the industry-led, bottom-up approach with some form of prioritisation (with input from MATRIX).[12] The extent to which sectoral prioritisation is allowed to drive cluster policy development is an important point. In Ireland support for clusters has been tailored to areas or sectors where there is a clear research prioritisation and recent research on small economies suggests that, given resources, a disproportionate approach may be warranted when looking at priority secors. However, the same research suggests (as does the practice in Ireland) that

[12] The MATRIX panel, which began its work in 2008, adopted a sectoral approach from the start and identified five sectoral clusters in NI (Advanced Manufacturing, Agri-Food, ICT Digital, Advanced Materials and Life & Health Sciences), to which MATRIX has applied capability analysis and foresight research using panels of specialists and publishing a series of important reports; see https://matrixni.org/challenges/clusters-2/ .

a disproportionate approach should not be same as an exclusive one (Skilling, 2019). Indeed, the mixing of bottom-up and top-down approaches may open opportunities for looking at deeper forms of partnership between government, business and research organisations, where risks and rewards are both shared.

12. Although, the consultations and the sectoral concentration mapping show how sectors tend to be located closely together, the argument remains strong for developing cluster policy and opportunities for support firstly on an NI-wide basis, unless a sound rationale supports sub-regional or city-based efforts.

13. In developing policy interventions, it may therefore be appropriate to balance eligibility criteria for provision of support with an element of industry self-identification; i.e. combining top-down and bottom-up approaches. This may take the form of competitive calls for support with clear eligibility and scoring criteria such as minimum numbers of participants, proportion of private sector funding (although this may not be a requirement initially), expected outcomes for industry and participants, and a critical assessment of market failure. More broadly, there is a role here for market intelligence and foresight on global trends when selection for support is being made.

14. In order to garner a critical mass of active participants, it will be important to promote the opportunities and benefits they offer in tangible terms for the potential participants. The consultations have shown how deepening the clustering activity means that these need to be realised at both an industry level and at the level of the individual firms.

15. While a high degree of competition is important in successful clustering, the majority of cooperation within a cluster takes place within the supply chain or across related industries/research actors. Government should therefore ensure that firms have access to knowledge on other organisations within their supply chains and relevant other sectors.

16. Given the requirement for a critical mass of firms willing to participate and actively collaborate in a cluster, government may find it helpful to utilise existing Collaborative Growth Networks (or other Invest NI programmes) to bring together potential participants both within and across sectors.

17. In order to minimise the ongoing resource requirement for government and maximise value for money, cluster policy should be sufficiently flexible that it may be applied across sectors and can be adjusted depending on cluster maturity. Likewise, the flexibility needs to take into account the relative maturity of the sector or collection of firms involved – supports may be quite different for Materials Handling as opposed to Immersive Technology.

18. All cluster participants should have clarity on the nature of support for clusters that might be expected over a 5-10 year time horizon. When developing policy and supports, it is important to factor in how clusters are long-term investments and policy should therefore seek to create an environment conducive to making such investments in time and/or other resource.

19. Although policy makers need to understand private sector requirements to tailor cluster policy appropriately, government should be cognisant of commercial incentives to ensure that additionality is minimised and value for money retained.

20. Additionally, consideration should therefore be given to the development of an exit plan for funding, and how the concept of "fast fails" [13] may be utilised in a cluster context.

R04: **In terms of data captured via industry / firm mapping, investigate feasibility of including (if available) data on:**
- **a. Participation of firms in government initiatives**
- **b. Receipt of funding or other support from government**
- **c. Exporter status of firms**
- **d. Inter-firm linkages**
- **e. Inter-industry linkages**

R05: **Support for emerging and established clusters should be targeted across NI using a competitive bid process with clear eligibility, selection processes and scoring criteria.**

R06: **Broaden the evaluation of existing programmes – especially in trying to understand specific barriers to innovation, growth and export development – in order to assess where it may be appropriate to use available cluster supports to address these barriers and further attract participants to collaborate in these areas.**

R07: **Government should lever existing initiatives and networks to increase industry knowledge about collaboration opportunities and potential partners.**

R08: **Ensure policy has a long term window and is flexible across a variety of industry/priority sectors and adaptable according to cluster maturity.**

R09: **Ensure full integration of cluster policy (and collaborative approaches) with wider, traditional policy and programmes. Ensure consistency with policy in GB and Ireland.**

R10: **Structure support in a way to maximise additionality. Consideration should be given to building in "fast fail" mechanisms within longer term strategies.**

4.3 Cluster policy implementation

21. Cluster policy implementation should follow the same guidelines as those informing the government's wider policy agenda and strategy. Policy makers should be clear about intended long-term outcomes with milestone objectives and setting SMART targets. Continuous monitoring and regular evaluation is needed, perhaps with tailoring to reflect some of the challenges in cluster evaluation, to ensure that policy is achieving its stated targets and objectives; and where not, revising approaches.

[13] This refers to a term in systems design where a break mechanism can stop normal operation rather than allowing a flawed process to continue.

22. To ensure this is successfully achieved, staff in policy roles should work with statisticians and economists from the outset of policy development to ensure targets are precise and measurable; and that data gathering mechanisms will be robust enough to assess impacts.

23. A clear objective for any cluster policy and then its implementation is that of deepening collaboration beyond the current levels. The consultations support a picture in the Community Innovation Survey[14], whereby collaboration is not the norm for most businesses, with the exception of where it is impossible to avoid: collaboration with customers and suppliers.

24. The three sectors consulted reflect this vertical type of collaboration being the most prevalent, followed by cooperative work with HE and FE institutions, more often on skills development but also to some extent on technology transfer. Collaboration with others – competitor firms and those in complementary sectors – is less common again, with risk capital providers rarely mentioned.

25. The nature of current collaboration – largely project-driven and finite in terms of time and resources – also speaks to the potential for further deepening of this activity. As consultees pointed out this would need firms to embrace collaboration with others as a pro-active rather than reactive element of their business and would need others to agree a broader direction for the particular sector they are operating in.

26. At the same time, consultees and other literature caution against policy that is implemented with the cluster itself being the only goal. Some consultees agree that the existence of a cluster can act as an attraction to inward investment – looking to Ireland or Denmark for examples of this. However, for policy makers, the metrics on firm productivity, innovation and internationalisation would also be desired outcomes and need to be measured for cluster participants.

27. Equally importantly, to ensure that the benefits of membership and participation are clear to potential participants, it will be important to see whether firms within a cluster are actually out-performing those outside it, following the example of Cluster Excellence Denmark.

28. In terms of assisting the emergence of clusters, the best practice, supported by some of the consultations[15], pointed to the need to enhance a sense of sector at an early stage. The development of a strategy and strategic direction for a sector takes time and needs to be done ensuring participant buy-in. This is likely to be among the first tasks when establishing a cluster.

29. Related to the question of developing a strategic direction for any emerging cluster is the decision around sectoral leadership. The consultations referred to the need for this on a regular basis – sometimes in terms of institutional actors who could fill the role (e.g. NI Screen) and at other times the need for a business of scale or an entrepreneur who could inspire others to become involved. A correct balance

[14] For more on the NI results of the 2017 Community Innovation Survey (released 19 June 2019) see https://www.nisra.gov.uk/statistics/other-surveys/innovation-survey

[15] These consultations tended to be with those involved in sectors or groups with high levels of collaboration or clustering, such as ADS and NIPA.

between enabling a person or organisation to run the sectoral initiative and ensuring wider buy-in from other actors will be an essential element of success.

30. The question of resources can be linked to the issue of leadership and participation. Given the predominance of micro-enterprises in the NI economy – in particular in nascent sectors such as the Creative Industries – a lack of time and financial resource can be a reality for any cluster initiative. This is likely to ensure the necessity of a CMO with well-resourced supports for any collaborative activity.

31. A key barrier to collaboration identified in the literature and in the consultations (across all three sectors but in particular in Materials Handling) is the absence of trust. This relates to a variety of fears, from staff being "poached" to innovations being lost, and needs to be addressed in many cases. Even where a lack of trust is not an issue, a lack of social capital or tacit knowledge of other potential partners can exist. Ideas of "starting small" or identifying a "common cause" were among some of the catalyst identified by consultees and one possibility, especially in mature sectors, can be around competitive challenges (access to skills, a lack of scale to enter certain markets, etc).

32. Collaboration with related industries and non-competitive actors (researchers, etc) is both a method of avoiding tackling trust issues directly and, particularly in some of the nascent technology areas consulted for this research, is a way of finding new customers. This might be considered as a priority area for any policy implementation.

33. The literature would suggest the establishment of a CMO is beneficial, and that the cluster facilitator role is critical. Invest NI is currently investigating appropriate training / sourcing of facilitation staff and this should be continued. The CMO may also be of benefit in establishing feedback channels between industry and policy makers, increasing policy agility and appropriate alignment to the business environment, particularly over the longer term where such needs may evolve.

34. The CMO may be leveraged to increase knowledge transfer across clusters, through the development of CMO networks and an openness to leverage resources from similar clusters elsewhere on the island of Ireland or in GB. This may be a relatively straightforward way to increase cluster policy impact, given limited resources and funding.

35. Finally, the literature and consultations both suggest that particular innovation and export development tools have been important in stimulating clusters, or at least helping participants identify potential rewards in becoming part of a cluster. Those tools which have a collaborative element or spur this activity should be given particular consideration as supporting actions.

R11: Intended outcomes of policy should be clearly identified with milestone objectives, SMART targets and embedded data gathering, monitoring and evaluation.

R12: Policy staff may find it helpful to work with statisticians and economists to ensure appropriate and robust data are available for use in monitoring / evaluation work; and to identify appropriate methodologies for such work. The communication of results should be considered in relation to assessing the benefits for participants.

R13: **Government should encourage the establishment of a CMO, particularly where a lack of strategic focus exists and firms are predominantly micro-enterprises with limited resources for coordination.**

R14: **Consideration to be given for the need (over time) for a CMO to reflect both sectoral expertise and expertise in the management of clusters and the support services for these.**

R15: **The priorities of a CMO are likely to depend on the nature of the sector involved; though it may be appropriate to require the building of a strategic vision and the creating of trust-building initiatives to be part of any initiation plan for the CMO.**

R16: **The CMOs should be regarded as a wider policy resource in this area, in particular in driving cross-sectoral and international policy learning and connections.**

R17: **Consideration should be given to how public sector and other actors can use particular tools (such as SBRI in the innovation space or 'global sourcing' missions for export development) as stimulants for collaboration and wider cluster development.**

Appendix A: Coded consultation responses

Q1: Contextual information on the nature of collaboration (N=60, 14, 24, 22)

Categorised response	Total	MH	HTC	IT
Collaboration on specific, discrete projects that address particular business need	**24**	**12**	**4**	**8**
Collaboration within supply chain / with customers only	**21**	**9**	**4**	**8**
Collaboration with related / complementary companies	**18**	**3**	**8**	**7**
Collaboration desired	**18**	**4**	**8**	**6**
Involved in INI networks	**18**	**2**	**6**	**10**
Sectoral buy-in needed for collaboration	**16**	**1**	**9**	**6**
Collaboration with education / research institution	**15**	**4**	**7**	**4**
Co-opetition	**14**	**4**	**6**	**4**
INI-led collaboration not effective on its own	**12**	**2**	**8**	**4**
Complementarity doesn't exist in sector	**4**	**3**	**1**	**0**

Note: MH = Materials Handling; HTC = High Tech Creative; IT = Immersive Technology

Q2: Relationships involved in collaboration, who leads, etc. (N=64, 19, 45)

Categorised response	Total	MH	HTC	IT
Self-initiated	**32**	**9**	**11**	**12**
Initiated by Supply chain partners	**25**	**14**	**4**	**7**
Utilising personal networks	**22**	**6**	**10**	**6**
Collaboration to solve a specific issue	**21**	**6**	**9**	**6**
Significant opportunities available in the sector	**20**	**5**	**9**	**12**
Nature of the industry lends itself / industry-identified need	**18**	**2**	**6**	**10**
Facilitator role is important	**16**	**1**	**6**	**9**
INI Collaborative Networks provide a good framework	**13**	**-**	**4**	**9**
Industry knowledge	**11**	**3**	**5**	**3**
Government funding is a factor in collaboration	**10**	**2**	**3**	**5**
Umbrella organisations / sectoral bodies are important	**9**	**1**	**3**	**5**

Q3: What is the purpose of the collaboration, what did it achieve and how did that outcome affect your views? (N=66, 22, 23, 21)

Categorised response: Purpose of collaboration	**Total**	**MH**	**HTC**	**IT**
Product innovation	**38**	**13**	**14**	**11**
Harness complementarities	**31**	**2**	**14**	**15**
Accelerate scale-up / grow firm revenue	**23**	**6**	**11**	**6**
Ensure appropriate skills pipeline	**22**	**12**	**5**	**5**
Completion of a specific project	**21**	**2**	**11**	**8**
Secure major contracts	**21**	**6**	**9**	**6**
Access new markets	**18**	**8**	**4**	**6**
Develop sustainable business models	**17**	**4**	**8**	**5**
Process innovation	**14**	**9**	**3**	**2**
Grow the industry	**13**	**3**	**4**	**6**
Knowledge sharing	**8**	**1**	**2**	**5**
Categorised response: Findings on collaboration				
Collaboration was unproductive	**28**	**10**	**10**	**8**
Collaboration was essential	**22**	**4**	**10**	**8**
Collaboration encouraging	**16**	**8**	**5**	**3**

Q4: Benefits of collaboration (N= 51, 15, 19, 17)

Categorised response	Total	MH	HTC	IT
No significant benefits	**13**	**8**	**3**	**2**
15-25% turnover	**18**	**5**	**8**	**5**
>25% turnover	**8**	**2**	**1**	**5**
Remaining competitive / increasing competitiveness	**23**	**5**	**7**	**11**
Global market access	**7**	**3**	**2**	**2**
Fulfilling customer needs	**25**	**11**	**8**	**6**
Unknown / not yet realised	**12**	**1**	**7**	**4**

Q5: Barriers to collaboration / clustering (N=64, 22, 22, 20)

Categorised response	Total	MH	HTC	IT
Resource requirement for cluster development	**28**	**4**	**14**	**10**
Cultural barriers / industry structure is prohibitive	**24**	**16**	**4**	**4**
Buy-in / trust between companies not present	**21**	**14**	**4**	**3**
Insufficient critical mass	**20**	**3**	**10**	**7**
Benefits realisation: long-term, unevenly distributed	**18**	**8**	**4**	**6**
Information gaps	**16**	**3**	**8**	**5**
Bureaucracy	**15**	**4**	**7**	**4**
IP concerns	**14**	**4**	**4**	**6**
Limited scope for collaboration / low value added	**12**	**4**	**4**	**4**
Policy is siloed in approach, no clear strategic purpose	**12**	**-**	**8**	**4**
Intense resource competition	**12**	**7**	**3**	**2**
Limited support in initiation phase	**11**	**2**	**6**	**3**
Cooperation would be a zero-sum game	**10**	**5**	**4**	**1**
Lack of collaboration / cluster strategic leadership	**5**	**3**	**1**	**1**
High technical barriers to entry	**4**	**-**	**1**	**3**
No significant barriers	**13**	**5**	**4**	**4**

Q6: Overcoming barriers to collaboration / clustering & other helpful measures (N=63, 18, 24, 22)

Categorised response	Total	MH	HTC	IT
Ensure clear benefits realisation plan from initiatives	**28**	**13**	**8**	**7**
Dedicated cluster management / development resource	**24**	**4**	**13**	**7**
Continual identification of firms & relationship / trust building actions	**22**	**9**	**9**	**4**
Prioritise promotion of collaboration between related industries, rather than between competitors	**21**	**9**	**4**	**8**
Ensure actions are based on addressing customer needs	**21**	**8**	**8**	**5**
Support / run trade missions	**19**	**4**	**7**	**8**
Develop critical mass	**19**	**4**	**9**	**6**
Strategic support to address skills pipeline	**18**	**12**	**4**	**2**
Government could act as a large buyer of the industry's output	**17**	**2**	**6**	**9**
Mentoring programme for start-ups as a condition of State support	**16**	**2**	**8**	**6**
Adoption of a more strategic & holistic view in policy / support to meet industry-identified needs	**15**	**5**	**4**	**6**
Utilise legal NDAs where needed / appropriate	**14**	**4**	**4**	**6**
Government run / supported needs analysis of the sector	**12**	**1**	**7**	**4**
Increase in / ensuring value added activities for meetings etc	**12**	**2**	**5**	**5**
Minimise bureaucracy in procedures [Recommendation to UX design forms & keep minimal?]	**11**	**3**	**5**	**3**
Provide relevant sectoral information, market intel / strategic direction	**10**	**1**	**6**	**3**
Ensure full stakeholder involvement from outset of projects to build partnership culture	**8**	**-**	**6**	**2**
Ensure umbrella organisations are appropriately utilised	**7**	**1**	**4**	**2**
Ensure appropriate communication pathways are maintained	**6**	**-**	**4**	**2**

Appendix B: Reference list

Akenremi, T. & Roper, S. (2019), 'Barriers to collaborative innovation in SMEs', presentation to ERC showcase, March 2019. Enterprise Research Centre.

Aragón, C., Aranguren, M.J., Iturrioz, C. & Wilson, J.R. (2014), 'A social capital approach to network policy learning: The case of an established cluster initiative', *European Urban and Regional Studies,* 21(2), 128-145.

Aranguren, M.J., de la Maza, X., Parilli, M.D., Vendrell-Herrero, F. & Wilson, J.R. (2014), 'Nested methodological approaches for cluster policy evaluation: an application to the Basque Country', *Regional Studies*, 48(9), 1547-1562.

Ben Letaifa, S. & Rabeau, Y. (2013), 'Too close to Collaborate? How Geographic Proximity Could Impede Entrepreneurship and Innovation', *Journal of Business Research* 66(10), 2071–2078.

Bonner, K. (2018). *NI local growth dashboard*. Enterprise Research Centre.

Boschma, R.A. (2005), 'Proximity and Innovation: A Critical Assessment', *Regional Studies* 39(1), 61–74.

Boschma, R.A., & Martin, R. (2010), 'The Spatial Evolution of Innovation Networks. A Proximity Perspective', in *The Handbook of Evolutionary Economic Geography*, edited by R.A. Boschma and R. Martin, 120–135. Cheltenham: Edward Elgar

Bresnahan, T.F. & Trajtenberg, M. (1995), 'General purpose technologies: "Engines of growth?"', *Journal of econometrics*, 65(1), 83-108.

Burger, M.J., Karreman, B. & van Eenanaam, F. (2015), 'The competitive advantage of clusters: Cluster organisations and greenfield FDI in the European life sciences industry', *GeoForum*, 65, 175-91.

Burger, P. et al (2015), *Cluster Promotion and Management: The Current Global Situation*. Report for Ministry for Education & Science, Slovak Republic.

Cogent Management Consulting LLP (2016), *Collaborative Network Programme – Phase II: Economic Appraisal*. Commissioned by Invest NI.

Combes, P. & Duranton, G. (2006), 'Labour pooling, labour poaching, and spatial clustering', *Regional Science and Urban Economics*, 36(1), 1-28.

Cozzolino, A. & Rothearmel, F.T. (2018), 'Discontinuities, competition and cooperation: Coopetive dynamics between incumbents and entrants', *Strategic Management Journal*, 39, 3053-3085.

Danish Agency for Science, Technology and Innovation (2015), *The impact of enterprises' participation in clusters and innovation networks*. Ministry of Higher Education and Science.

De Silva, M., Howells, J. & Meyer, M. (2018), 'Innovation intermediaries and collaboration: knowledge-based practices and value creation', *Research Policy*, 47(1), 70-87.

Delgado, M., Porter, M.E. & Stern, S. (2016), 'Defining clusters of related industries', *Journal of Economic Geography*, 10, 495-518.

Department for Business, Energy and Industrial Strategy (2017), *Industrial Strategy: Building a Britain fit for the future*.

Department for the Economy (2018), *Entrepreneurship in Northern Ireland: Context paper*.

European Commission (2016), *Smart guide to cluster policy*. Ref. Ares (2016) 2507138.

Feser, E, Sweeney, S. & Renski, H (2005), 'A descriptive analysis of discrete US industrial complexes', *Journal of Regional Science*, 45(2), 395-419.

Fitjar, R.D., Huber, F., & Rodríguez-Pose, A. (2016), 'Not too close, not too far: testing the Goldilocks principle of "optimal" distance in innovation networks', *Industry and Innovation*, 23(6), 465-487.

Frenken, K., Van Oort, F. & Verberg, T. (2007), 'Related variety, unrelated variety and regional economic growth', *Regional Studies*, 41, 685–697.

Giuliani, E., Maffioli, A., Pacheco, M., Pietrobelli, C. & Stucchi, R. (2013), *Evaluating the impact of cluster development programs*. Inter-American Development Bank.

Gordon, I. R., & McCann, P. (2005), 'Innovation, agglomeration and regional development', *Journal of Economic Geography*, 5(5), 523–543.

Hartog, M., Boschma, R. & Sotarauta, M. (2012), 'The impact of related variety on regional employment growth in Finland 1993-2006: High-tech versus medium/lowtech', *Industry and Innovation*, 19 (6), 459–476.

Hart, M., Bonner, K., Levie, J. & Heery, L. (2017), *GEM UK: Northern Ireland Report 2017*. Global Entrepreneurship Monitor.

Havierniková, K., Kordoš, M. & Vojtovič, S. (2016), *V4 cluster policies and their influence on the viability of cluster organisations: Cluster policy in the Slovak Republic*. Visegrad Fund.

Hewitt-Dundas, N. & Roper, S. (2018), *Understanding micro-businesses in Northern Ireland*. Enterprise Research Centre.

Hospers, G. (2005), 'Best practices and regional cluster policy in Europe', *Tijdschrift voor Economische en Sociale Geographie*, 96 (4), 452-457.

Invest NI (2017), *Leveraging clusters and cluster policies for successful implementation of RIS3: Peer Review Northern Ireland*.

Kergel, H., Meier zu Kocker, G. & Nerger, M. (2014), *New approaches to improve the performance of Cluster Management in Europe*. European Secretariat for Cluster Analysis (ESCA), Berlin.

Kergel, H., Meier zu Kocker, G., Nerger, M. & Ziegler, O. (2018), *Cluster management excellence in the Danube region*. ESCA.

Ketels, C. & Protsiv, S. (2016), *European Cluster Panorama 2016*. European Commission.

Kiese, M. (2013), 'Regional cluster policies in Germany – A multi-level governance perspective on policy learning', *ERIEP*, no.5.

Kiese, M. (2017), 'Regional cluster policies in Germany: Challenges, impacts and evaluation practices', *Journal of Technology Transfer*, 1-22.

Lämmer-Gamp, T., Meier zu Köcker, G. and Christensen, T.A. (2012), *Let's make a perfect cluster policy and cluster programme: SMART recommendations for policy makers*. The Danish Ministry of Science.

Maffioli, A., Pietrobelli, C. & Stucchi, R. (2016), *Impact evaluation of cluster development programme*. Available from https://voxeu.org/ last accessed 14 January 2019.

Magennis, E. & Gough, A. (2015), *Mapping the potential for all-island sectoral ecosystems: A summary report*. InterTradeIreland.

Maxwell Stamp PLC (2013), *Guidelines for cluster development: A handbook for practitioners*. Prepared for the Government of the Republic of Croatia.

Mazzucato, M. (2017), 'Mission-Oriented Innovation Policy: Challenges and Opportunities', IIPP working paper 2017-01. Institute for Innovation and Public Purpose, UC London.

McAdam, M. & Debackere, K. (2017), 'Beyond "triple helix" toward "quadruple helix" models in regional innovation systems: Implications for theory and practice', *R&D Management*, 48(1), 2-6.

Miozzo, M., Desyllas, P., Hsing-Fen Lee & Miles, I. (2016), 'Innovation collaboration and appropriability by knowledge-intensive business services firms', *Research Policy*, 45(7), 1337-51.

NISRA (2019), *UK Innovation Survey 2017: Northern Ireland results, 2014-2016*. June 2019.

Padula, G. & Dagnino, G. B. (2007), 'Untangling the rise of coopetition: the intrusion of competition in a cooperative game structure' *International Studies of Management and Organization*, 37(2), 32–53.

Parrilli, M.D., Aranguren, M.J & Larrea, M. (2010), 'The role of interactive learning to close the "innovation gap" in SME-based local economies: A furniture cluster in the Basque Country and some policy implications', *European Planning Studies*, 18(3), 351-370.

Pine, B.J. & Gilmore, J.H. (1998), 'Welcome to the experience economy', *Harvard Business Review* 31(7), 8-15.

Polozhentseva, Y. and Klevtsova, M. (2015), 'Instruments of development of cluster policy: Stages, models, international practice', *Procedia Economics and Finance*, 27, 529-537.

Porter, M. (1990), *The Competitive Advantage of Nations*. Basingstoke: Palgrave.

Porter, M.E. (1998), 'Clusters and the new economics of competition', *Harvard Business Review*, 76(6), 77-90.

Roper, S., Love, J.H., & Bonner, K. (2017), 'Firms' knowledge search and local knowledge externalities in innovation performance', *Research Policy*, 46(1), 43-57.

Saha, N., Sáha, T & Sáha, P. (2018), 'Cluster strategies and smart specialisation strategy: Do they leverage on knowledge and innovation-driven territorial growth?', *Technology Analysis & Strategic Management*, 30(11), 1-13.

Schmiedeberg, C. (2010), 'Evaluation of cluster policy: A methodological overview' *Evaluation*, 16(4), 389-412.

Skilling, D. (2019), *The strategic integration of skills and innovation policy in Northern Ireland: An international small economy perspective*. Prepared by Landfall Strategy Group for the Department for the Economy.

Trippl, M, Grillitsch, M., Isksen, A. & Sinozic, T. (2015), *Understanding cluster evolution*. Lund University / CIRCLE Innovation Working Paper, 2015/46.

Uyarra, E. & Ramlogan, R. (2012), *The effects of cluster policy on innovation: Compendium of evidence on the effectiveness of innovation policy intervention*. Manchester Institute of Innovation Research and NESTA.

Uyarra, E. & Ramlogan, R. (2018), 'Cluster policy in an evolutionary world? Rationales, instruments and policy learning', in D. Fornahl & R. Hassink (eds), *The Life Cycle of Clusters. A Policy Perspective*. Cheltenham: Edward Elgar, 33-55.

van Egeraat, C. (2018), 'Identifying clusters – A review of methodological approaches, *SOTA Review*, no.9. ERC.

van Egeraat, C. & Doyle, E. (2018), 'Rethinking Irish cluster policy', *Administration*, 66(1), 107-128.

Wilson, J. R. (2019), 'Cluster policy resilience: New challenges for mature policy', *International Journal of Business Environment*, pre-publication draft.

Wise, E., Wilson, J. & Smith, M. (2017), *Do clusters yield positive effects on firm performance? A review of cluster programme effect analyses in Sweden and internationally*. Swedish Agency for Economic and Regional Growth.

Appendix C: Department for the Economy (NI) cluster assumptions

1. Collaboration leads to:
    - higher levels of innovation;
    - increased turnover;
    - collectively seeking larger contracts and funding opportunities;
    - increased access to international markets; and/or
    - sharing of knowledge / processes / resources.
2. SMEs / microbusinesses don't collaborate as much as larger companies.
3. SMEs / microbusinesses don't collaborate due to time constraints / financial pressures but would collaborate if they had more time / money.
4. Companies are not aware of the benefits or concept of clustering.
5. Geographical proximity does not mean / necessarily encourage cluster behaviours.
6. In high-tech companies, secrecy is a barrier to collaboration – IP concerns.
7. Companies in the same sector largely see each other as competitors rather than potential partners.
8. Informal networks exist in emerging technology sectors; collaboration is largely restricted to knowledge sharing and there are limited formal links between companies.
9. Emerging technology companies are more comfortable with collaborating than companies in more established industries.
10. There is a level of collaboration in Mid-Ulster re materials handling (links with academia – in respect of course provision, etc).
11. Sectoral organisations play an important role in encouraging collaboration.
12. Business organisations (CBI, IoD, Chamber of Commerce etc) play a role in promoting collaboration.
13. Some high tech companies have collaborative links with colleges / universities; however, in the main, companies do not have links with academia.
14. Companies are not willing to fully- or part-fund a cluster facilitator post.
15. Existing collaborations are mainly short-term, supply-chain-based, informal, and without international partners.
16. Project funding would enable greater collaboration (addressing time / money constraints felt particularly by SMEs).
17. Companies are not aware of the support available in respect of collaboration.
18. Companies would like to see and would engage with a sectoral organisation that supports collaboration and other cluster activities.
19. There is a large level of collaboration (value chain etc.) between Immersive Tech companies and Creative Industries.

20. The sectors have different needs in respect of sustained collaboration – i.e. various levels of support would be required dependent on cluster / sector maturity.

Appendix D: Cluster policy 'dos and don'ts'

Don't...	Do...
Support individual specialised firms	Support new activities, in particular those being undertaken by groups or networks of related industries
Create clusters from scratch (i.e. implementing 'wishful thinking' of policy-makers)	Facilitate the growth of clusters by building upon existing strengths (i.e. implementing evidence-based policy by building upon a comparative analysis of regional strengths and 'entrepreneurial discovery')
Fund large numbers of widely varied clusters	Fund strategic cluster initiatives that focus on promoting the strengths, linkages and emerging competences, and which are in line with the aims of national / regional smart specialisation strategies
Follow growth trends without reflection	Capitalise upon regional competences to diversify into new activity areas and to develop emerging industries
Follow a narrow sectoral cluster approach	Follow a systemic cluster approach focusing on related industries by capturing cross-sectoral linkages
Develop and implement cluster policy in isolation from other policy areas	Adopt an inclusive and participatory cluster approach (i.e. involving businesses, investors, academics and policy-makers, and making links with related policy themes such as R&D, innovation, entrepreneurship, access to finance, SME internationalisation etc.)
Support cluster initiatives that are only inward looking	Support cluster initiatives that have an international perspective on the positioning of the cluster in international value chains
Focus exclusively on strengthening regional partnerships	Build regional partnerships as a basis for joining European Strategic Cluster Partnerships

Source: European Commission (2016). *Smart guide to cluster policy*. Ref. Ares(2016) 2507138.