Innovation skills - international developments and Northern Ireland economic priorities

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Innovation Skills: International Developments and Northern Ireland Economic Priorities

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First Issue

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Reach heights unimagined

Ulster University

About this document

This report was prepared by **Professor Michael Brennan** (Ulster University), **Dr Shirley Davey** (Ulster University), and **Charlie Tuxworth** (Celsio) for the Department for the Economy, Northern Ireland.

The report is an output of the Innovation Competency Framework for Inclusive Innovation (ICF) research project that addresses the need for an evidence base to inform Northern Ireland's economic priorities. It provides a greater understanding of the innovation skills landscape through a review of contemporary international innovation competency frameworks and the views of key innovation ecosystem stakeholders.

The authors would like to thank DfE for their support during the project, and the stakeholders for their time, insights, and contribution during the workshop and interviews. We've included samples of what we heard on the dividing pages throughout the report.

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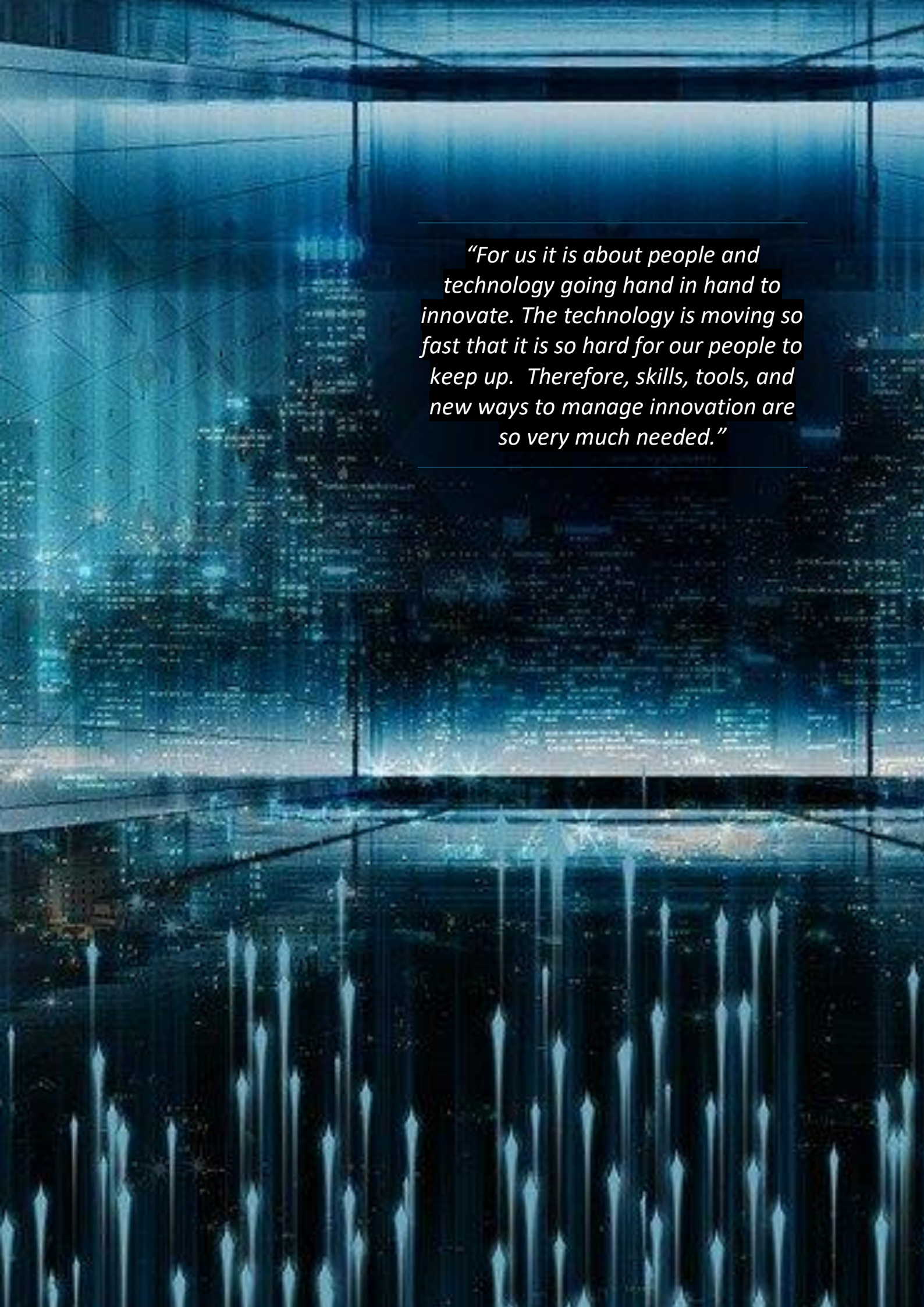

"For us it is about people and technology going hand in hand to innovate. The technology is moving so fast that it is so hard for our people to keep up. Therefore, skills, tools, and new ways to manage innovation are so very much needed."

Executive Summary

Innovation is widely recognised as a key driver for productivity, economic growth, social well-being, and environmental sustainability. However, innovation is not only the result of scientific and technological breakthroughs, but also of the creative and collaborative efforts of diverse individuals and organisations. Inclusive innovation is the process of developing and implementing new solutions that address the needs and aspirations of a broad range of stakeholders, especially those who are marginalised or underserved.

To foster inclusive innovation, it is essential to develop and enhance the innovation competencies of individuals, teams, organisations, and ecosystems. Innovation competencies are the knowledge, skills, attitudes, and behaviours that enable people to effectively participate in, and contribute to, innovation processes. They include cognitive, social, emotional, and ethical dimensions, as well as domain-specific and cross-cutting abilities.

This report is an output of the Innovation Competency Framework for Inclusive Innovation (ICF) research project. The aim of the project was to provide a greater understanding of the innovation skills landscape through a review of contemporary international innovation competency frameworks and the views of key local stakeholders.

The project involved:

- A systematic review of existing innovation competency frameworks from various sectors, regions, and levels of analysis.
- A stakeholder engagement process, consisting of an online survey, interviews, and workshops, to elicit the perspectives of representatives from academia, industry, government, and civil society.
- A synthesis and analysis of the findings including a set of recommendations for policy and practice relevant to the three areas of focus for the regional economy: improving R&D performance; establishing innovation driven enterprises; and comprehensive innovation that encompasses the wider business base.

The main contributions and implications of this report are:

- It provides a comprehensive and contemporary overview of the state-of-the-art in innovation competency research and practice, highlighting the diversity, complexity, and dynamism of the field.
- It identifies the commonalities and differences among the existing frameworks, as well as the strengths and gaps in their coverage, applicability, and assessment.
- It offers a novel and holistic perspective on innovation competencies, that integrates technical, humanistic, and critical dimensions, and emphasises the importance of inclusivity, diversity, and ethics in innovation.
- It reflects the views and needs of the Northern Ireland innovation ecosystem, while also drawing on international best practices and benchmarks.

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- It proposes an approach that can be used for various purposes and audiences, such as curriculum design, professional development, organisational change, evaluation and monitoring, and regional strategy.

The report presents the following recommendations relating to each of the areas of innovation focus for the Northern Ireland economy:

1. Improving R&D Performance
    - Cluster specific user case development that illustrates how innovation takes place.
    - Aligning skills development in R&D with Horizon Europe and the dynamic ESCO-O*NET systems.
    - Developing cluster/ sector specific frameworks for innovation.
2. Establishing Innovation Driven Enterprises
    - Strategic planning that embraces the entrepreneurial opportunities emerging from the transition to the green economy.
    - An examination of job roles, recruitment needs and offers adapted for UK-EU dual market access.
    - A review of new career and learning paths for innovation.
3. Comprehensive Innovation
    - Alignment with UN concept of inclusive innovation for sustainable development that is human centric, sustainable, and resilient.
    - Development of future skills workplace scenarios that demonstrate agility, interrelationships, and a systems perspective.
    - Ongoing engagement with international initiatives relating to generic skills and competencies for innovation to support a greater understanding.

In addition, a series of wider actions and recommendations is presented that reflect contemporary international priorities and the approaches adopted by key organisations: the United Nations (UN); the Organisation for Economic Co-operation and Development (OECD); the European Commission (EC); the European Skills, Competences, Qualifications and Occupations system (ESCO); the United States Occupational Information Network (O*NET); the World Bank; the World Economic Forum (WEF); and the International Standards Organisation (ISO).

The recommendations are included in the Innovation Competency Framework for Inclusive Innovation which can be found in the Findings and Recommendations section of the report. This framework also includes an alignment with the new economic priorities for Northern Ireland introduced in 2024.

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Introduction

The **Innovation Competency Framework for Inclusive Innovation (ICF)** research project contributes to the need for an evidence-base that will inform innovation policy in the Northern Ireland regional economy.

The overall purpose of the project was to provide a greater understanding of the innovation skills landscape through a review of contemporary international innovation competency frameworks and the views of key local stakeholders. This report is an output of the ICF research project.

It should be recognised that the definition and understanding of innovation has changed over time. A contemporary view of innovation is that it relates to the creation of value and can be considered both as an activity as well as the outcome of that activity.

The structure of the report is as follows:

Strategic Context: there is a recognition that the regional economy requires a step change in economic performance with greater productivity, innovation, inclusive growth, and sustainability. There is a need to develop detailed implementation plans and clearly link activities to outcomes and impact.

International Skills for Innovation: global megatrends are fundamentally changing the international innovation skills landscape. Such megatrends include: the transition to **net zero**; the emergence of a new industrial revolution characterised as **Industry 5.0**; and the rapid development of **new skills frameworks** (ESCO and O*NET).

Stakeholder Engagement: engagement with key stakeholders through a dedicated workshop and one-to-one interviews confirmed the perception of a 'fractured and fragmented' skills ecosystem in the regional economy as highlighted by the Lyons Review (2023).

Implications for the Economy: the evidence generated by the research suggests a strategic opportunity to develop implementation plans that clearly align with both innovation policy and the recently introduced economic priorities.

Findings and Recommendations: key findings from the research and stakeholder engagement are presented, and recommendations proposed.

For this report, we adopted a description of innovation found in the OECD Oslo Manual Guidelines[1] (the de facto international reference source for innovation studies) for the collection, reporting and use of data on innovation:

[1] Oslo Manual

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> *"Key components of the concept of innovation include the role of knowledge as a basis for innovation, novelty and utility, and value creation or preservation as the presumed goal of innovation."*
>
> *(Oslo Manual 2018:20)*

Business capability is identified as of critical importance for understanding the effect of innovation on organisation performance and includes knowledge, competencies, and resources.

The Oslo Manual identifies four types of capabilities relevant to understanding the innovation performance of all firms:

- the resources controlled by a firm.
- the general management capabilities of a firm.
- the skills of the workforce and how a firm manages its human resources.
- the ability to design, develop and adopt technological tools and data resources, with the latter providing an increasingly important source of information for innovation.

  (Oslo Manual 2018:35)

Innovation is therefore of relevance to both the management of organisations and worker occupational skills.

Two major occupational skills frameworks were identified as primary sources of information on occupational information - including skills typically associated with innovation:

- O*NET [2] – Developed by the U.S. Department of Labor/Employment and Training administration.
- ESCO [3] – Developed by the European Commission.

In addition, we adopt the **Institute for Apprenticeships and Technical Education** (IfATE) definition of key terms used in occupational standards.[4]

Knowledge - the information, technical detail, and 'know-how' that someone needs to have and understand to successfully carry out duties. Some knowledge will be occupation-specific, whereas some may be more generic.

Skills - the practical application of knowledge needed to successfully undertake duties. They are learnt through on and/or off-the-job training or experience.

Behaviours - mindsets, attitudes or approaches needed for competence. Whilst these can be innate or instinctive, they can also be learnt. Behaviours tend to be very transferable. They may be more similar across occupations than knowledge and skills.

[2] O*NET skills framework
[3] ESCO skill framework
[4] Institute for Apprentices Occupational Standards

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The methodology adopted was a systematic review utilising public data and the team's academic research and international peer network (See **Appendices**

Appendix A – Methodology). In addition, the team engaged with key stakeholders to capture and report upon current understanding of innovation skills and competencies.

The content of the report is intended as a reference to support future articulation, definition, and description of:

- Skills and competencies for innovation across the economy.
- Job roles, recruitment needs and offers, and other types of competence specifications.
- Education, training, and competence development programs, qualification frameworks, certification of persons (including certification schemes), and other relevant curricula.
- New career and learning paths, formal and non-formal, and continual professional development needs.
- Competence and skills gaps analysis at the individual, team, or organisational level.

The research informing the report was undertaken during January to March 2024 and includes signposting to key sources of information and relevant examples of innovation skills frameworks.

Analysis is presented that relates these developments to the Department for the Economy's three areas of focus. These are: improving Research & Development performance, supporting more and better Innovation Driven Enterprises, and encouraging innovation across the wider business base (Comprehensive Innovation). Specific skills, capabilities and knowledge areas for local companies are highlighted. In addition, recommendations are proposed that address the need to operationalise innovation skills policy and relate these to the new economic priorities introduced in 2024.

The intended audience for the report is primarily policy makers and innovation / skills support delivery agents.

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"There's a need to learn and practice business skills in a safe place. How can someone know if they have the aptitude, talent, or drive for innovation unless they are given the chance to try it out."

Strategic Context

The current strategic context for innovation in the Northern Ireland economy can be understood in terms of economic priorities and areas of innovation focus. In February 2024 the Minister for the Economy set out four priorities: to raise productivity, increase the proportion of working-age people in good jobs, promote regional balance, and reduce carbon emissions.[5]

Innovation is regarded as a key policy lever in driving the four economic priorities. The Department for the Economy has identified three areas of focus for creating a more innovative economy with widespread societal benefits. These include improving R&D performance; supporting more and better innovation driven enterprises; and encouraging innovation across the wider business base (Comprehensive Innovation).

Collectively, these three areas of focus are intended to support productivity growth both within the most tradable sectors and across the wider economy. The purpose is to ensure that businesses across the region increase their innovation, create additional jobs, and address key challenges such as the economic transition to net zero.

Previous valuable work (since 2019) includes some twenty strategies, reviews and initiatives undertaken by a range of international organisations and specialist consulting groups relating solely to the Northern Ireland regional economy. Appendix B presents an overview of the reports consulted as part of our research (**Appendix B – Northern Ireland: Innovation Competency Related Strategies, Reviews, and Initiatives**).

Work by the Landfall Strategy Group (*The Strategic Integration of Skills & Innovation Policy in Northern Ireland, Skilling 2019*) can be viewed as a starting point for the strategic integration of skills and innovation policy in Northern Ireland. This report recommended the following (page 14):

- The need for a stronger response from government in terms of a skills and innovation strategy.
- The need to translate strategies into specific programmes and initiatives.
- The need for a wider societal understanding of the strategic direction for skills and innovation development to overcome the perception of a fragmented approach.

The DfE published *Skills Strategy for Northern Ireland* (2022) identified three key policy objectives: addressing skills imbalances; creating a culture of lifelong learning; and enhancing digital skills. In addition, this report highlighted the need for specific supporting policy enablers: enhancing policy cohesion, building strong relationships, and investment in the skills system.

Further work completed by Skilling (*Integrating Sustainability into the 10X Agenda, 2022*) identified the need to integrate sustainability into economic development and highlighted the entrepreneurial opportunities emerging from the transition to net zero.

[5] Statement from Minister Murphy - economic vision

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These insights and recommendations were further developed in a wide-ranging analysis undertaken by the Lyons Review in 2023.This review was commissioned to provide an independent assessment of the work of Invest NI through extensive stakeholder engagement and international research. The completion of this work generated considerable insights relating to innovation in the economy. This analysis addressed the following key contextual factors:

- EU Exit and the Northern Ireland Protocol.
- Programme for Government (2018).
    - Economic outcomes.
    - Strong, competitive, regionally balanced economy.
    - An innovative creative society where people can fulfil their potential.
    - More people working in better jobs.
- New Decade, New Approach (2020).
- Skills Barometer (2021).
- Energy Strategy – Path to Net Zero Energy (2021).
- A 10X Economy – Northern Ireland's Decade of Innovation (2021).
- Skills Policy / Strategy (2022).
- Energy Strategy and Green Growth (2022).
- Draft Green Growth Strategy to 2050.

This detailed and extensive study highlighted the muti-faceted nature of the Northern Ireland economy and the central role of skills and innovation. In addition, the appendices provide a comprehensive index of source documents and extensive links to web-based resources.

Further work intended to support the Lyons Review was completed by external consultants Technopolis. This research evaluated contextual factors in more depth and was presented in three discrete reports:

- Invest NI benchmarking and best practice review (December 2022).
- Invest NI performance review (December 2022).
- Review of Invest NI: Successful local economic development ecosystems (August 2022).

The detailed analysis presented in these reports provides an extensive and independent evaluation of the strategic context for understanding innovation skills development from an international perspective.

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Lyons Review: Key Findings

Whilst the Lyons Review addresses the performance of Invest NI it also provides invaluable insights into the wider context for innovation.

Given that Invest NI is the lead economic agency and provider of innovation interventions, the following is an attempt to create an innovation profile of the regional economy based on a summary findings and recommendations (**Appendix C – Lyons Report Findings and Recommendations**).

I. **Portfolio of Programmes**: a large and unwieldly portfolio that is difficult for companies and staff to understand. Review of programmes appears to be sporadic and non-strategic. The portfolio of programmes needs to align with economic impact.

II. **Green Growth**: immature support for sustainability. And slow appreciation of the strategic significance of the green economy. A need to agree policy priorities across government departments.

III. **Skills**: cluttered skills ecosystem that is uncoordinated and involves duplicated efforts. Scope to review the entirety of the regional skills offering.

IV. **Performance Metrics**: The impact of interventions cannot be demonstrated. A focus on outputs rather than outcomes with a need to widen metrics to include innovation. A well-defined set of SMART performance metrics should be set and aligned with future policy priorities.

V. **Intelligence & Digitisation**: A need for programme monitoring and evaluation.

VI. **Communications**: The need for strategic communication to articulate the impact of activities.

VII. **Risk and Control**: Lack of effective post project evaluation and a need to ensure delivery against objectives.

VIII. **Invest NI and a New Economic Vision**: Slow progress in developing detailed implementation plans tangibly liked to strategy and the Programme for Government.

The above profile highlights the need for a strategic approach to skills development that explicitly addresses the need to demonstrate impact, clear objectives, well-defined performance metrics, and the need for a programme of monitoring and evaluation.

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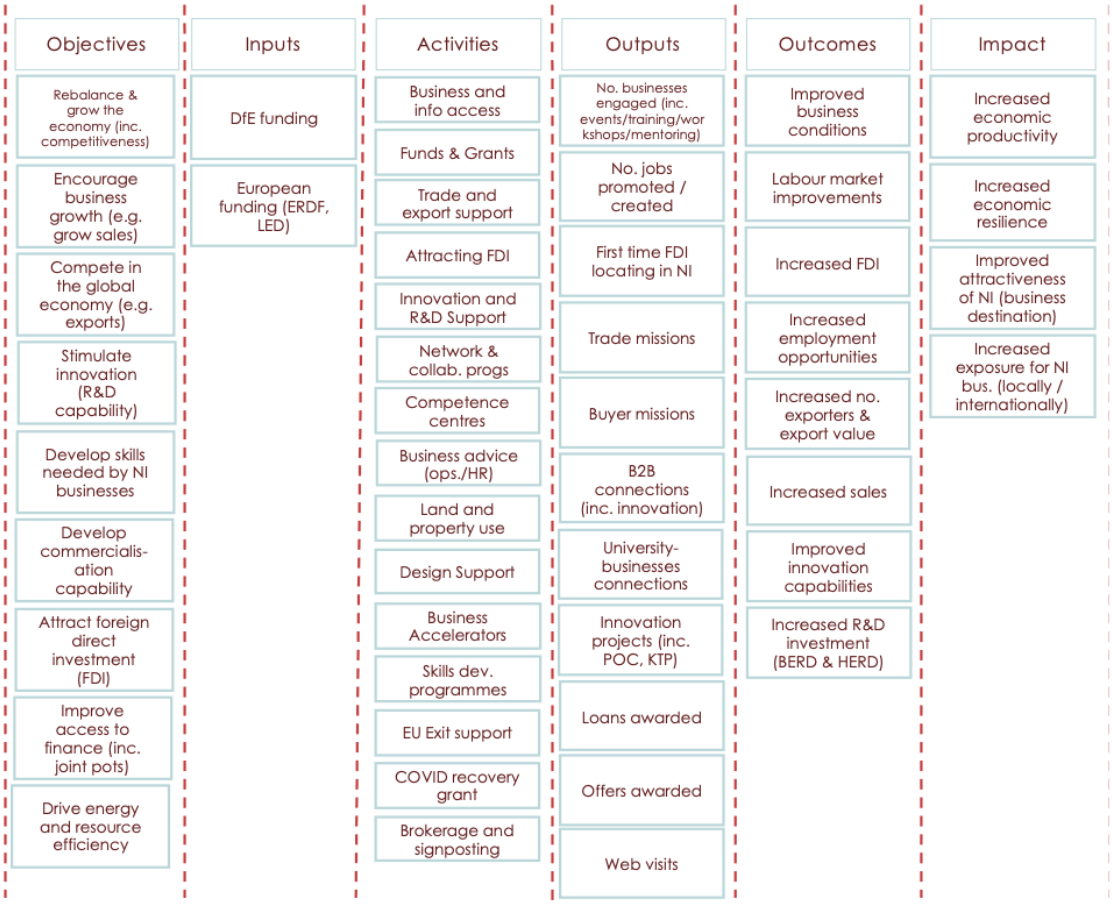
The Technopolis logic model and theory of change

In addition to the key findings from the Lyons Review, the Technopolis Performance Review developed an outline logic model and theory of change as a way of capturing the activities of Invest NI in simple terms. This model is presented in Table 1.

Table 1: Logic Model for Invest NI



(Source: Technopolis Performance Review 2022:12)

Technopolis argued that the rationale for the development of a logic model is that it clearly explains how objectives are achieved and impact delivered. Technopolis summarise this approach as follows:

> *"A logic model is used to present how (Invest) NI works to deliver results. This is done by defining what is ultimately sought as a result of the organisation's work (the objectives), what resources are available to achieve those goals (inputs), how activity is measured (outputs), and traces the expected changes (outputs, outcomes and impacts). In addition to setting out these components of an organisation's work, a theory of change establishes the links and causal relationships across areas of activity, in order to understand which factors may enable or limit the achievement of objectives." (Technopolis p.12)*

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The significance of the above for the development of innovative skills in local companies is that it operationalises the strategic priorities of the regional economy into a coherent strategy.

More importantly, the logical model approach combined with a theory of change can be understood as part of a wider family of approaches identified a *Results-Based Management* (RBM): a strategic management approach central to international economic development, including the achievement of the United Nations Sustainable Development Goals (SDGs).

Future Skills: Scenarios for the NI Economy 2023

In 2020 the Matrix commissioned external consultants to carry out a 'Future Skills' study relating specifically to skills and workforce needs to 2035, in priority technology-based clusters:

- Digital, ICT and Creative Industries
- Fintech / Financial Services
- Life and Health Sciences
- Agritech
- Advanced Manufacturing and Engineering

The Future skills report utilised the World Bank's typology of skills (foundational and higher order skills; socio-emotional skills; and specialised skills) in four alternative scenarios relevant to Northern Ireland . These scenarios were based on uncertainty relating to global challenges, and uncertainty relating to the application of technology.

Four type of workplace scenarios were identified:

- **Autonomous Workplaces** describes a future where the application of technology is widespread and supranational collaboration is low. Technologies are used to manage workflow and cut costs.
- **Net Zero Workplaces** describes a future where the application of technology is widespread and supranational collaboration is high. Corporates and skilled staff work flexibly and move constantly, fuelling city-level competition. Skill shortages and wage inflation accelerate in regions that fail to attract talent.
- **Optional Workplaces** describes a future where the application of technology is focused, and supranational collaboration is low. Economic activity and growth have slowed worldwide as governments focus on low carbon living and working. Public funding of technology supports this endeavour.
- **Shuttered Workplaces** describes a future where the application of technology is focused, and supranational collaboration is low. The east is on the rise and the west moves in and out of recession as concerns over privacy, equality, bias, and resource-intensity cause a societal backlash.

  (Source Future Skills 2023:7)

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Each scenario was mapped against NI innovation policy objectives and is summarised in Table 2.

Table 2: MATRIX Skills Scenarios

Innovation objectives	Autonomous Workplace		Net Zero Workplaces	
Economic growth	• Slow		• Strong	
Growth in high tech jobs	• Thousands of high tech jobs generated in the last decade		• High. NI is attractive to mobile high skill tech workers	
A high performing economy driven by innovation	• Strong focus on tech as the route to economic security • Strong innovation infrastructure	↑	• NI enjoys a high tech innovative culture • A highly mobile workforce increases the rate of adoption of new tech and new ideas	↑
High levels of collaboration	• Government has to pick winners • Strong regional partnerships drive growth	↑	• Strong collaboration between business, universities, government and civil society enable sustained growth	↑
Increase in innovation start ups and performing businesses	• Limited and focussed on strategically important sectors	→	• Significant • High levels of entrepreneurship	↑
Increase in innovation across the wider business base	• Limited and focussed on strategically important sectors	→	• Increasing, but more to do	↗
Overall Innovation Rating		↗		↑

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Innovation objectives	Optional Workplaces		Shuttered Workplaces	
Economic growth	• Low		• Flat	
Growth in high tech jobs	• Flat		• Limited to strategic sectors • Government trying to increase high skills development	
A high performing economy driven by innovation	• NI has lost technology talent to other economies • Employment is high. Workers are overqualified	→	• Innovation is weak across all sectors	↘
High levels of collaboration	• Only exist where government leads	↘	• Government, business and FE/HE are working together in limited areas to improve efficiency	→
Increase in innovation start ups and performing businesses	• No increase in innovation start ups	↓	• Not achieved. There is little entrepreneurial energy	↓
Increase in innovation across the wider business base	• Limited sector specific increase in innovation across the business base	↘	• Not achieved. There is little culture of innovation outside the tech sector	↓
Overall Innovation Rating		↘		↓

(Source: Future Skills 2023:110)

The broad conclusions emerging from the study highlighted the following trends:

I. Core skills in technology sectors are changing constantly.

II. Socio-emotional skills are key to future strategic adaptability.

III. NI's technology focus may be too broad and may need to be narrowed.

IV. Government and business may need to work more closely with FE and HE to shape the future technology skills pipeline.

The scenarios and conclusions presented above further highlight the need for a *theory of change* that clearly states assumptions and includes effective monitoring and evaluation as part of innovations skills development.

Emerging Economic Policy Objectives

A final perspective for understanding the strategic context for innovation skills development is in terms of an evolving economic policy landscape. These objectives, and previous priorities over the last twelve years, are summarised in Table 3.

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Implicit in the actions associated with each objective is the need for innovation – doing things in new ways to create value. Innovation is needed to engage with emerging opportunities in the economy but also to address significant societal and environmental challenges.

Table 3: Overarching Economic Policy Objectives

Economic Strategy (2012)	**Economic Vision (2021)**	**Economic Mission (2024)**
Rebalance the NI Economy, and [create] a sustainable and growing private sector.	[Create] a tenfold increase in innovation.	Increase the proportion of working-age people in good jobs.
Stimulate innovation, R&D and creativity.	Create inclusive growth: [Ensure] that innovation provides opportunities across all sectors ... and disperses economic and societal benefits. Achieve a fairer distribution of opportunities ... to participate in and benefit from [NI's] economic growth.	Promote regional balance.
Improve the skills and employability of the entire workforce .	[Focus] on the core technologies and clusters where Northern Ireland can be a global leader within the next decade.	Raise productivity.
Compete effectively within the global economy.	[Inspire] and [prepare] a future generation of workers that can respond flexibly to future skills requirements, ensuring everyone has opportunities to thrive.	Reduce carbon emissions.
Encourage business growth and increase the potential of our local companies (including in social and rural economies).		
Develop a modern and sustainable economic infrastructure that supports economic growth.		

(Adapted from Technopolis 2022:13)

Understanding changing economic policy priorities is important in that innovation skills development underpins the achievement of those priorities. Strategies to deliver innovation skills development are commonly organised and communicated as a logic model that clearly articulates a programme of activities, their intended outputs, and how this achieves a desired outcome – and ultimately *impact* in terms of economic priorities.

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A key driver for such impact will be the City and Growth Deals[6] which target or synthesis resources, based on a deep understanding of regional needs and ambitions. The goal of City and Growth Deals is to transform regional economies for the widest possible benefit. The NI Executive and the UK Government have committed £1.2bn capital funding over the next 15 years to four Northern Ireland City and Growth Deals: Belfast Region City Deal (£700m); Derry-Londonderry and Strabane Region City Deal (£210m); Causeway Coast and Glens Growth Deal (£72m), and Mid South West Growth Deal (£252m).

The Derry and Strabane City Deal and Inclusive Future Fund was launched in February 2021 and will contribute to building a stronger, more competitive, resilient and inclusive economy, including the delivery of **higher paid jobs and contributing to the creation of a more regionally balanced economy.** This City Deal includes the Innovation Digital and Health Pillar, and the SMART/Digital City programme supporting the development of smart specialisations across a range of sectors and public service delivery.

The Belfast Region City Deal (BRCD) was signed in December 2021 securing substantial financial commitment from central government and BRCD Partners. The BRCD is projected to generate up to 20,000 jobs over the next 10-15 years. It includes world leading centres for which future innovation skills will be crucial, such as the Advanced Manufacturing Innovation Centre (AMIC (in partnership with Queen's University Belfast) and the Centre for Digital Healthcare Technology (CDHT) (in partnership with Ulster University).

For the regional city deals to succeed in their full ambitions, it will be important that as wide a range of people as possible have the skills needed to avail of the opportunities to accelerate the development of innovative technologies and create a dynamic and productive open innovation ecosystem (BRCD, 2024)

In conclusion, this section has focussed on regional innovation strategies in Northern Ireland. However, the authors recognise that innovation ecosystems extend beyond regional boundaries. This is particularly important for dual access to EU / UK markets, the All-Island economy, and emerging opportunities. Indeed, All-Island collaboration is a key pillar of Impact 2030: Ireland's Research and Innovation Strategy and can be seen as increasingly important given the need to find effective solutions to global challenges including climate change, digitalisation, and health.

[6] City and growth deals

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Summary of Strategy Context

This section has focussed on regional innovation strategy in Northern Ireland.

What does the above evidence suggest about innovation in the regional economy?

- The strategic context for innovation has been examined extensively and has been the subject of some twenty reports (strategies, reviews, and initiatives) in the period 2019-2024. This work clearly demonstrates the importance of innovation as a key economic driver for the regional economy.
- Key contextual factors have been identified and examined in depth including international best practice (Technopolis Reports).
- There is a need to rationalise skills development as part of a strategy to achieve economic priorities. This rationalisation needs to involve a clear alignment of skills development with economic priorities (Skilling Reports).
- Detailed implementation plans for innovation-related activities linked to measurable outputs, desired outcomes and impact are needed. Such plans need to include effective monitoring and evaluation measures (Lyons Report).

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“I work in Digital Healthcare and 30 years ago digital health didn’t exist. If we don’t understand innovation, then we will not be able to maximise the use of new digital solutions and our patients will suffer.”

International skills for innovation

The international knowledge base for skills, competences and occupations is vast, continually evolving, and is utilised in a multitude of ways.

This section includes the following:

- Highlights key international information resources. Namely, the European Skills, Competences, Qualifications and Occupations system (**ESCO)** and United States Occupational Information Network system (**O*NET**).
- Identifies key organisations undertaking activities relevant to skills.
- Identifies skills frameworks relevant to innovation skills development for NI companies.
- Provides three examples of frameworks that explicitly address innovation skills development:
    - Innovation Caucus – a national framework for individual organisations and in particular people selection and development.
    - Nesta – an international framework for public sector problem solving and team development.
    - International Standards Organisation (ISO) – an international framework for innovation management for all organisations, and particularly the management of innovation as a systematic process.

International Information Resources

The European Skills, Competences, Qualifications and Occupations (**ESCO)** is the European classification that describes, identifies, and classifies professional occupations and skills relevant to the EU labour market.

First published in 2017, the aim of ESCO is to provide a common language on occupations and skills that can be used by those interested in employment, education, and training. It includes over 3,000 occupations and almost 14,000 skills linked to those occupations and is freely available online.

The ESCO portal search function is organised in a hierarchical structure allowing for different levels of analysis from concept through to different levels of granularity. In addition, the system is continually updated to include the use of AI machine learning models that suggest matches between occupation concepts and input such as job titles and occupation labels.

In comparison, the United States Occupational Information Network (**O*NET**) contains hundreds of standardised and occupation-specific descriptors relating to over 1,000 occupations found in the US economy.

O*NET is based on a content model that allows occupational information to be applied across jobs, sectors, or industries and within occupations. The O*NET portal allows search

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strategies that includes worker characteristics, worker requirements, experience requirements, occupational requirements, workforce characteristics, and occupation-specific information.

The O*NET classification system is explicitly linked to the 2018 OECD Oslo Manual workforce characteristics of relevance to innovation:

- cognitive abilities, in particular idea generation and reasoning abilities of the workforce.
- adaptability and flexibility towards change.
- social skills to work with people to achieve goals.
- complex problem-solving skills, to solve novel, ill-defined problems in complex, real-world settings.
- systems skills to understand, monitor, and improve sociotechnical systems.
- work values and styles such as those related to entrepreneurialism, teamwork, creativity, and autonomy.

  (Oslo Manual 2018:116)

International Frameworks

In addition, six international organisations were identified that explicitly or implicitly inform innovation competency-related strategies and initiatives. Table 4 identifies these international organisations and lists the specific frameworks of relevance.

Table 4 International Frameworks

International Organisation	Framework
United Nations (sdgs.un.org)	Sustainable Development Goals (2015-2030). Education for Sustainable Development (2015-2030). Global Framework on Transferable Skills (2019).
Organisation for Economic Co-operation and Development. (oecd.org)	Frascati Manual framework for measuring science, technology, and innovation (2015). Oslo Manual framework for measuring innovation (2018). OECD Future of Education and Skills 2030.
European Commission (research-and-innovation.ec.europa.eu)	Horizon Europe - Industry 5.0 (2020). European Green Deal (2021). EU Competency Frameworks: DigComp (2022).

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	EntreComp (2016). GreenComp (2022). LifeComp (2020).
World Bank (worldbank.org)	World Bank Typology of Skills and Workforce Development (2024).
World Economic Forum (weforum.org)	Future of Jobs Report (2023). Putting Skills First: A Framework for Action (2023).
International Standards Organisation. (iso.org)	Guidance for Innovation Management Systems: ISO56002. (2019). Certifiable Standard ISO56001 (In Development).

Our review of key organisations resulted in the following conclusions:

- Frameworks have been developed and adopted by different organisations. These organisations have different aims, and the skills frameworks are constructed for different purposes.
- Frameworks are essentially 'organising ideas' that need to be relevant and adapted to the priorities of a particular economic context – such as the NI regional economy.
- The idea of applying 'international best practice' fails to understand the nature of innovation as a system of 'interactions' unique to a particular geographical context.
- Exemplars of best practice (e.g., Singapore) highlight the significance of stable governance and strategic planning that clearly links policy to programmes whose purpose is to increase the innovation potential of an economy.

In addition, the review of the frameworks identified three interrelated 'megatrends' important for innovation. (**Appendix D – Megatrend Academic Articles** provides a sample of academic articles relevant to such megatrends and further research.)

I. The transition from unsustainable to sustainable development.
II. The articulation of an emerging industrial revolution - industry 5.0.
III. The development of a wide range of generic competency frameworks.

Whilst these megatrends cut across the mission and work of such global organisations, there is increasing co-ordination of efforts to agree international standards that are applicable to any economic, societal, and environmental setting.

The implications of global frameworks and megatrends have profound implication for every aspect of the local economy and workplace.

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International Innovation Framework Challenges

In undertaking this research, three major challenges in understanding international innovation frameworks were identified:

- The meaning of innovation and related concepts has evolved and changed over time. This is evidenced by the changing definition of key terms in the de facto international reference document for innovation; the OECD's Oslo Manual. This has undergone several iterations over the period 1992 – 2018 and is currently in a fourth edition.
- The international organisations identified in Table 4 use innovation in different ways and for different objectives. For example, the OECD Oslo Manual has a focus on definitions suitable for innovation measurement; whereas ISO has a focus on definitions to enable standardisation.
- The outworking of megatrends means that the skills needed for innovation are changing, and alternative frameworks developed, depending on the particular purpose of different international organisations. For example, the EU has prioritised the concept of Industry 5.0 (with a focus on value) in addition to the concept of Industry 4.0 (with a focus on technology).

Those tasked with developing innovation policy and operationalising such policies with a view to demonstrating impact are faced with further challenges:

- The regional and national context: historical developments, priority economic clusters, and political priorities.
- Existing innovation legacy discourses or narratives.
- The operationalisation of innovation strategies.

Innovation Caucus: Innovation skills framework

The Innovation Caucus Innovation skills framework is an example of a country-specific approach of relevance to individual organisations, and in particular people selection and development.

This framework was commissioned by the UK Department for Business, Energy, and Industrial Strategy (BEIS) and Institute for Apprenticeships and Technical Education (IfATE). It was published in 2023 as a response to a perceived need to define what innovation skills are in practice.

Originally designed for IfATE's development of standards and qualifications, it was judged to be of value for a wide range of organisations.

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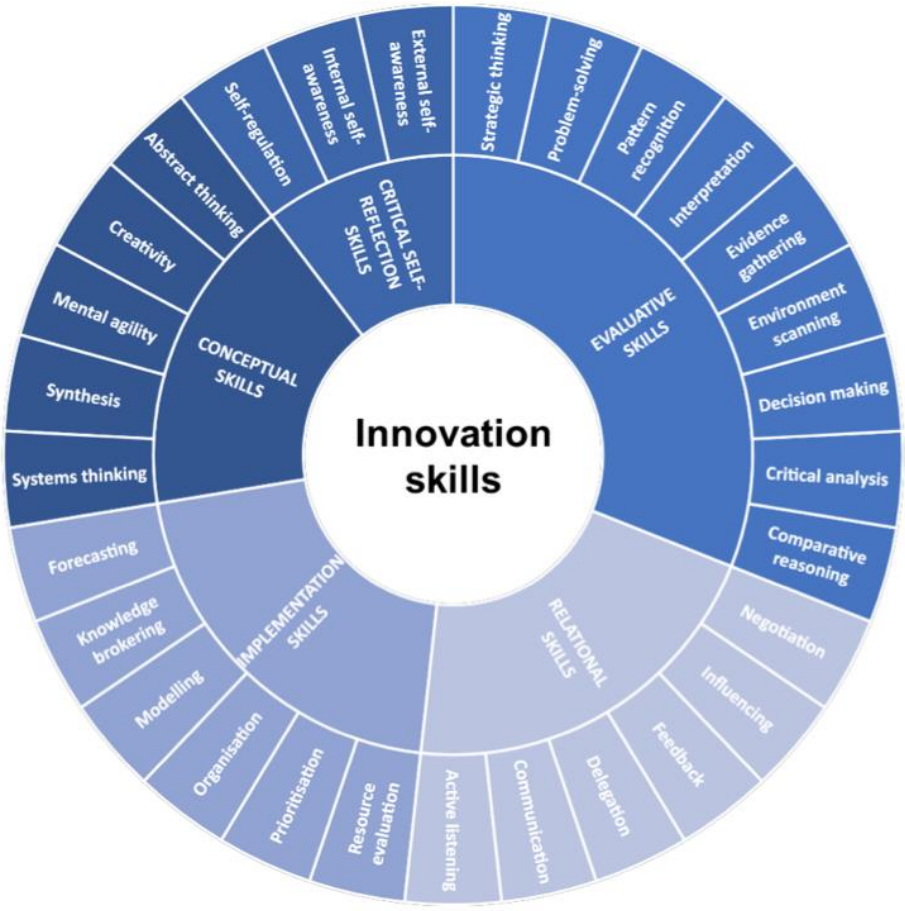

Figure 1 Innovation skills framework

(Source: Nelles et al. 2023:7)

The framework consists of five skill groups: conceptual, critical self-reflection, evaluative, implementation, and relational. Each skill group consists of several component skills each of which is linked to both *Innovation Execution* and *Innovation Management*. For example, 'Creativity' is a particular skill located within the Conceptual Skills Group and is defined as follows:

- Innovation Execution - to find ways to solve a problem, develop a new (or improved) product, process, or business model.
- Innovation Management – to enable innovators to be creative themselves, secure resources, and support innovation.

A key feature of the design process was the development of a guide to translate the framework into a range of practical situations. These outcomes were stylised into three scenarios:

- Deploying skills with a view to organisational effectiveness.
- Developing skills with a view to human resource development.
- Sourcing skills with a view to recruitment and candidate selection processes.

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The authors of the Innovation Caucus framework make the important point that the framework is not a solution but requires reflection about organisation goals and context (p.17). In addition, the guide provides a useful guide for application summarised as:

- Identify goals.
- Identify relevant innovation tasks.
- Design and execute the evaluation process.
- Design in innovation skills.
- Review outcomes.

These are then related to each of the three stylised scenarios. The guide also includes a valuable set of skills templates for:

- Building innovation into curricula and training programmes.
- Organisational innovation building.
- Personnel innovation skills management.

Nesta: Competency framework

The Nesta competency framework is an example of the evolution of an international framework for public sector problem solving and team development.

The Nesta framework was launched in 2017 and identifies the core skills and attitudes that teams of innovators can use to tackle public problems. The framework was tested across a range of countries and international innovation experts.

Figure 2 Nesta competency framework

(Source: Nesta 2017:1)

The framework consists of three parts:

1. A central circle that identifies the aim as public problem solving.
2. The surrounding key attitudes that create the basis for problem solving and change slowly over time.
3. Core skill categories organised in three distinct skill areas.
    - Working together e.g., stakeholder engagement.
    - Accelerating learning e.g., systems thinking.
    - Leading change e.g., demonstrating value.

Each skill is linked to two types of behaviour:

- commonly observed behaviours e.g., the culture of an organisation.
- innovative behaviours e.g., open, explorative, and imaginative problem solving.

The use of the framework centres around the use of reflective questions for each skill:

- Crafting and designing new job roles when recruiting.
- Defining the aims and outcomes of training or capacity building programmes.
- Identifying the strengths and weaknesses when setting up an innovation team.
- Exploring the skills and attitudes of an existing innovation team to identify weaknesses or blind spots.

International Standards Organisation (ISO)

In 2019 ISO published the ISO56002 international standard for managing innovation systems. This was the result of a six-year consultation with innovation professionals from over 50 countries. It involved the evolution of an international framework for innovation management for all organisations, and particularly the management of innovation as a systematic process.

The objective for this initiative was to promote the professionalisation of the field by providing a framework for management and organisational practice: comparable to the development of international standards in quality management and project management. The purpose for developing the framework was stated as follows:

- Practical guidance that is compatible with other management systems to increase organisational understanding and value without prescribing specific actions or tools. Guiding principles are required that allow for implementation flexibility.
- A common language and framework based on consensus in an international community of experts and practitioners.
- A durable foundation for innovation management that is applicable for most sectors, organisation types and sizes. (Source Hyland and Karlsson 2021: xii)

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Eight innovation management principles were developed to guide the effective management of innovation management activities: realisation of value; future-focused leaders; strategic direction; culture; exploiting insights; managing uncertainty; adaptability; and a systems approach.

The latter was particularly relevant as it conceptualised innovation management as interrelated and interacting elements, with the need to regularly evaluate performance and improvements of the system. Figure 3 presents a visualisation of the framework.

Figure 3 Innovation Management System Structure

(Source: Hyland and Karlsson 2021: xiv)

1. **CONTEXT**: The organisation should track external and internal issues and trends, e.g., user preferences, technology developments, and internal capabilities, to identify opportunities and challenges that can trigger innovation activities.
2. **LEADERSHIP**: Based on the understanding of the context, top management should demonstrate leadership and commitment by establishing an innovation vision, strategy, and policy, including the necessary roles and responsibilities.
3. **PLANNING**: Innovation objectives, organisational structures, and innovation portfolios should be established based on the direction set by top management and the identified opportunities and risks.

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4. **SUPPORT**: The support necessary for innovation activities should be put in place, e.g., people with the right competences, financial and other resources, tools and methods, communication and awareness creating activities, as well as approaches for intellectual property management.
5. **OPERATIONS**: Innovation initiatives or projects should be established in line with the strategies and objectives. Innovation processes should be configured according to the types of innovations to be achieved and include the following generic innovation activities: identify opportunities, create and validate concepts, and finally develop and deploy solutions.
6. **EVALUATION**: The performance of the innovation management system should be regularly evaluated to identify strengths and gaps.
7. **IMPROVEMENT**: Based on the evaluation, the system should be improved by addressing the most critical gaps with regards to the understanding of the context, leadership, planning, support, and operations.

   (Source: Hyland and Karlsson 2021: xiv)

The ISO standard aims to provide guidance for establishing, implementing, maintaining, and improving innovation management systems within organisations (Johnsson *et al*. 2023). Theis is important for all advanced economies (including Northern Ireland) given the integrated nature of international supply chains and innovation ecosystems.

Summary of International Skills for Innovation

What does the above evidence suggest about international skills for innovation?

1. Skills development is a vast topic with many thousands of individual skills identified and numerous skills frameworks in existence.
2. Innovation skills is increasing in importance and work is currently underway to develop generic frameworks.
3. Six international organisations carry about extensive research and develop frameworks relating to innovation skills development.
4. All frameworks reviewed refer to the OECD Oslo Manual as the *de facto* guide for the international guidelines for measuring innovation activities.
5. Frameworks for been developed to address national priorities e.g., the Innovation Caucus Innovation Skills Framework in the UK.
6. Frameworks have been developed internationally to address generic challenges e.g., the Nesta Competency Framework.
7. Work is currently underway to develop an internationally agreed competency framework for innovation management under the auspices of the International Standards Organisation. An indicative innovation skills framework can be found for reference in **Appendix G – F!SK® Framework for Innovation Skills.**

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“We’ve built a culture that enables us to do lots and lots of new tactical stuff at scale. Now we need innovation to be a natural muscle move.”

Stakeholder Engagement

Introduction

In parallel with the work on international innovation frameworks, a series of stakeholder engagement events was undertaken in February and March 2024. The purpose of these events was to capture stakeholder current views on innovation skills priorities across a range of sectors in the regional economy.

Two approaches were used to capture stakeholder input:

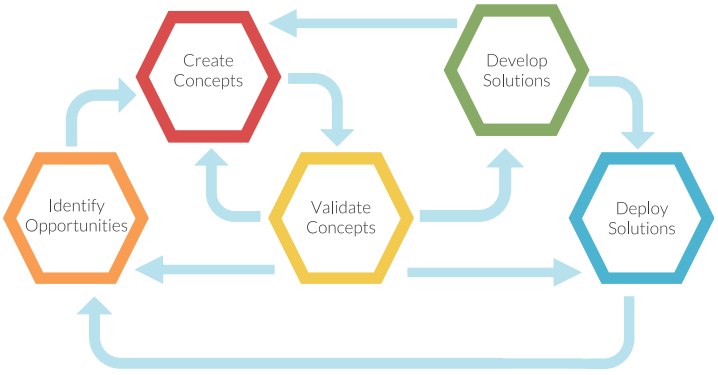
- A collaborative workshop held at Ulster University on Wednesday 21st February 2024, at which 20 stakeholders from a diverse range of sectors and organisations gathered to discuss, explore, and capture a wide range of opinions and innovation skill needs.
- One-to-one in-depth conversations with leaders from several organisations that represent the views, needs, and aspirations of active sectors in the economy.

This section of the report addresses the approach, methodology, and outputs from these engagements[7].

Workshop Approach and Methodology

When discussing innovation there can be a tendency to focus on the five-stage process starts with an opportunity for innovation and ending with deployment for rollout or commercialisation.

The following representation is a simplification of the process as defined in **ISO 56002:2019 - Innovation management system – Guidance**, which is the de-facto international best practice for systematic approaches to innovation.



The skills required for this “innovation process” are well documented and form the basis for much of the available innovation training and education.

[7] Tables and figures are embedded in the narrative for ease of reference.

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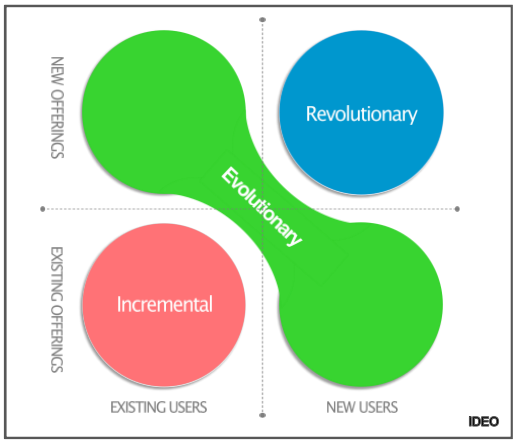
During the customer engagement it was important to push past that and look at the skills and competencies required to make innovation and innovative thinking core business functions.

This was achieved by providing a simplified working definition of innovation **"Innovation is the creation of value using ideas that are new to the challenge at hand"** (derived and simplified from ISO56002), and then using proven models from recognised innovation leaders to explore levels and types of innovation.

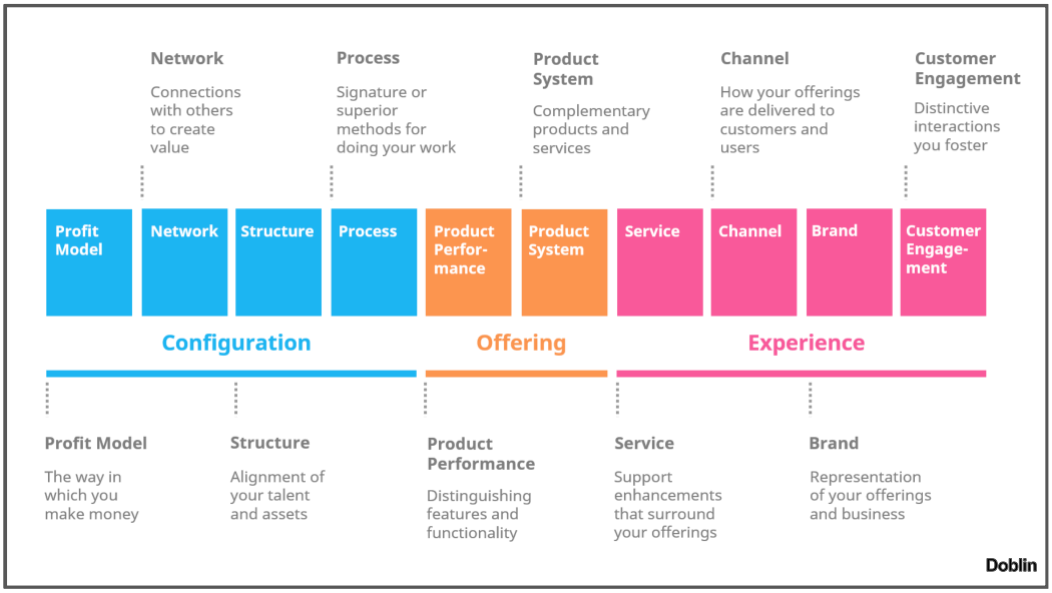
The models referenced during the workshop were:

IDEO's Levels of innovation quadrants from the **IDEO Human-Centred Design Course**.

- This model (right) highlights the different levels of innovation (incremental, evolutionary, and revolutionary).
- There are various descriptors for innovation levels (Horizons 1,2,3; radical; disruptive, etc), but IDEO's model was used for its clarity and simplicity.
- Note that the term 'offerings' used on this model is a generic term that can be used to represent products, services, and/or operational or organisational processes.



To determine where in the organisation innovation is required, we referred to **Doblin's 10 types of innovation** model which captures the most common types of innovation into 10 categories (below).



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The core areas of activity for systematic innovation were informed by the chapter headings of **ISO56002:2019**. These were condensed down to four main areas for simplicity and for the purposes of this workshop, as follows:

- **Strategy & Leadership.** Leaders are responsible for the development of a clear innovation strategy which is aligned to the organisational goals. They have responsibility for ensuring resources are available to execute that strategy, achieving a suitable balance between innovation risk & reward, building innovation capability, and creating an organisational culture supportive of innovation.
- **Culture & Context.** Having an organisational culture that is supportive of change and collaboration is critical to maximising the potential of any innovation programme. Collaboration lies at the heart of innovation as does the ability to build internal and external networks to improve diversity of ideas, views, and opinions.
- **Projects & Delivery.** These can be considered the "engine room of innovation" and cover many of the more tactical innovation skills. The skills in this category provide the necessary know how to support individuals and organisations in the identification of opportunities; the generation of ideas; the validation of concepts; and the development of solutions.
- **Measurement & Improvement.** The delivery of positive innovation outcomes, and the continuous improvement of the innovation system and processes, sit at the heart of successful innovation eco-systems. Providing evidence of the positive impact innovation is having on an organisation helps to ensure ongoing commitment to, and investment in, the innovation initiative.

Workshop approach

On the afternoon of 21st of February an invited group of representatives from a range of NI industries and sectors gathered to discuss, debate, and capture the key skills for innovation that they believe are required to drive forward the Northern Ireland economy.

A short introduction set the scene and provided a working definition of innovation, and the participants then worked in groups for 20 minutes to populate the provided worksheet (shown below) with

- the sector or sectors whose views they were representing.
- the levels of innovation that were relevant to that sector.
- the types of innovation relevant to the sector
- who (in terms of roles and responsibilities) needs to be innovating.

The groups where then give 40 minutes to identify the top mandatory, desirable, and nice-to-have innovation skills against each of the four areas, starting with "Projects and Delivery". This represents the aspect of innovation that most people re familiar with, as this is where idea generation (ideation) and commercialisation sit.

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Any additional thoughts or observations were also captured on the form for later consideration.

Each group in turn reported back on worksheet, identifying key insights, skills and challenges relating to the delivery of innovation within their sectors.

Limitations of the approach

The attendees had a good understanding of innovation prior to the event, and therefore were able a more comprehensive view of innovation skills than might have been possible with a group of attendees with a less developed understanding of the discipline.

The level of expertise in the room allowed for a more open conversation, but perhaps make the views less representative of innovation maturity in the NI economy. However, as the purpose of this report is to identify the innovation skills needed to drive the economy, this skew towards expertise was considered justified.

The event took place at ulster University business School with over 25 senior executives from a wide range of sectors operating in NI.

The event was constrained by time, and this was a deliberate decision,

(a) to reduce the time commitment required from senior leaders, and

(b) to focus on the challenge at hand rather than to allow for expansive discussions around the challenge.

Where more time was identified as being needed to deep-dive into any given sector or priority, one-to-one meetings were arranged to facilitate that. The approach, rational, and findings relating to the one-to-one discussion are covered later in this report.

A reference list of skills (below) was provided to each group to avoid 'blank page terror' which would have slowed initial progress and reduced the overall effectiveness of the event.

The attendees were informed that this was not to be considered as a definitive list of innovation skills, and that there may be some examples given that were in fact unrelated to innovation in any form. Important to note that one group did use this sheet is the primary reference and looked to include most if not all these skills on their worksheet.

This list was derived from research undertaken outside of this project, capturing views of over 180 innovation professionals around the world through a series of workshops and interviews.

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Workshop Outputs

Level and types of innovation.

The levels and types of innovation were not capture on the worksheets in most cases, but each group provided verbal feedback during the reportage of insights and findings.

There was consensus that whilst some organisations focus on a subset of the levels (for example start-ups and academia have a keen interest in world firsts (**revolutionary innovation** on the IDEO model), most organisations have no need or desire to create new offerings for new markets.

Most sectors seem more comfortable looking at how innovation and innovations can allow them to

(a) improve what they do today (**incremental innovation**) perhaps through the application – rather than creation – of transformative methods and technologies; and

(b) either find new markets/users for existing offerings or create new offerings for their existing markets/users (**evolutionary innovation**).

In terms of the types of innovation, the responses were not surprisingly sector specific with each sector having different needs and priorities for change. Interestingly, some commented on how some of the categories on the Doblin model had not previously been seen as areas for innovation in the context of their sector.

Who should be innovating?

The intention of this area of the worksheet had been to identify specific roles where innovation is, or should, be a primary focus. The discussion amongst the participants indicated that innovation is, and should be, everyone's responsibility.

This feedback perhaps counters the common perception that innovation is best left to a designated innovation team. While the need for leadership and a team to drive innovation across an organisation, the "Innovation lab" approach was considered detrimental to inclusive and collaborative approaches to change as they tend to promote a culture of innovation being someone else's responsibility.

Innovation Skills

The worksheet used in the workshop had been designed to allow participants to differentiate between the relative importance of skills, allowing prioritisation of skills development where gaps were identified.

However, this was universally overruled by all groups who reported back that that the skills being highlighted were all critical in equal measure to successful innovation.

A further attempt to prioritise the skills was undertaken during the one-to-one discussions covered later in this document.

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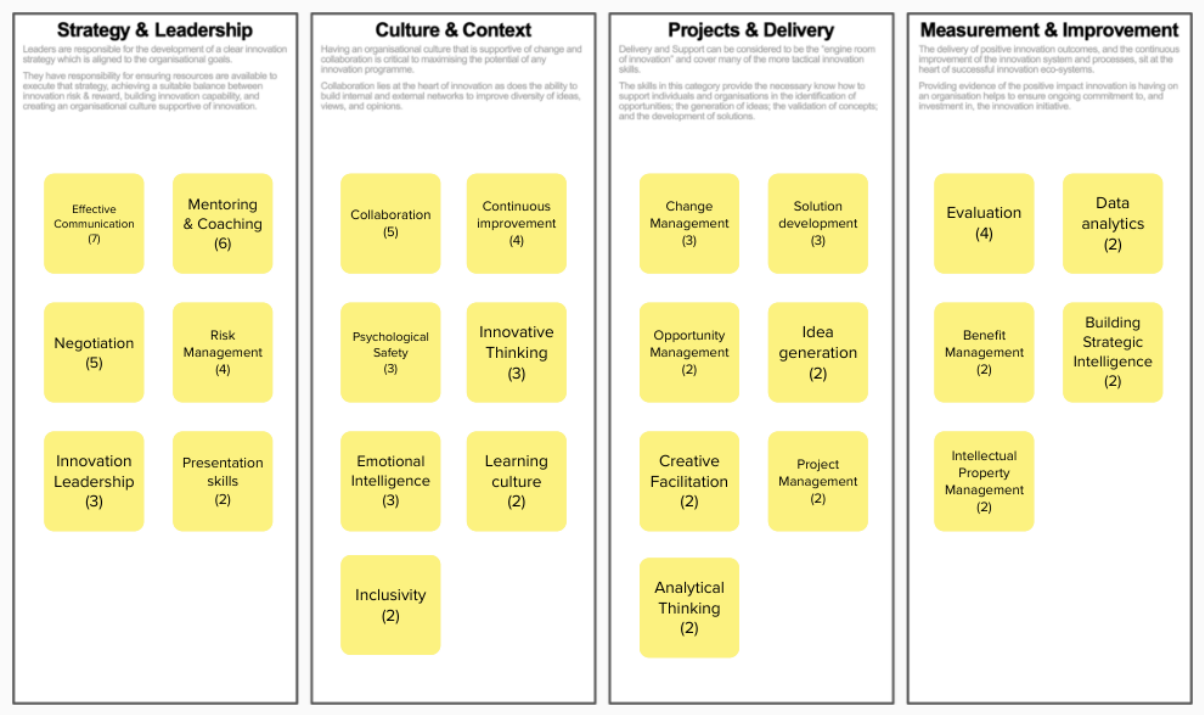
The following table summarises the key innovation skills identified by the participants grouped by area. The numbers in brackets indicate how many times the skill was cited across groups.

Note that some skills appeared in multiple columns within the same group. This reflects differences of opinion across the groups, but also difficulty within a single working group in assigning these skills to one area.

In the image below, the skills identified more than once have been grouped together to allow comparison with international best practice later in this report.



The skills that were referenced just once in the worksheet can be found on the digitised versions of the worksheets from the workshop, and list of participating organisations can be found in **Appendix E – Stakeholder Engagement.**

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Interview Approach and Methodology

In addition to the cross-sectional workshop on 21st February, the research team has also undertaken a series of one-to-one discussions with a range of key individuals from the public and private sectors, policy makers, and those driving innovation at an industry level within Northern Ireland.

Some interviewees had attended the workshop and had requested a more in-depth conversation and others had planned to attend but were unable to make it along to the workshop.

The interviews took place in-person, or on-line, and where permitted were recorded to allow a more natural conversation to take place whilst a full transcription was created in the background for subsequent, more detailed analysis.

The discussions addressed the following key areas:

- Key priorities and trends relating to innovation in the interviewee's industry or sector.
- The key skills required for organisations in that sector to thrive, or indeed survive in the current economy. These skills were not necessarily directly related to innovation, and could include technical, process or industry specific skills.
- Identification of which of the skills are relevant to innovation and change.
- Identification of the top 3 innovation skills needed in the sector in relation to the four areas of
    - Innovation Strategy and Leadership
    - Innovation Context and Culture
    - Innovation Projects and Delivery
    - Innovation Measurement and Improvement
- The source and availability of those skills, whether through education, on-the-job training, or other means.
- The urgency of innovation and the development of the critical innovation skills.
- Finally, we asked whether the innovation skills identified are the same skills that their workforce will need to address sustainability.

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Interview Outputs and Findings

This section presents the main findings from a series of interviews conducted to gather views on the innovation skills of key importance to their sector or organisation.

The interviews were semi-structured and lasted about 45 minutes each. The following sections summarise the key themes that emerged from the analysis of the interview transcripts.

These findings provide valuable insights and suggestions for areas where there is a need for the Northern Ireland government to support the development of innovation capability and capacity.

The majority participants believed that the skills required to manage successful innovation are the same skills required to address sustainability.

Key skills for Innovation

Some of the specific requirements and skills for successful innovation, as identified by the participants, are listed below under the same areas as used in the workshop:

Strategy and Leadership

- **Effective communication**. Clearly communicating innovation challenges, approaches, and outcomes to all stakeholders and inspiring them to buy in. This includes presentation skills and the ability to communicate complex concepts simply and appropriately for the target audience.
- **Empowerment.** Enabling the workforce through delegation, devolved responsibility, capacity, capability, permission, accountability with responsibility.
- **Building networks.** Working with others both inside and outside of the organisation and promoting collaboration and knowledge sharing at all levels of organisational hierarchy. Also considering increased collaboration between industry and academia.
- **Strategic thinking.** The ability to identify opportunities, set a vision, and develop a plan to achieve innovation goals.

Culture and Context

- **Diversity.** Creation of a diverse and cross-functional team to deliver innovation.
- **Environment.** Creating an environment that encourages creativity, collaboration, and experimentation.
- **Psychological Safety**. Creating a safe place for people to try new things, and to potentially fail.
- **Resilience.** Building determination and stamina in a dynamic environment and an understanding that change can be hard.
- **Adaptability**. Agility to navigate change, respond to challenges, and pivot strategies as needed.

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- **Succession planning**. Innovation should not be allowed to die when one key individual leaves an organisation, and planning is required in place to ensure innovation holds and retains a seat in the executive team.

Projects and Delivery

- **Problem-solving and critical thinking**. Identification of problems, analysis of potential solutions, and sound decision making. Solving problems, rather than simply coming up with ideas.
- **Domain Expertise**. Having a deep understanding of the specific industry being innovated within is important.
- **Risk management.** Assessing and mitigating risks associated with innovation while still being willing to take calculated risks.

Measurement and Improvement

- **Foundational skills.** Financial literacy, productivity tools, and an understanding of performance metrics are essential for innovation as they allow businesses to function efficiently and make informed decisions.
- **Using indicators.** An innovation indictor should be just that – something that indicates progress to be used as the basis for discussion and decision making, rather than a destination.
- **Demonstrating value.** Innovation must add value to the organisation, which can be in many forms, including of making (or saving) money, societal impact, or even survival.

Innovation mindsets

Whilst not strictly skills, some of the participants identified behaviours and mindsets that they felt were required or beneficial for innovation within their organisations:

- **Being open-minded**: This involves being receptive to new ideas and approaches.
- **Being flexible and adaptable**: This involves being able to adjust to new situations and challenges.
- **Having an ability to navigate complexity**: This involves being able to deal with develop deep insights in the face of uncertainty, and cope with unanticipated outcomes.
- **Being open to being challenged**: This involves being willing to have your ideas and assumptions questioned and tested.
- **Managing conflicting concepts**: This involves being able to deal with and make sense of complex, often conflicting, thoughts and concepts.
- **Having a strategic mindset**: This involves being able to think about the long-term goals and direction of the organisation.

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- **Having a process mindset**: This involves being able to think about how to improve and streamline processes to achieve better innovation results.

Inhibitors to Innovation

Some of the challenges faced by Northern Ireland in relation to securing and developing the skills needed for innovation were identified as:

- **The lack of a systematic and structured approach to innovation:** Industry is often focused on incremental and functional innovations, without capturing and sharing the best practices or learning from the failures.
- **The low quality from some innovative methods:** Rapid innovation can lead to implementation without proper quality control, document control, and verification. These methods can lead to poor outcomes and potentially safety issues.
- **The conservative and siloed culture of the industry:** Industries can be resistant to change and collaboration, and often rely on traditional and proven methods.
- **High turnover and migration of workers**: high turnover of staff can make it difficult to retain and transfer new knowledge and skills.
- **A lack of specific training and support for innovation:** Without the proper training and support, individuals may not have the skills or knowledge necessary to drive innovation.
- **A lack of clear definition for innovation skills.** The lack of a centralised, universally accepted, definition of innovation skills makes it difficult to translate innovation skills into actionable curriculum.
- **Lack of basic skills in some businesses.** To deliver systemic innovation, companies need to “do the basics brilliantly”. Foundational skills such as financial literacy, and productivity (Microsoft Office, Google Docs, etc) are essential to innovation as they allow businesses to function efficiently, make informed decisions, and measure impact and performance.
- **Organisational inertia**: All levels of innovation involve change; change is often uncomfortable, and this can lead to an organisational reluctance to promote and support innovative thinking.

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Sector specific views on innovation.

This section summarises the position of innovation within some of the key sectors involved in the stakeholder engagement.

The Construction Sector

The construction sector is mainly focused on two areas of innovation: BIM (building information modelling) and MMC (modern methods of construction). However, these are not very revolutionary or widely adopted, and there are issues with quality, compliance, and knowledge management.

The challenges for innovation include the conservative and risk-averse nature of the industry, the lack of standardisation and certification, the high turnover and diversity of the workforce, the low level of functional and technical training, and the difficulty of measuring and sharing the impact of innovation.

Some of the potential solutions and recommendations for innovation in this sector include adopting a systemic and systematic approach to innovation, using existing tools and techniques for problem-solving and idea generation, leveraging external support, and funding mechanisms, engaging in cross-functional and cross-sectoral collaboration, and creating a culture of learning and feedback.

The Public Sector

The Public sector has responsibility for the public purse, and as such generally must take a conservative approach to decision making. An underlying need to avoid negative press for what might be perceived as 'bad' decisions has led to a risk-averse culture in the sector. Poor access to latest technologies and the low availability of high-quality leadership development are seen as blockers to innovation in this sector, and indeed across the wider NI economy.

There is an expectation that the NI economy will see a reduction on reliance on the public sector, and a move towards a more private sector driven economy.

Innovation is seen as a broad term in the public sector, and companies successfully generating value through innovation are those with the right mindset and leadership. It was noted that may micro-businesses struggle to innovate due to their focus on survival – although survival can, itself, be a driver for innovation.

The Voluntary Sector

The voluntary sector representative we spoke to is focussed on developing business skills, capability, and confidence in the next generation workforce. Working closely with education from primary through to universities, supplementing the traditional curriculum with real experience of entrepreneurial, financial management, and enterprise skills.

The impact of COVID on the next generation workforce should not be underestimated. Many of those entering the workplace have had reduced opportunities for contact and

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collaboration with businesses, and many have missed the opportunity to develop commercial awareness and business acumen through part time jobs and placements.

Anyone entering a workplace brings new ideas and fresh thinking, and the new starts need to develop the skills to communicate those ideas in a manner that is relevant to the business. Perhaps more importantly, those well established in businesses need to develop the skills to pause, listen to fresh thinking, plan, and then move forward. There is a need to create a culture where it is safe to challenge, coupled with a sense of resilience and the ability to learn from those ideas that are not accepted or that simply will not work.

The Business Services Sector

The business services sector we spoke to has moved from a traditional and consulting firm to a managed service provider working in partnership with their clients. A core business model is to co-deliver processes, and drive transformation and change, but this model itself is subject to innovation.

Such a business model requires a wider range of innovation than a solely inward facing model might require. The customer facing team require strong communication skills, an ability to be comfortable in the face of changing needs and priorities, and a drive for excellent, a curious mindset, and solid business and technical capabilities.

The skills required to manage innovation within the business, and to manage the knowledge and insights generated by the client facing team are quite different, with a need to create a common purpose and approach to deliver of innovation across a broad range of client sectors.

The Technology Sector

The technology sector operates on two sides of innovation. **Technology push** – where horizon scanning, or technology foresight, anticipates and understands the potential of new technologies to push out into solutions for clients; and **Market pull** - where understanding of the needs and opportunities of customers leads to the creation of novel solutions.

Once a technology has become relatively established, there are still massive opportunities for innovation. At this point, innovation requires a good understanding of not just what the client needs, but what is happening in the technology space. Then, the two can be joined together to create innovative products and solutions.

Operating within a clear framework and supported by internally developed resources, creates a standardised language around innovation, which enables individuals to learn the innovation skills most relevant to their role and responsibilities.

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Key conclusions from stakeholder engagement

The stakeholder engagement provided a cross-sectional view of innovation skills need across the NI economy. Whilst it was not possible to capture views from every sector and industry, the combination of the workshops and the one-to-one interviews captured the views of a broad range of organisations and sectors.

The types and levels of innovation identified from sector to sector were wide ranging. This was expected and confirms that the definition and importance of innovation is unique to each organisation, and is determined by their individual ambitions, access to resources, and appetite for risk.

When compared against the key innovation skills identified by workshops undertaken with global innovation networks (ISPIM[8], Innovate Island[9], Innovationsledarna[10]), and models working toward the professionalisation of innovation (RISE[11], CoFIM[12], F!Sk®[13]) there are some gaps identified across the four key areas considered.

Organisations in the NI Economy might benefit from considering adding the following skills to their innovation toolkit.

Strategy and Leadership

- **Demand Management.** Proactively coordinating and managing demands for innovation from across the organisation, including requests for the creation of new products, services, technologies, or techniques; or the making of modifications and improvements to existing services and products.
- **Knowledge Management.** Systematically managing the insights, knowledge, ideas, and concepts created through innovation programme so that they are not lost from the organisation - even if they are not appropriate for today.

Culture and Context

- **Political Awareness.** Understanding the corporate culture - the unwritten rules and people that are necessary to open the doors for advancing innovation.
- **Negotiation.** Influencing and gaining support for new ideas from stakeholders; knowing who needs convincing and utilising a range of methods to achieve a positive outcome.

Projects and Delivery

- **Portfolio Management.** Defining and delivering a systematic approach to managing the full portfolio of innovation activities, ensuring the balance between incremental, evolutionary, and revolutionary innovations is aligned to agreed organisational needs.

[8] IPSIM (International Society for Professional Innovation Management)
[9] Innovate Island (Ireland / N. Ireland innovation cluster)
[10] Innovationsledarna (Swedish innovation cluster)
[11] RISE (Research Institute of Sweden)
[12] CoFIM Competency Framework for Innovation Management
[13] F!Sk® Framework for Innovation Skills (Celsio)

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- **Managing Uncertainty.** Innovation involves deliberately trying things that might not work. Innovation leaders need to have the skills to manage that approach to risk.

Measurement and Improvement

- **Standardisation.** Understanding and applying innovation best practice in the implementation of a sustainable model for innovation within the organisation.
- **Demonstrating Value.** These skills are lacking or underdeveloped in industry. There is a need for more systematic and rigorous methods to capture and share the lessons learned and best practices from innovative projects, and to assess their impact and value.

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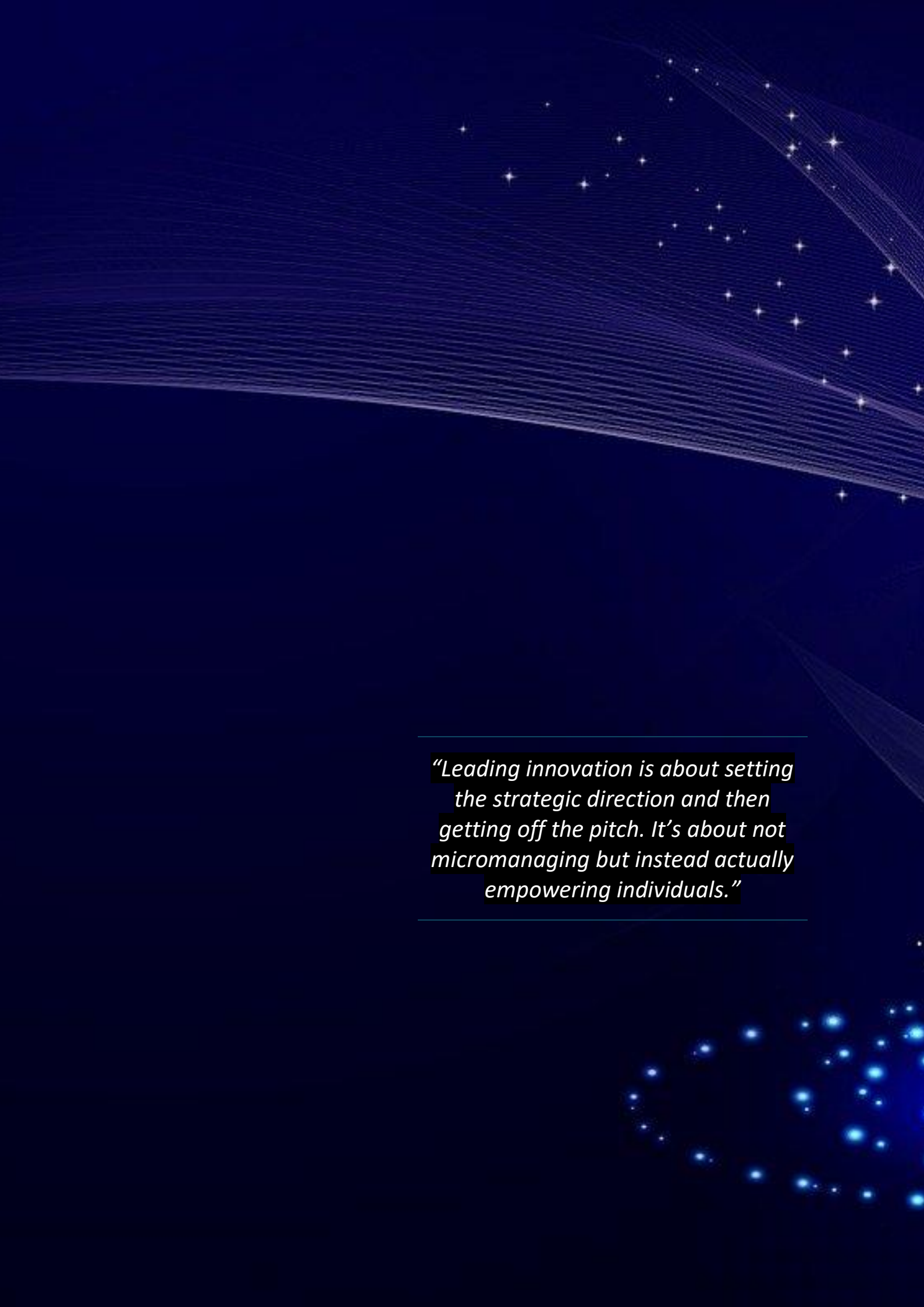
“Leading innovation is about setting the strategic direction and then getting off the pitch. It’s about not micromanaging but instead actually empowering individuals.”

Implications for the Economy

In 2024 the United Nations System Staff College (UNSSC), responsible for supporting leadership and management relating to the UN Sustainable Development Goals, identified results-based management (RBM) and the Logical Framework Approach (LFA) as key for achieving impact.

> "Results-based management starts long before the logical frameworks traditionally associated with RBM. It begins with a causality analysis that lays sound foundations for the theory of change to address deeply interrelated and interdependent development challenges."
>
> Source UN System Staff College 2024[14]

The evidence presented in the previous sections relating to the strategic context, emerging international frameworks, and stakeholder engagement suggests three possible actions with significant implications for Northern Ireland:

- The adoption of a results-based management approach that will address the actions recommended by the Skilling Report (2019) on the integration of skills and innovation policy.
- The active engagement with dynamic skills frameworks such as the emerging ISO competency framework for innovation management that will inform innovation skills development globally.
- The mapping of innovation ecosystems to reflect dual market EU/UK access for local business.

The above actions are supported by a summary review of Public and Private Sector Reports on Innovation Competency located in **Appendix F – Public and Private Sector reports on Innovation Competency.**

[14] Results-Based Management to Support the 2030 Agenda

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The Logical Framework Approach (LFA)

The OECD's Oslo Manual (2018) for the measurement of scientific, technological and innovation activities highlight the significance of a logic model for organising innovation activities and demonstrating actual impact in an economy. Figure 4 presents this simplified logic model.

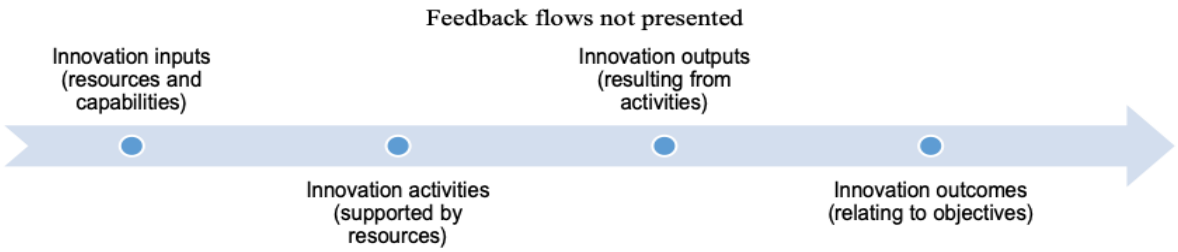

Figure 4 Logic Model

(Source: Oslo Manual 2018: 231)

A logic model is central to the Logical Framework Approach (LFA) which has been used in international development for over fifty years. Increasingly, the LFA is being used to link policy, programme, and projects across a wide range of applications – including innovation.

The United Nations identifies such approaches as results-based management and crucial for economic development and the achievement of the UN Sustainable Development Goals (2015-2030). For example, the Swedish International Development Cooperation Agency (SIDA) describes LFA as follows:

> *"LFA is an extensive, participatory and integral method that delivers a well-structured plan with clearly measurable objectives and well-defined, relevant activities and indicators. The method facilitates the planning, monitoring and management of change processes so that they can achieve positive and sustainable results."*
>
> *(Source: SIDA 2016:3)*

The reported significance of the LFA approach is summarised as follows:

- A complete and clear project plan – a relevant, realistic, and sustainable plan.
- It creates the precondition for a constructive dialogue between all involved (different categories of stakeholders).
- Strengthens local ownership of a project and ensures that the project acquires a focus on the beneficiaries' needs.
- Clarifies objectives, activities, responsibilities, and indicators which facilitates implementation and monitoring.
- Project work becomes well-structured and effective, which leads to time and cost savings and facilitates project management.

  (Source SIDA 2016:24)

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Critical to the success of a LFA approach is a nine-stage planning process

1. Analysis of the project's context/environment.
    - Background information.
2. Problem analysis/situation analysis.
    - What main problem shall be solved by the project?
    - Which are the causes and effects of this main problem?
3. Analysis of stakeholders.
    - Which individuals and stakeholders are affected by, and affect the project?
4. Formulation of objectives.
    - What do we wish to achieve with the project?
    - What are SMART objectives?
5. Activity planning.
    - Which measures shall be implemented to achieve the objectives?
6. Resources planning.
    - Time management, staff, and budget.
7. Indicators and means of verification.
    - How do we measure results?
8. Risk analysis and risk management.
    - Which factors may affect our results?
9. Analysis of assumptions.
    - Prioritisation.

    (Source SIDA 2016:5)

The planning process clearly addresses many of the issues highlighted by the Skilling, Lyons and Technopolis Reviews summarised in the Strategic Context section of this report.

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Engagement with emerging competency standards

CoFIM (Competency Framework for Innovation Management)

The global CoFIM project (a collaboration of academia, industry, standards bodies, and the International Standards Organisation) is currently developing a competency framework that will focus on providing guidance for individuals. CoFIM will support the development of innovation skills within the context of an organisation or team and provide clear definitions of what is expected in a variety of innovation roles.

The CoFIM project has to date involved more than 250 participants from over 40 countries as shown in Figure 5 below.

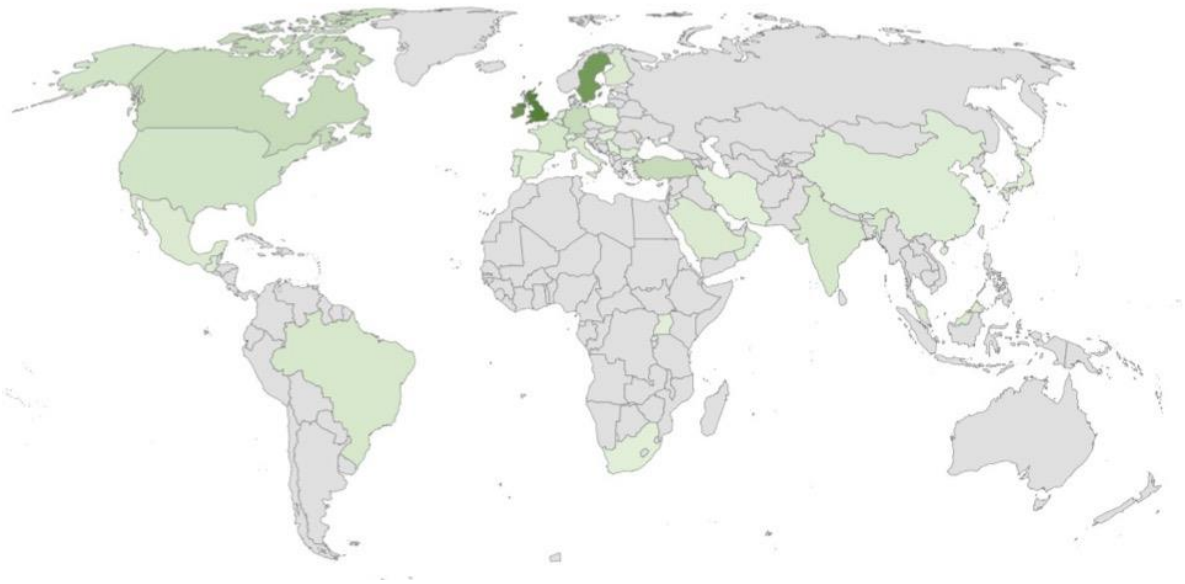

Figure 5: CoFIM development participation by country

The innovation competency framework is an emerging model created collaboratively by leading innovation experts around the world. It has been designed to complement and inform international, government, education, and support agency programmes for increasing innovation capability and competency.

CoFIM will be used as the basis for

- job roles & recruitment needs.
- training and personal development programs.
- learning materials and qualification frameworks.
- Continual professional development.
- University & school curricula.

CoFIM has started the process to transition into a new ISO standard for innovation competency that will sit as part of the ISO56000 suite of standards.

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By actively participating in the creation of this new international standard, Northern Ireland has the potential to become a global centre of excellence for innovation competency development.

Mapping Innovation ecosystems

A final suggested action with significant implications for Northern Ireland is the mapping of innovation ecosystems to reflect dual market EU/UK access for local business.

Innovation ecosystems continue to receive considerable attention linked to encouraging innovation and is central to the Horizon Europe strategic plan.[15]

A particular focus of the latter relates to the

> '…existing strengths of national, regional and local ecosystems and pulling in new, less well-represented actors and territories to set, undertake, and achieve collective ambitions towards challenges for the benefit of society, including the green, digital, and social transitions.'
>
> (European Innovation Ecosystems)[16]

Previous work by InterTradeIreland examining clustering and sectoral ecosystems has demonstrated the All-Island synergies from such innovation ecosystems. This has added impetus with the new economic mission that includes proactively engaging with dual market access for Northern Ireland businesses.

In addition, Ireland's Research and Innovation Strategy (Impact 2030) includes All-Island, EU and Global Connectivity as one of five strategic pillars. This includes North-South Research Programme and Horizon Europe.

The strategic benefits for mapping and engaging with such innovation ecosystems include:

- Increased excellence in research.
- Establishing long-term international collaborations for excellence and impact.
- Capacity building in knowledge absorption, human capital, and research infrastructures.
- Achieving economies of scale to tackle common challenges.
- Cultural change in R&I including increased adoption of transdisciplinary, open innovation, and participative approaches.
- Increased linkages between research and policy for better policy outcomes.
- Wider economic and social benefits including new jobs, new companies, and an economy at the frontier of science and technology.
  (Source Impact 2030:48)

[15] Horizon Europe strategic plan 2021-2024
[16] European Innovation Ecosystems

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Recent work by InterTradeIreland examining clustering on the Island of Ireland (2022) has highlighted the need to align with international best practice and the development of policy, programmes, and key performance indictors with appropriate time scales across the island.

Previous work by InterTradeIreland, Mapping the Potential for All-Island Sectoral Ecosystems (2015) highlighting the significance of :

- **Information and Knowledge Flow:** The benefits of innovation and other knowledge are enhanced through information and knowledge flows (on product or process innovation, market development, access to finance, legal and regulatory issues) both within and between enterprises.
- **Networks and Networking:** Formal and informal networks, such as industry associations, are one way to increase information flows as well as to enable businesses to organise joint marketing campaigns, develop labour market links, connections with third level institutions.
- **Cooperation:** Enterprises as well as other stakeholders can derive significant benefits from cooperating in some of the areas of potential advantage, ranging from the development and sharing of specific infrastructure to mutual education and training initiatives.
- **Competition:** Competition among enterprises, particularly in product and labour markets, can result in increased productivity and innovation, which can spill over to other firms with a beneficial impact on a sector.

  (Source Sectoral Ecosystem Report 2016: 11)

Such an approach directly contributes to the Northern Ireland economic priorities through an enhanced understanding of how micro businesses can be impowered to create **Good Jobs** with the skills needed for innovation. It will also enable policymakers and managers to tailor policies and strategies, rather than taking a one-size-fits-all approach.,

With global economies constantly changing future research is needed to explore the fullness of opportunity for innovation to **increase productivity**, particularly given the needs for local adaption.

In addition, a comprehensive approach to innovation in needed to ensure good jobs for all, thus empowering businesses of all sizes to make decisions that will **stimulate sustainable growth** in the longer term.

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“Innovation is important not only for firms, but it is about how we are funded as a region. If we are not innovating, then we will be left behind as a country.”

Findings and Recommendations

The need for innovation in Northern Ireland is well documented, but if there is a failure to actively drive innovation across the economy, the stakeholders consulted highlighted:

- The economy will start to stagnate and fall further behind other economies – both adjacent and further afield.
- There has been a history of government assistance for some sectors, and it feels unlikely that in future this level of support will be available, or desirable.
- There will be an increased risk of business failure across a wide range of sectors.

In addition, the stakeholder engagement found that:

- The types and levels of innovation identified from sector to sector were wide ranging. This suggests that the definition and importance of innovation is unique to each organisation, and is determined by their individual ambitions, access to resources, and appetite for risk.
- While there is a clear need for leadership and a team to drive innovation across an organisation, the 'Innovation lab' approach was considered detrimental to inclusive and collaborative approaches to change as this tends to promote a culture of innovation being someone else's responsibility.
- The leadership skills required to address sustainability issues are similar to those required to successfully deliver innovation.

To address these concerns, and to start to bring the economy to the level of best performing regional economies, as well as to other economies wider afield, the following actions are recommended:

Leadership In Innovation:

- Idea generation and commercialisation skills are generally well established, and the techniques, support, and skills needed are readily available. Focus needs to shift to leadership and the creation of strategic 'scaffolding' for innovation using, for example, the emerging Innovation Management Standards (ISO56000).
- Focus should look to provide practical and actionable recommendations to address some of the innovation leadership skills gaps as detailed in the key conclusions from stakeholder engagement.

Innovation Language:

- Work is underway at an international level to develop a set of consistent and transferrable innovation skill definitions. NI should look to leverage and align to that work.

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- Consider ways to align the key innovation skills and competency to current and future delivery models, providing guidance around consistent use of the terms and key skills across the education and training sectors. This should start with primary schools, through further and higher education, and on to workplace-based training, leadership, and personal development training.

Innovation Logic:

- Consider the adoption of a Logical Framework Approach (LFA) that links innovation policy, programmes, and projects in a strategic and holistic manner. This approach should be informed by a theory of change agreed by key stakeholders; and transparent monitoring and evaluation with a view to demonstrating impact.
- Consider the adoption of a results-based management approach which addresses the recommendation from the Landfall Strategy Group's research to better integrate skills and innovation policy.

Innovation Management:

- Engage with the team developing a new international competency framework for innovation management (ISO5600). Emphasis should be on the practice of innovation through sector specific case studies and job role personas of practical relevance to the local economy.

Innovation Ecosystem:

- Map and promotion of innovation ecosystems beyond the regional economy as a complement to the unique dual market access (EU and UK) enjoyed by local businesses.

Innovation Skills Framework:

- Innovation is everyone's responsibility within an organisation. Whilst recommending a specific set of innovation skills for Northern Ireland is premature, a set of generic innovation skills aligned to international best practice is provided in **Appendix G – F!SK® Framework for Innovation Skills.**
- Any future work on developing innovation skills should be cognisant of the three megatrends which are common across international frameworks:
    - Sustainable Development
    - Industry 5.0
    - Competency Framework Development

Innovation Toolkit:

- Whilst this research found that innovation skills will be unique to each company and differ between sectors, there are some broad skills which can apply to all innovating businesses. Local organisations might benefit from considering adding the following skills to their innovation toolkit

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Strategy and Leadership:

- Demand Management: Proactively coordinating and managing demands for innovation from across the organisation, including requests for the creation of new products, services, technologies, or techniques; or the making of modifications and improvements to existing services and products.
- Knowledge Management: Systematically managing the insights, knowledge, ideas, and concepts created through innovation programme so that they are not lost from the organisation - even if they are not appropriate for today.

Culture and Context:

- Political Awareness: Understanding the corporate culture - the unwritten rules and people that are necessary to open the doors for advancing innovation.
- Negotiation: Influencing and gaining support for new ideas from stakeholders; knowing who needs convincing and utilising a range of methods to achieve a positive outcome.

Projects and Delivery:

- Portfolio Management: Defining and delivering a systematic approach to managing the full portfolio of innovation activities, ensuring the balance between incremental, evolutionary, and revolutionary innovations is aligned to agreed organisational needs.
- Managing Uncertainty: Innovation involves deliberately trying things that might not work. Innovation leaders need to have the skills to manage that approach to risk.

Measurement and Improvement:

- Standardisation: Understanding and applying innovation best practice in the implementation of a sustainable model for innovation within the organisation.
- Demonstrating Value: These skills are lacking or underdeveloped in industry. There is a need for more systematic and rigorous methods to capture and share the lessons learned and best practices from innovative projects, and to assess their impact and value.

The insights and analysis presented in the previous sections is synthesised into nine strategic recommendations and summarised in Table 5 below. These recommendations reflect approaches adopted by key international organisations, the economic priorities of the Northern Ireland regional economy, and the views expressed though the stakeholder engagement exercise completed for this report.

Each recommendation is linked to one of the main global megatrends identified in the study, and then linked to the new Northern Ireland economic priorities introduced in 2024 (Table 5 rows). In addition, each recommendation is clearly linked to one of the three Northern Ireland Innovation Areas of Focus (Table 5 columns).

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Table 5 Innovation Competency Framework for Inclusive Innovation

Megatrends	NI Areas of Focus			NI Economic Priorities 2024
	Improving R&D Performance	**Innovation Driven Enterprises**	**Comprehensive Innovation**	
Sustainable Development	Cluster specific user case development: Digital, ICT and Creative Industries; Fintech / financial services; Life and health sciences; Agritech; Advanced manufacturing and engineering.	Strategic planning that development embraces entrepreneurial opportunities emerging from the transition to the green economy.	Alignment with UN concept of inclusive innovation for sustainable development that is human centric, sustainable, and resilient.	**Reduce carbon emissions.**
Industry 5.0	Alignment with Horizon Europe and dynamic ESCO-O*NET systems.	An examination of job roles, recruitment needs and offers adapted for UK-EU dual market access.	Development of future skills workplace scenarios that demonstrate agility, interrelationships, and a systems perspective.	**Increase the proportion of working-age people in good jobs.**
Competency frameworks	Cluster specific frameworks for innovation.	A review of new career and learning paths for innovation.	Ongoing engagement with international initiatives relating to generic skills and competencies for Innovation.	**Raise productivity.**
Innovation Ecosystem	Supported by a logical framework / results-based approach.	Supported by a logical framework / results-based approach.	Supported by a logical framework / results-based approach.	**Promote regional balance.**

1. **Improving R&D Performance**

   The OECD Science, Technology and Innovation Outlook 2023; OECD guidelines for collecting and reporting data on research and experimental development (Frascati Manual 2015); and OECD guidelines for collecting, reporting and using data on innovation (Oslo Manual 2018) all emphasise the importance of understanding and addressing the needs of sector specific economic clusters and in particular skills development as a way of improving R&D performance.

   Consideration should therefore be given to:

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- Cluster specific user case development that illustrates how innovation takes place.
- Aligning skills development in R&D with Horizon Europe and the dynamic ESCO-O*NET systems.
- Developing cluster/ sector specific frameworks for innovation.

2. **Innovation Driven Enterprises**

   For Innovation Driven Enterprises, that is a specific cohort of businesses which are effectively high-potential, tech-focused companies and have global potential, there may be additional benefit in:

   - Strategic planning that embraces entrepreneurial opportunities emerging from the transition to the green economy.
   - An examination of job roles, recruitment needs and offers adapted for UK-EU dual market access.
   - A review of new career and learning paths for innovation.

3. **Comprehensive Innovation**

   Support for ensuring companies have the right skills to drive innovation within the workforce is likely of particular importance to this focus area, as those operating within the wider base may be less likely to have a dedicated innovation adviser within the organisation.

   Some additional areas which may support the focus on driving innovation across the wider economy include:

   - Alignment with the UN concept of inclusive innovation for sustainable development that is human centric, sustainable, and resilient.
   - Development of future skills workplace scenarios that demonstrate agility, interrelationships, and a systems perspective
   - Ongoing engagement with international initiatives relating to generic skills and competencies for innovation to support a greater understanding.

Finally, the purpose of the recommendations is presented as the 'bottom line' in Table 5: an innovation ecosystem that is supported by a logical framework and is results based.

In conclusion, the work completed for this project highlights the complex, highly dynamic and challenging nature of innovation skills development at a global level. In addition, much work has been undertaken in the last five years relating to innovation and skills development to the Northern Ireland context, and in particular the need to reform how the regional economy operates. The new Northern Ireland economic priorities provide an opportunity to reconfigure this innovation ecosystem in order to improve R&D performance, establish more and better innovation driven enterprises, and embrace comprehensive innovation. This is crucial for increased productivity and economic development.

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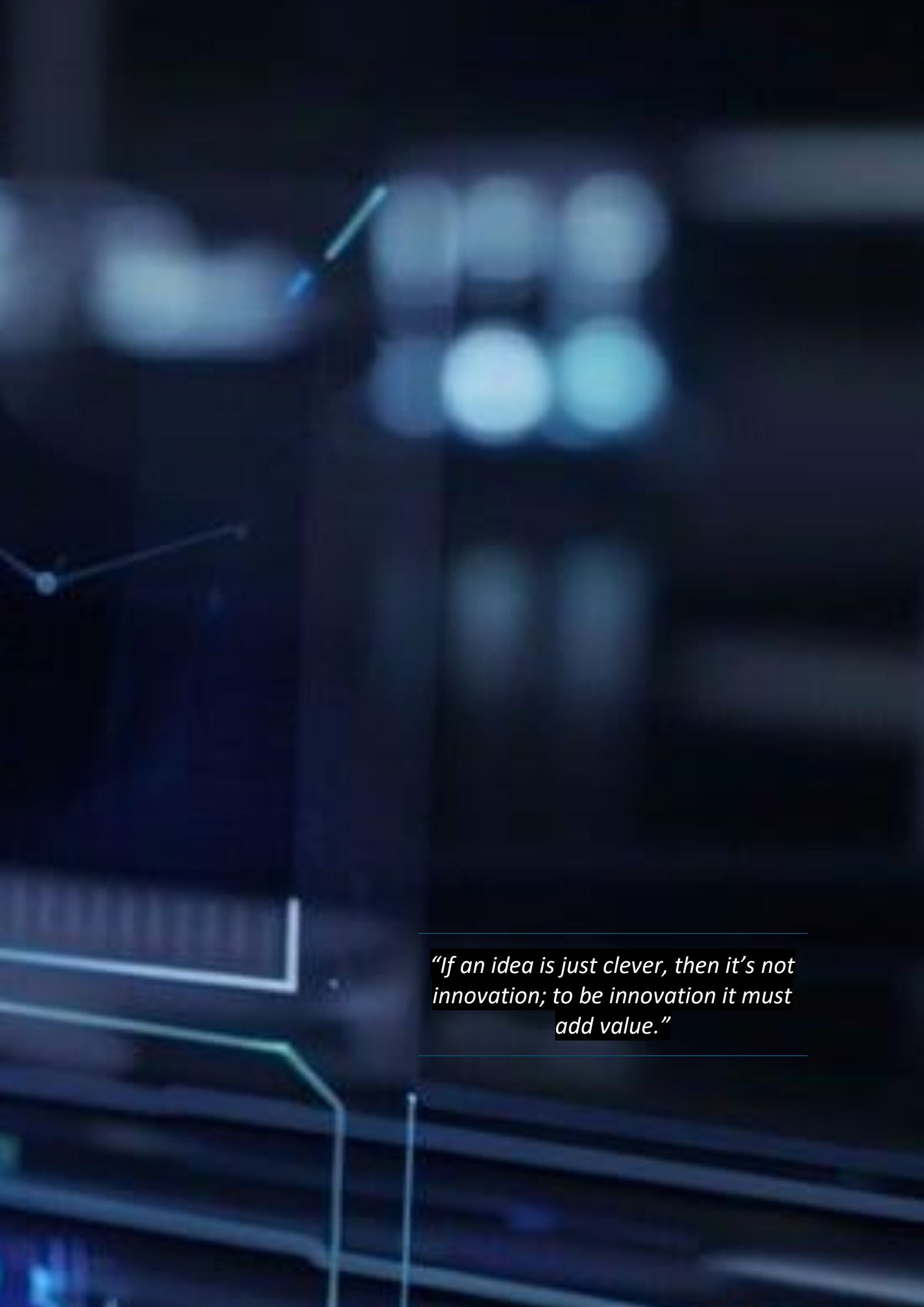
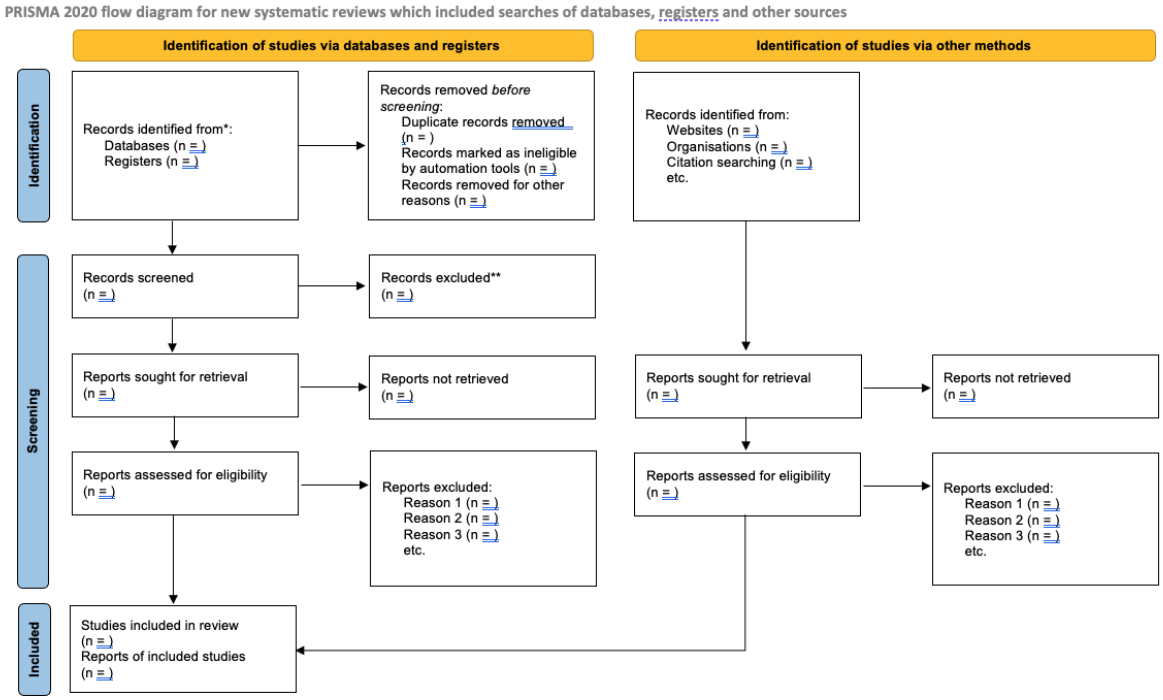


“If an idea is just clever, then it’s not innovation; to be innovation it must add value.”

Appendices

Appendix A – Methodology



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

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Appendix B – Northern Ireland: Innovation Competency Related Strategies, Reviews, and Initiatives

Year	Strategy / Review / Initiative	Organisation
2019	The Strategic Integration of Skills and Innovation Policy in Northern Ireland: An International Small Economy Perspective.	DfE/Landfall Strategy Group
2020	Institutional Design to Support and Integrated Economic, Skills and Innovation Policy Agenda.	DfE/Landfall Strategy Group
2020	Evaluation of Success through Skills – Transforming Futures.	DfE
2020	OECD Skills Strategy Northern Ireland: Assessment and Recommendations.	DfE/OECD
2021	A 10X Economy: Northern Ireland's Decade of Innovation	DfE
2021	Software Skills for a 10x Economy.	Digital Skills Network NI
2021	Northern Ireland Skills Barometer 2021 Update.	DfE/UUEPC
2022	Energy Strategy for Northern Ireland: The Path to Net Zero	NI Executive
2022	Skills Strategy for Northern Ireland: Skills for a 10X Economy	DfE
2022	Measuring Success: 10X Metrics Baseline report	DfE
2022	Integrating Sustainability into the 10X Agenda	Landfall Strategy Group
2022	Invest NI benchmarking and best practice review	Technopolis Group
2023	Independent review of Invest Northern Ireland	Lyons Report
2023	Measuring Success: 10X Metrics Annual Report	DfE
2023	10X Delivery Plan 2023/24	DfE
2023	Future skills: Scenarios for the NI Economy	DfE
2023	People Planet Prosperity	NI Civil Service
2024	Invest NI Action Plan: Delivering Change to achieve a 10X Economy	DfE / Invest NI
2024	Circular Economy Strategy for Northern Ireland	DfE

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Appendix C – Lyons Report Findings and Recommendations

Area	Finding	Recommendation
Portfolio of Programmes	**Finding 4a:** The portfolio of programmes that Invest NI offers to companies is too large and unwieldy, with the organisation, including at the most senior level, struggling to clearly define the exact number available. This makes it difficult for companies and staff to understand what is on offer and questions the efficiency and effectiveness of the programme offering. **Finding 4b:** There appears to be very little consideration of what is offered by other delivery organisations when designing new programmes or reviewing current ones. Reviews of programmes appear to be sporadic and non-strategic. Some evaluation frameworks are in operation, but these appear to only be on individual programme level, and not across the portfolio.	**Recommendation 4a:** Invest NI needs to ensure a streamlined portfolio of programmes is offered to align with the growth ambitions for the NI economy and deliver additionality and value for money. A strategic audit of all Invest NI programmes should take place, in conjunction with DfE, to assess economic impact, ensure they are based on current priorities, meet Key Performance Indicators and eliminate duplicate provision (including taking account of external provision). **Recommendation 4b:** Invest NI should ensure that an agile framework is in place to appoint external organisations to deliver programmes, especially in regard to the latest and emerging technologies.
Green Growth	**Finding 5a:** Whilst a dedicated unit within Invest NI has been established to support the development of the green economy, it is immature in its development and has insufficient resources. **Finding 5b:** Despite the strategic importance of the Net Zero agenda, the Panel heard evidence from DfE that Invest NI had been slow to recognise the significance of the green economy and has been slow to respond to the development of new schemes to support the delivery of DfE's Energy Strategy.	**Recommendation 5:** Invest NI should urgently engage with DfE and DAERA to agree the policy priorities in relation to the green economy. Invest NI should develop a clear and ambitious plan to determine the appropriate financial and human resources required to deliver upon these priorities.
Skills	**Finding 7:** We heard significant evidence regarding the importance of skills, however there is a perception that the NI skills ecosystem is somewhat cluttered, uncoordinated and involves duplicated efforts.	**Recommendation 7:** DfE should lead on a review all of skills programmes that it provides funding for, including the offer of Invest NI, to ensure focus, reduce duplication and eliminate wasteful provision. Consideration should be given to widening the scope of this review to

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		take account of the entirety of the regional skills offering.
Performance Metrics	**Finding 8a:** The current outward facing metrics do not allow Invest NI to demonstrate the impact of its interventions. They are not wide enough to capture the full range of activity and in some cases better reflect how clients perform rather than what difference financial assistance has made. **Finding 8b:** The current emphasis of metrics unduly focuses on outputs, particularly job promotion rather than outcomes and should be widened to include higher productivity, job quality and innovation impacts. **Finding 8c:** Existing KPIs do not tell the full story of Invest NI's work, and this contributes to suboptimal external communication. **Finding 8d:** The 10X Vision provides an opportunity for DfE and Invest NI to establish a new set of KPIs that will provide a much more focused approach to how Invest NI leads and supports economic development in NI.	**Recommendation 8:** A well-defined set of SMART performance metrics should be set, and evaluated, by DfE in close coordination with Invest NI. They should focus on demonstrating where the organisation adds value to the NI economy and be better aligned to the 10X Vision and any future policy priorities of the NI Executive.
Intelligence & Digitisation	**Finding 14c:** Invest NI does not fully utilise learning from programme evaluations. Monitoring and evaluation are important steps in delivering value for money.	**Recommendation 14b:** Invest NI needs to develop a strategy for the proactive sharing of economic and market intelligence to policy makers and key stakeholders in NI.
Communications	**Finding 15a:** Invest NI does not have a strategic communications and engagement strategy that articulates the breadth of its activities or impact that these have.	**Recommendation 15a:** Invest NI needs to develop a comprehensive strategic communications and engagement strategy recognising the needs of different audiences. The Invest NI Board needs to take a more active role in delivering this strategy by making full use of its ambassadorial role.
Risk and Control	**Finding 16d:** The current arrangements for Post Project Evaluations are not satisfactory, with project owners carrying out evaluations in some areas.	**Recommendation 16c:** Invest NI should consider how oversight mechanisms for the large number of lower value projects, not assessed by the Invest NI Appraisal

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		Team, can be strengthened to ensure delivery against objectives and value for money.
Invest NI and a New Economic Vision	Finding 17b: Slow progress in developing detailed implementation plans is having a direct impact on Invest NI's own ability to plan for the long term.	Recommendation 17a: DfE must ensure that the 10X Vision and subsequent action plans are tangibly linked to future NI Executive strategies, particularly the Programme for Government.

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Appendix D – Megatrend Academic Articles

The transition from unsustainable to sustainable development.

Álvarez Jaramillo, J., Zartha Sossa, J.W. and Orozco Mendoza, G.L., 2019. Barriers to sustainability for small and medium enterprises in the framework of sustainable development—Literature review. *Business Strategy and the Environment*, *28*(4), pp.512-524.

Meschede, C., 2020. The sustainable development goals in scientific literature: A bibliometric overview at the meta-level. *Sustainability*, *12*(11), p.4461.

Saffari, G., 2024. Moving Towards Sustainable Development in Business Management. *International journal of industrial engineering and operational research*, *6*(1), pp.16-29.

Vatananan-Thesenvitz, R., Schaller, A.A. and Shannon, R., 2019. A bibliometric review of the knowledge base for innovation in sustainable development. *Sustainability*, *11*(20), p.5783.

The articulation of an emerging industrial revolution - industry 5.0.

Ghobakhloo, M., Iranmanesh, M., Mubarak, M.F., Mubarik, M., Rejeb, A. and Nilashi, M., 2022. Identifying industry 5.0 contributions to sustainable development: A strategy roadmap for delivering sustainability values. *Sustainable Production and Consumption*, *33*, pp.716-737.

Narkhede, G., Chinchanikar, S., Narkhede, R. and Chaudhari, T., 2024. Role of Industry 5.0 for driving sustainability in the manufacturing sector: an emerging research agenda. *Journal of Strategy and Management*.

Rabiul Hasan, M., Khan, M.A. and Wuest, T., 2024. Towards Industry 5.0: A Systematic Literature Review on Sustainable and Green Composite Materials Supply Chains. *arXiv e-prints*, pp.arXiv-2402.

Raffik, R., Roshan, R.P., Sanjeev, K.B. and Subash, C., 2024. Emerging Technologies to Enhance Human-Machine Interaction and to Facilitate Industrial Paradigm Shift to Industry 5.0: A Comprehensive Review. *Human-Centered Approaches in Industry 5.0: Human-Machine Interaction, Virtual Reality Training, and Customer Sentiment Analysis*, pp.1-23.

The development of a wide range of generic competency frameworks.

Akimov, N., Kurmanov, N., Uskelenova, A., Aidargaliyeva, N., Mukhiyayeva, D., Rakhimova, S., Raimbekov, B. and Utegenova, Z., 2023. Components of education 4.0 in open innovation competence frameworks: systematic review. *Journal of Open Innovation: Technology, Market, and Complexity*, p.100037.

Butschan, J., Heidenreich, S., Weber, B. and Kraemer, T., 2019. Tackling hurdles to digital transformation—The role of competencies for successful industrial internet of things (IIoT) implementation. *International Journal of Innovation Management*, *23*(04), p.1950036.

Lepore, D., Vecciolini, C., Micozzi, A. and Spigarelli, F., 2023. Developing technological capabilities for Industry 4.0 adoption: An analysis of the role of inbound open innovation in small and medium-sized enterprises. *Creativity and Innovation Management*, *32*(2), pp.249-265.

McPhillips, M. and Licznerska, M., 2021. Open innovation competence for a future-proof workforce: A comparative study from four European universities. *Journal of Theoretical and Applied Electronic Commerce Research*, *16*(6), pp.2442-2457.

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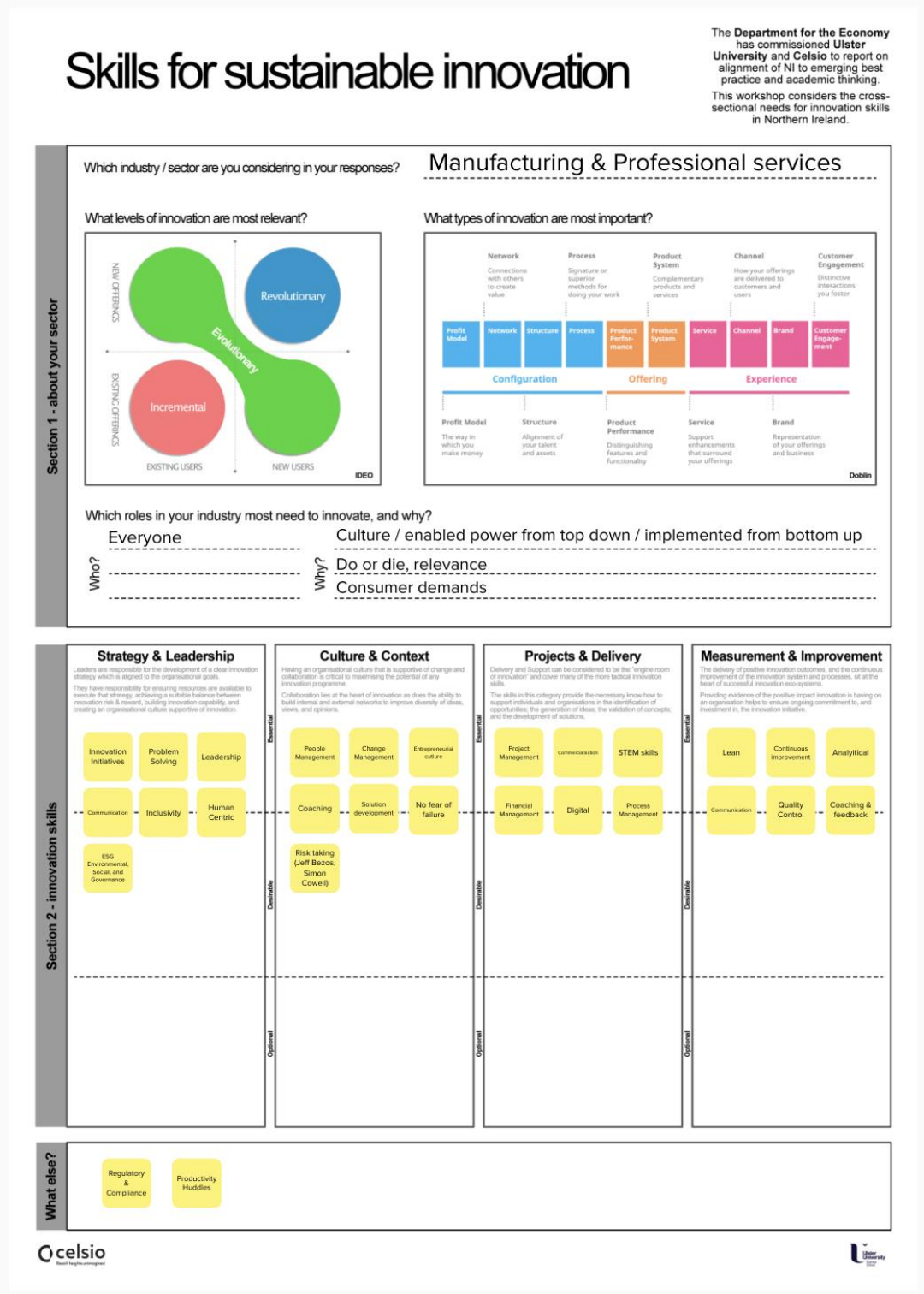
Appendix E – Stakeholder Engagement



Skills for sustainable innovation

The **Department for the Economy** has commissioned **Ulster University** and **Celsio** to report on alignment of NI to emerging best practice and academic thinking.

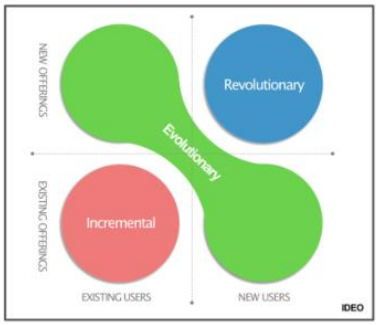
This workshop considers the cross-sectional needs for innovation skills in Northern Ireland.

Section 1 - about your sector

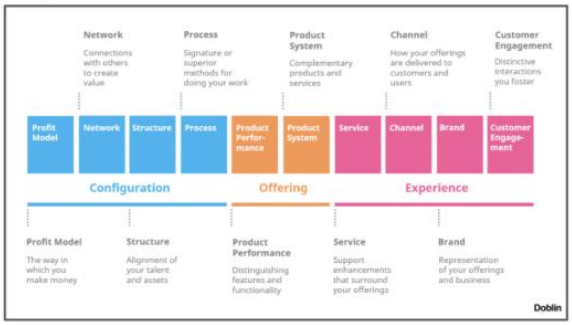
Which industry / sector are you considering in your responses?

Government, FinTech, Academia, Funder / policy

What levels of innovation are most relevant?



What types of innovation are most important?



Which roles in your industry most need to innovate, and why?

Who?	Why?
SMEs	Business growth, survive, new products, competitive services
Officials	Standard, timeframes, attract investment
Data Collection	more beneficial if data is from wider source
All island	Learning from RoI - productivity gap

Section 2 - innovation skills

Strategy & Leadership	Culture & Context	Projects & Delivery	Measurement & Improvement
Leaders are responsible for the development of a clear innovation strategy which is aligned to the organisational goals. They have responsibility for ensuring resources are available to execute that strategy, achieving a suitable balance between innovation risk & reward, building innovation capability, and creating an organisational culture supportive of innovation.	Having an organisational culture that is supportive of change and collaboration is critical to maximising the potential of any innovation programme. Collaboration lies at the heart of innovation as does the ability to build internal and external networks to improve diversity of ideas, views, and opinions.	Delivery and Support can be considered to be the "engine room of innovation" and cover many of the more tactical innovation skills. The skills in this category provide the necessary know how to support individuals and organisations in the identification of opportunities; the generation of ideas; the validation of concepts; and the development of solutions.	The delivery of positive innovation outcomes, and the continuous improvement of the innovation system and processes, sit at the heart of successful innovation eco-systems. Providing evidence of the positive impact innovation is having on an organisation helps to ensure ongoing commitment to, and investment in, the innovation initiative.
Essential			
Building Networks	Building Capability	Simplification of the Complex	Adaptability
Emotional Intelligence	idea Generation	Solution development	
Effective Communication	Collaboration	Presentation	
Desirable			
Political Awareness	Coaching	Continuous Improvement	Demand Management
Innovative Thinking	Continuous Improvement	Change Management	Benefit Management
Continuous Improvement	Opportunity Identification		Analytical Thinking
Negotation	Intrapreneurship		Value Realisation
	Creative Facilitation		
Optional			
		Intellectual Property	

What else?

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Skills for sustainable innovation

The **Department for the Economy** has commissioned **Ulster University** and **Celsio** to report on alignment of NI to emerging best practice and academic thinking.

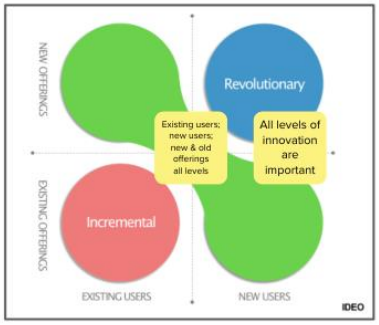
This workshop considers the cross-sectional needs for innovation skills in Northern Ireland.

Section 1 - about your sector

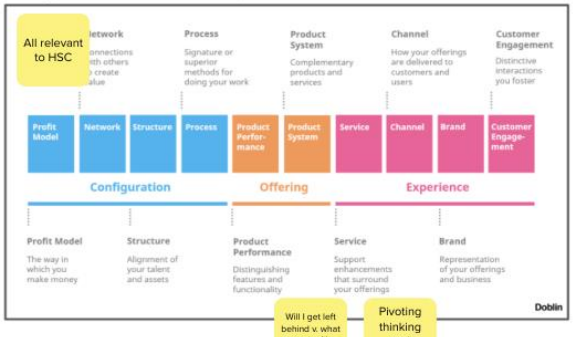
Which industry / sector are you considering in your responses?

HSC. Professional Services, Research, Support to ethnic minorities, Education

What levels of innovation are most relevant?



What types of innovation are most important?



Will I get left behind v. what opportunities from new tech

Pivoting thinking and expertise

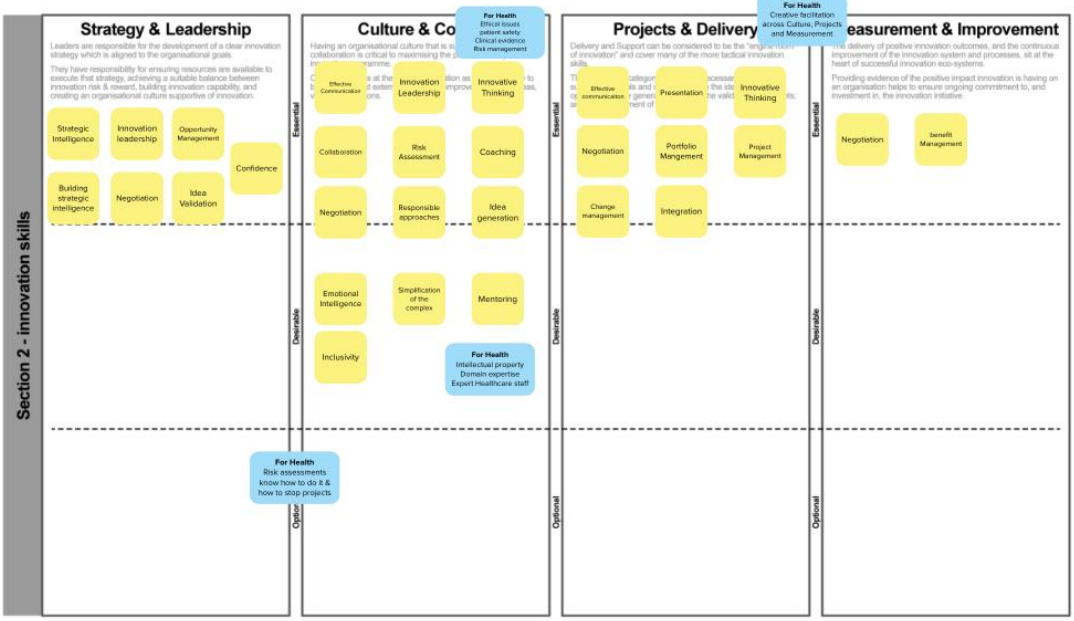
Which roles in your industry most need to innovate, and why?

Who?
- All working in HSC
- Healthcare professionals
- Digital health

Why?
- Challenges like COVID need new ways of thinking
- healthcare challenges are on the rise, as are resource constraints
- Opportunities in digital health / tech & data
- For business growth & survival

Dynamic Challenges

Section 2 - innovation skills



What else?

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Skills for sustainable innovation

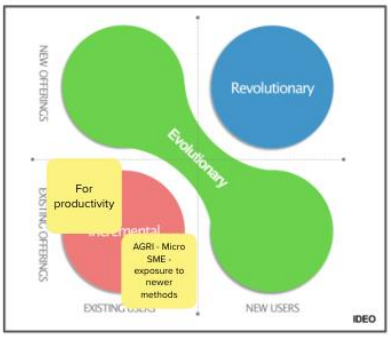
The **Department for the Economy** has commissioned **Ulster University** and **Celsio** to report on alignment of NI to emerging best practice and academic thinking.

This workshop considers the cross-sectional needs for innovation skills in Northern Ireland.

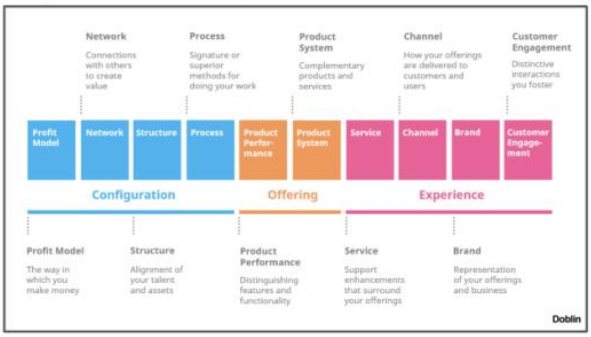
Section 1 - about your sector

Which industry / sector are you considering in your responses? Non-profit, education, economic development, agri-food
Start up and incubation

What levels of innovation are most relevant?



What types of innovation are most important?



Which roles in your industry most need to innovate, and why?

Who? Barriers competition & time - customers + sales

Why? Skills 21st Century skills, Insights, SDG, continuous learning, Shared wisdom; Skills Open minded cross-departmental; Skills Space for learning awareness of what innovation is

Section 2 - innovation skills

Strategy & Leadership

Leaders are responsible for the development of a clear innovation strategy which is aligned to the organisational goals.

They have responsibility for ensuring resources are available to execute that strategy, achieving a suitable balance between innovation risk & reward, building innovation capability, and creating an organisational culture supportive of innovation.

- Essential: Foresight + data trends; Mentoring & coaching; Curiosity
- Desirable: Agile / nimble leadership; Awareness to innovate; Team of Teams; Collaboration
- Optional:

Culture & Context

Having an organisational culture that is supportive of change and collaboration is critical to maximising the potential of any innovation programme.

Collaboration lies at the heart of innovation as does the ability to build internal and external networks to improve diversity of ideas, views, and opinions.

- Essential: Psychological Safety; Emotional Intelligence; Attitude to risk; Resilience; Response to failure; Learning culture
- Desirable: Facilitation; Collaboration
- Optional:

Projects & Delivery

Delivery and Support can be considered to be the "engine room of innovation" and cover many of the more tactical innovation skills.

The skills in this category provide the necessary know how to support individuals and organisations in the identification of opportunities, the generation of ideas, the validation of concepts, and the development of solutions.

- Essential: Ownership; Individual Empowerment; Evaluation; learning loops
- Desirable: Collaboration
- Optional:

Measurement & Improvement

The delivery of positive innovation outcomes, and the continuous improvement of the innovation system and processes, sit at the heart of successful innovation eco-systems.

Providing evidence of the positive impact innovation is having on an organisation helps to ensure ongoing commitment to, and investment in, the innovation initiative.

- Essential: Evaluation; KPIs v OKRs Objectives and key results; Feedback
- Desirable: Data
- Optional:

What else?

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Thanks to the following key stakeholders who contributed their views and experiences during the workshop and the one-to-one interviews.

Organisation	Role (s) of Participants
Almac group	Funding & Government Affairs Manager|
Belfast Harbour	People & Digital Transformation Director
Catalyst	
Celsio	Director
Danske	HR Director
Department for the Economy	Sector Lead
Digital Catapult NI	Director UK Digital Twin Centre
GRAHAM Construction	
HIRANI	Chief Executive
HSC	Digital systems Lead
Innovation Factory	Innovation Manager.
InvestNI	Director of Skills
Kainos	Group CTO
Manufacturing NI	
Moy Park	
MRANI	Director & Founder
Ormeau Baths	GM & Co Founder
PWC	Director, Market Research
PWC	Director Capability & Development
ROAM	Head of Sales
Social Innovation	Founder
The Fintech Corridor	CEO
Translink	
UUBS	Director BEU
UUBS	Professor
UUEPC	
West Coast Electrical,	Director
Young Enterprise NI	Chief Executive

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Appendix F – Public and Private Sector reports on Innovation Competency

(2024, Authors construction)

Organisation	Report	Regional/ Global	Key insights	Links with N. Ireland Strategy, 2024
International Standards Organisation (ISO)	ISO56002:2019 Innovation Management System Guidance	Global	Guidance for the establishment, implementation, maintenance, and continual improvement of an innovation management	Organisations seeking sustained success link with supporting innovative economic growth in a way that is inclusive and sustainable.
World Economic Forum	Future of Jobs Report: Davos 2020 WEF The Future of Jobs Report 2023	Global	Analytical Thinking and Innovation tops the list top 10 work skills Half of us will need to reskill in the next five years (as a result of the "double-disruption") Funding for skills training ranks ahead of flexibility, tax and other interventions.	'Unless we see meaningful intervention by the government or business community, a widening inequality gap is likely to get worse' Increasing need for Innovation to address rising inequality
PWC	Workforce of the future: The competing forces shaping 2030 Report See also: PwC Net Zero Economy Index 2023	Global	Scenario based report outlining the competing forces shaping 2030 Future views of 'thinking machines' are replacing human tasks, changing the skills that organisations are looking for in their people.	Innovation rules – A world that is a perfect incubator for innovation with organisations and individuals racing to give consumers what they want.
Nesta	Skills, attitudes and behaviours that fuel public innovation, 2019	Global	Nesta's Competency Framework for Experimenting and Public Problem Solving	Strong focus on teams and the individual upskilling in areas where there are big challenges facing

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				society. 'innovation means turning bold ideas into reality and changing lives for the better.'
KPMG	Benchmarking Innovation Impact 2023 See also: Platform X Platform X Services	Global	Survey results from executives at 216 global companies, interviews with 'Innovation leaders' and executives.	New context for Innovation in Hybrid environment (value of in-person innovation in a Digital world). Vision important but employee engagement and capability building is key for innovation.
Deloitte	Global Human Capital Trends, Leadership for the 21st Century 2023 Innovation Survey: Elevating the pivotal role of innovation Power Up: *UK skills* Boosting transferable *skills* to achieve inclusive growth and *innovation (2020)*	Global Regional: Greece U.K.	The era of skills, innovations, and strong leaders. Employees Skills in emerging sectors vs 'situation is much more conservative in the public sector.' Insights on 'Business perception of innovation' in a region.	Exemplar from Ukraine – focus on employee's skills (as opposed to qualifications) rise of knowledge sharing platforms. 'Harness disruption as a catalyst to drive innovation' Explores strategic relationship between innovation & sustainability.
OECD	Core Skills for Public Sector Innovation, OPSI	Global – Public sector specific	Focus on strengthening government capacity to innovate	Four focus areas: - Purpose - Potential - Capacity

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	OECD Innovation Portfolios with examples			- Impact Need for leveraging innovation as an integral part of policymaking and administration and enhance their capacity to proactively adapt.
Scottish Government	Scotland's National Innovation Strategy	Scotland	Supports Scotland's National Strategy for Economic Transformation Mapping of Scotland's Innovation Ecosystem Process for Identifying Priorities: ii. Application of innovation into business iii. Business capabilities (closest to market):	Cluster approach to Innovation Priorities: •Energy Transition •Health and Life Sciences •Data and Digital Technologies •Advanced Manufacturing Case study on Innovation District (e.g.GRID)
Welsh Government	Innovation strategy for Wales Wales innovates: creating a stronger, fairer, greener wales	Wales	Aims to create and nurture a vibrant innovation culture for a stronger, fairer, greener Wales	Skills are central to Innovation vision in Wales as it supports the development of innovation skills and knowledge throughout people's lives in Wales. Define Innovation as the creation and application of new knowledge to improve the world.
Department of Further and Higher Education, Research,	Impact 2030: Ireland's Research and Innovation Strategy	Ireland	Emphasis on: - Talent; - Inclusion;	Pillars or success Maximising the impact of R & I on Economy and society

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Innovation and Science, Ireland			- Innovation; - International; - Governance; and - Capacity.	Innovation Driving Enterprise Success *'Innovation solutions will be developed to enable all sectors of our enterprise base and society respond to twin challenges of climate and digital transition.'*
Department of Enterprise, Trade and Employment, Ireland	National Smart Specialisation Strategy for Innovation 2022-2027 *Updated* *28 February 2024*	Ireland	Aligned with EU priorities on: Digitalisation and digital transformation; Green transformation for enterprise; Innovation diffusion	Innovation diffusion is supported by underlying framework conditions, including the standards and regulatory environment supported by NSAI
Enterprise Ireland	Agile Innovation Fund Digital Process Innovation project	Ireland	This fund supports clients to quickly develop innovations and respond to opportunities and threats in new and existing markets.	
European Commission 1	Horizon Europe: EU Missions	European/ Global	Results of the First Review of EU Missions Published	New thinking on innovation initiatives e.g. European Bauhaus is a creative and interdisciplinary initiative that connects the European Green Deal
European Innovation Council, European Commission	European Innovation Council Pathfinder initiatives December 2023	European	Dedicated to SMEs and start-ups to develop and scale up "deep tech" innovations in critical fields	The EIC is Europe's flagship programme to identify, develop and scale up breakthrough

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				technologies and game changing innovations Challenge led innovation
Vanguard	Vanguard Initiative	38 of the most advanced industrial regions in Europe	A place based network to boost regional innovation ecosystems. Regional Innovation Valleys (RIV) programme	DfE objective to promote Regional Balance driving forward delivery of projects that improve regional balance
European Commission Smart Specialisation (S3) Forum 2023	S3 Community of Practice December 2023 - 340 in-person participants	European	S3 practitioners, experts, policymakers, and key stakeholders from across various European regions	New CoP on Innovation Diffusion *Recommend a new focus on SME management skills to improve capacity to work with, embed and benefit from support*
Centre for the Understanding of Sustainable Prosperity (CUSP)	Upskilling the UK Workforce for the 21st Cenury	U.K.	institutional capacity to devolve powers and funding at the local level, in order to maximise the opportunities afforded by upskilling and reskilling programmes.	Securing an adequate skills supply for a low carbon economy
Gartner	Innovation Insights 2023+ The Gartner Top Strategic Technology Trends for 2024	Global		
OECD **Eurostat**	Oslo Manual	Global	international reference guide for collecting and	*A business innovation is a new or improved product or business process (or combination*

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	Link with ISO 560002		using data on innovation.	*thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm.*
University of Cambridge	UK INNOVATION REPORT 2023	U.K.	Benchmarking the UK's industrial and innovation performance in a global context	*Discussions on the relation between innovation and sectoral competitiveness*

Note Innovation skills are:

- **Multi-dimensional and interrelated**: skills can be (1) cognitive, (2) socio-emotional or non-cognitive, and/or (3) technical or job-relevant, but they can also be of basic order or high order.
- **Cross-disciplinary**: the same skill can be taught across different disciplines with similar or different purposes –for example: problem solving.
- **Transversal**: the same skill can be relevant to a broad range of occupations or sectors, not only to an individual's current occupation –for example: communication.
- **Transferable**: a core objective of skills is that they can be transferred to and applied in different occupations or contexts –for example: decision making.
- **Acquired during different developmental periods**: skills can be acquired and developed during different age periods, according to individuals' needs and maturity. Typically, cognitive skills are developed during early childhood and childhood and tend to plateau around adulthood, while job-relevant skills are usually acquired during late adolescence and adulthood.
- **Ultimately evaluated in the workplace and in life**: even though individuals are supposed to acquire some of the most important skills in school, it is several years later, in the workplace and/or in life, that they will be able to assess whether they have acquired them or not.

An organisation's ability to innovate is recognized as a key factor for sustained growth, economic viability, increased well-being, and the development of society. The innovation capabilities of an organisation include the ability to understand and respond to changing conditions of its context, to pursue new opportunities, and to leverage the knowledge and creativity of people within the organisation, and in collaboration with external interested parties.

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The newly developed innovation management system in ISO 56000 is a set of interrelated and interacting elements, aiming for the realisation of value. It provides a common framework to develop and deploy innovation capabilities, evaluate performance, and achieve intended outcomes.

Academic Concepts and Definitions

Review of Core Elements of the ISO56002 Standard for Innovation Management Systems

ISO56002 :2019 Standard "Managing Innovation Systems"	**Relevant core innovation topics from the body of knowledge**	**Framework for innovation skills (F!SK) Primary skill categories**	**Seminal studies**	**Recent research and reviews**
Leadership and Intent	Individual roles, goals, context	Leadership & Direction	Howell and Avolio (1993); Macdonald and Williams (1994)	Isaksen and Tidd (2006); Hughes *et al* (2018)
Organisation	Climate and culture, structure, teams, collaboration	Culture & Context	Allen (1977); Burns and Stalker (1966)	Anderson *et al* (2014); Tidd (2021)
Planning and Support	Strategy, resource-based view, core capabilities	Leadership & Direction Delivery & Support	Teece *et al* (1997)	Barreto (2010); Teece (2010); Keupp *et al* (2012)
Process:	Stage-gate, development funnel, non-linear models,	Delivery & Support	Rothwell (1994); Cooper (1994); Wheelwright and Clark (1992)	O'Reilly and Tushman (2013); Tidd and Bessant (2021)
1. Identify opportunities	Sources of innovation, search strategies	Delivery & Support	Pavitt (1984); von Hippel (1988).	Chesbrough (2003); Leiponen and Helfat (2010)
2. Create concepts	Creativity, fuzzy front end, idea management	Delivery & Support	Smith and Reinersten (1992); von Hippel (1994)	Gassmann and Schweitzer (2013)
3. Validate concepts	Design-thinking, prototyping, lead users	Delivery & Support	Kelly (2001)	Ries (2011)

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ISO56002 :2019 Standard "Managing Innovation Systems"	Relevant core innovation topics from the body of knowledge	Framework for innovation skills (F!SK) Primary skill categories	Seminal studies	Recent research and reviews
4. Develop solutions	New product and service development	Delivery & Support	Cooper and Kleinschmidt (1995)	Schweitzer and Tidd (2018)
5. Deploy solutions	Implementation, diffusion of innovation	Delivery & Support	Rogers (2003)	Perese et al (2010); Tidd (2010); Iyengar et al (2011)
Performance evaluation	Innovation metrics, success factors	Results & Improvement	Rothwell et al (1974)	Brem et al (2019)
Improvement	Capturing learning, dynamic capabilities	Results & Improvement	Levitt and March (1988); Cohen and Levinthal (1990)	Nonaka and Takeuchi (1995)
Value	Appropriability regime, business model innovation, intellectual property	Results & Improvement	Teece (2010)	Osterwalder and Pigneur (2010); Spieth et al (2013)

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Appendix G – F!SK® Framework for Innovation Skills

F!Sk® is a comprehensive **Framework for Innovation Skills**, identifying a broad range of skills and competency levels required by an organisation to add value systematically and repeatedly through innovation.

F!Sk® was created from the ground up in 2020 by **Celsio**, a Northern Irish company with extensive commercial experience in Innovation Management Systems; building innovation teams; and developing innovation capabilities. **F!Sk®** is aligned to international best practice in the for of ISO56002:2019 and EFQM's Innovation Excellence Model.

In 2021, **Ulster University Business School (UUBS)** undertook exploratory and academic research into the **F!Sk®** model. UUBS found:

- **F!Sk®** is unique in that its skills development framework has been designed to strategically link with the associated principles of ISO 56002:2019.
- **F!Sk®** complements and supports government and support agency programmes, sharing a common goal to build innovation skills and capability to increase innovation.
- **F!Sk®** provides beneficial information to support innovation decision-making and tactics at both an individual and organisational level.
- The **F!Sk®** toolkit improves the skills of the individual as the 'innovator' within the context of an organisation's innovation ambitions as opposed to measuring the value on an innovation per se.

F!Sk® now represents a key input into ISO's forthcoming project to develop an international innovation competency standard.

Below is a high-level overview of the skills identified in **F!Sk®**.

Leadership & Direction

Where we'll find the strategic skills required to accomplish innovation goals.

Skill	Extract from F!Sk® definition
Strategic Planning	Creating, implementing, and maintaining a clear and documented strategy for innovation that is aligned to, and delivers against the broader organisational vision, strategy, and goals.
Innovation Leadership	Developing a supportive climate for innovation, where employees feel safe to challenge the status quo, put forward ideas, and fail (for the right reasons) without the fear of retribution.

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Finance & Investment	Identifying, sourcing, and securing the funding required to implement, deliver, and sustain the approach to innovation as defined by the innovation strategy.
Building Strategic Intelligence	Proactively monitoring the emergence of new products, services, methods, and technologies that could have an impact on the organisation, whether potentially positive or negative.
Demand Management	Proactively coordinating and managing demands for innovation from across the organisation, including requests for the creation of new products, services, technologies, or techniques; or the making of modifications and improvements to existing services and products.
Risk Management	Managing the risks associated with innovation on behalf of the organisation and applying new or existing organisational policies and procedures to manage and control all risks associated with the innovation strategy.
Benefit Management	Establishing an approach for the identification, documentation, and monitoring of the benefits the organisation expects to gain from innovation activities.
Stakeholder Engagement	Identifying, creating, and maintaining relationships with stakeholders, using both formal and informal communication channels to support positive outcomes and gain commitment for innovation initiatives.

Delivery & Support

The “engine room of innovation” and where we find many tactical innovation skills.

Skill	**Extract from F!Sk® definition**
Project Management	Taking responsibility for the management of all aspects of innovation implementation projects, from concept elaboration, validation, and development, ensuring the expected outcomes are delivered within scope, timescales, and budget, and are delivered to an acceptable level of quality.
Identifying Opportunities	Identifying and capturing opportunities for innovation within the organisation, by reviewing the services and products offered and identifying those that can be made to add

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	value through the generation and application of new ideas and concepts.
Generating Ideas	Seeking, capturing, and promoting the creation of novel ideas, whether from sources within or outside the organisation using a variety of ideation techniques.
Creative Facilitation	Facilitating the full creative process by generating an atmosphere of understanding and support for the creative processes involved.
Validating Concepts	Verifying the feasibility, desirability, and commercial viability of a concept before embarking on expensive and time-consuming solution development.
Developing Solutions	Progressing validated concepts through to the development of practical solutions that are ready for exploitation or commercialisation.
Knowledge Management	Systematically managing the insights, knowledge, ideas, and concepts created through the innovation programme in a Knowledge Management System (KMS) so that they are not lost from the organisation - even if they are not appropriate for today.
Tools & Methodologies	Actively seeking and identifying innovation enabling technologies and assessing the potential of these technologies to best support the organisation's innovation initiatives.
Innovative Thinking	Generating novel solutions to problems by observing, monitoring, and paying attention to your surroundings to spot associations and join up the dots between ideas, concepts, events, experiences, and insights.

Results & Improvement

Skills needed to demonstrate the positive impact innovation is having on the organisation.

Skill	**Extract from F!Sk® definition**
Building Capability	Promoting and encouraging the personal development of innovation skills, confidence, and capability.

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Value Realisation	Tracking concepts created by the innovation activities that have progressed into deployment, delivery, and exploitation.
Demonstrating Value	Making the case for innovation at an organisational level by articulating the value; selling the vision; explaining its worth; and providing the evidence to support ongoing investment in innovation.
Portfolio Management	Defining and delivering a systematic approach to managing the full portfolio of innovation activities, ensuring the balance between incremental, sustainable, and disruptive innovations is aligned to the agreed innovation strategy.
Intellectual Property	Understanding intellectual property right protection in its various forms and knowing how best to protect the innovations developed by the organisation.
Continuous Improvement	Planning and implementing a continuous improvement programme for the organisation's innovation programme, often facilitated by the introduction of an Innovation Management System (IMS) and associated innovation processes.
Best Practice & Standardisation	Understanding and applying innovation best practice, including the important role of an Innovation Management System in the implementation of a sustainable model for innovation within the organisation.

Culture & Context

Skills that ensure the organisation has a culture supportive of successful innovation.

Skill	**Extract from F!Sk® definition**
Change Management	Recognising the need for change and embracing new ways of thinking and working that align to the business objectives and targets through the innovation strategy.
Collaboration	Working in a positive manner, sharing knowledge, good practice, and experience. Building supportive, trusting, and professional relationships with internal colleagues and external stakeholders while having the confidence to challenge assumptions.

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Mentoring & Coaching	Increasing the breadth of innovation expertise within the organisation by the sharing of information and advice to others on how to perform, improve and succeed in innovation.
Political Awareness	Understanding the corporate culture - the unwritten rules and people that are necessary to open the doors for advancing innovation.
Intrapreneurship	Providing entrepreneurial input within the organisation, challenging the status quo, and using business acumen to create innovation opportunities.
Building Networks	Networking with a diverse range of individuals and organisations to source innovation opportunities.

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Appendix H - References

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“You don’t need to be da Vinci to innovate.”