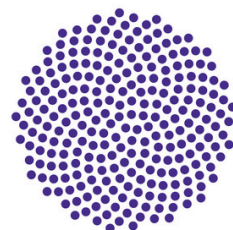
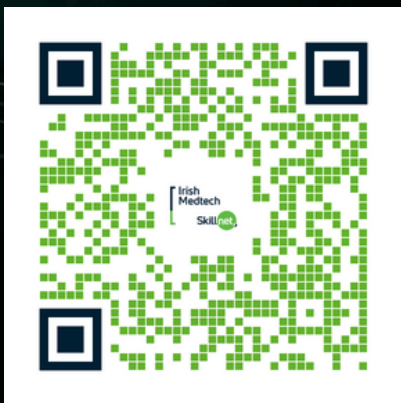




Master of Science in Digitalisation of Manufacturing



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irishmedtechskillnet.ie

The Irish Medtech Skillnet and contracting organisation, Irish Medtech, in collaboration with the IDEAM Research Institute at the Technological University Shannon (TUS) are delighted to present the Masters in Digitalisation of Manufacturing.

There is a growing demand in the Irish Manufacturing and Technology sector for key skills needed in digitalisation, such as data analytics, visualisation and automation, as well as an ability to leverage tools such as artificial intelligence (AI). New challenges and opportunities are being faced in areas, such as, sustainability and cyber-security. In addition, leadership skills in innovation, change-management and communications, are vital to drive business case development.

This programme takes a research-led approach to support professionals in the transition to advanced manufacturing through digitalisation, ensuring the continuous professional development of industry leaders and the continued growth, prosperity and sustainability of the manufacturing sector.

In collaboration with:



ABOUT IRISH MEDTECH SKILLNET

Irish Medtech Skillnet is a business network operating in the Medtech and Manufacturing Sector, proactively nurturing technical and non-technical skills and talent development, and driving best practice knowledge sharing to its network, in enhancing Ireland's position as an emerging global Medtech hub. The Irish Medtech Skillnet is promoted through Irish Medtech, and our skills support to business is co-funded by Skillnet Ireland and member companies. Skillnet Ireland is funded from the National Training Fund and the European Union through the Department of Further and Higher Education, Research, Innovation and Science.

ABOUT IRISH MEDTECH

Irish Medtech is the business association within Ibec representing the medical technology sector. Irish Medtech has more than 250 members, located throughout the island of Ireland. The group's broad focus is to promote and support an environment that encourages the sustainable development and profitable growth of our FDI multinational and SME member companies. Irish Medtech is led by a Board of CEOs and Chief Representatives, it implements its strategy through working groups and taskforces.

OBJECTIVES

The Masters in Digitalisation of Manufacturing is a practice-based professional award for experienced employees in all sectors of manufacturing. The programme focuses on the challenges and benefits of applying advanced digital technologies to drive productivity, capacity and growth.

The majority of the credits and learning outcomes are work-based, underpinned by a training programme of masterclasses and research supports, delivered through bootcamps, workshops, and on-line tutorials, and supported by guest lecturers and site-visits.

The masterclasses provide an expert-level appraisal of relevant technologies, tools and techniques so that the Learner can assess current trends, engage with specialist professionals, and identify the potential benefits of digitalisation of manufacturing and embracing Industry 4.0/5.0.

The completion of the applied research project and research management modules brings significant advances in terms of professional and personal development, critical thinking, communication skills and confidence to present proposals and results. The necessary research and transversal skills (communications, research management) will be delivered through online, self-directed modules with regular workshops in the University.

ENTRY REQUIREMENTS

The programme is aimed at existing manufacturing, mechanical, technological or engineering professionals, and those migrating from associated disciplines. The principal entry requirement for the Masters programme is a Level 8 honours degree, at minimum second class honours (NFQ or other internationally recognised equivalent), in a relevant scientific, engineering, computing, or technology discipline. Applicants from other Level 8 degree disciplines who have a minimum of three years experiential learning in an appropriate manufacturing environment (with a demonstrable knowledge of mathematics and computing) may also apply. Their admission to the program will be determined by the Technological University Shannon (TUS) Recognition of Prior Learning (RPL) Process. A deep knowledge of manufacturing environments and the potential benefits and challenges facing manufacturing from digitalisation would be beneficial.

Registration may also be available to International (non-EU) students with a 2:1 grade in their primary degree and evidence of a minimum of a Level 6 in the IELTS or equivalent. Registration is subject to the verification of appropriate visa and sponsorship arrangements.

COURSE OVERVIEW

Core Technical Modules

- Data Analytics & Machine Learning 5 ECTS Hybrid
- Database Design & Data Visualisation 5 ECTS Hybrid
- Cyber-Physical Systems & IoT 5 ECTS Hybrid

Electives (1) *

- Integrated Database Systems 5 ECTS Hybrid
- Manufacturing Automation & Robotics 5 ECTS Hybrid
- Digital Twins in Production Operations 5 ECTS Hybrid

Thesis

- Applied Research Dissertation 85 ECTS Industry-based
- Scientific Dissemination 5 ECTS Industry-based

Research Management Modules

- Research Integrity 5 ECTS Online
- Research Methodologies 5 ECTS Online

Core Technical Modules and Elective Modules are available to attend as stand-alone accredited modules, also known as micro-credentials. Micro-credentials are small, accredited courses designed to meet the demands of learners, enterprise and organisations, which offer a highly flexible, bite sized and accessible way of upskilling and reskilling.

** Electives: Choice subject to availability and prioritised relevance to research topic. Additional elective courses may also be available from cognate masters' and PhD programmes in TUS and RUN-EU.*

CERTIFICATION

Industry-based over 2 years MSc Research Degree Award with potential for progression to PhD
NFQ Level 9 - 120 credits

PROGRAMME COSTS

This programme is co-funded by the Government of Ireland, the European Union, and network companies. Please see IrishMedtechSkillnet.ie for latest schedule and pricing.

DELIVERY

The delivery of the programme will be through scheduled Bootcamps and Workshops, and online through the Institutes Virtual Learning Environment (Moodle), and is assessed through project work and completion of the Applied Research Dissertation.

On-campus Time: The structured elements require attendance in-person of up to 24 days over the two years structured into four Bootcamps (4 days, Wed-Sat) and four Workshops (2 days – Fri-Sat). The in-person bootcamps and workshops promote peer-to-peer exchange of knowledge and build the Learners' professional network. Regular online tutorials will ensure continuous contact with the academic staff. The learner effort over the two years is estimated at approximately 15% of their working commitment, thus strong employer and management support for the learner is vital, as is the relevance and potential value of the Applied Research Project to the host enterprise.



CORE LEARNING**Data Analytics & Machine Learning:**

This module will review the application of statistics and experimental design to applications in industry. The aim of the module is to enable the learner to program statistical, and in particular, machine learning applications, based on manufacturing data sets, using standard mathematical tools.

Database Design & Data Visualisation:

This module adopts an applied learning approach to identify opportunities and work with data through the lens of the relational database model. The aim of this module is to enable the learner to interface with standard industrial systems and collect and interpret datasets for data-driven intelligence. Therefore learners will acquire the skills necessary to design and develop database systems, collect, clean, visualise and interpret data rooted in best data analysis practice.

Cyber-Physical Systems & IoT:

This module adopts an applied learning approach to understanding embedded systems, the Internet-of-things (IoT) and the cyber-physical systems (sensors, control boards) necessary for data acquisition in industrial environments. The aim of this module is to enable the learner to programme standard ICT Boards, I/O, sensors and gateways in order to collect time-series data streams. Furthermore, the application of data stream analysis at the Board/Gateway level (edge computing) will be explored.

Applied Research Dissertation:

The learner is expected to apply an innovative approach to a complex problem while collaborating with an industrial partner in a professional manner. The applied research project will require the completion of a comprehensive range of relevant elements, including; a review of existing knowledge, the evaluation of change requirements, the definition and analysis of a manufacturing digitalisation problem in industry, the design, planning and/or implementation of a solution within a constrained schedule and budget, appropriate consideration of social and ethical norms, the validation of performance (value engineering) and the dissemination of the project's results and impacts. The applied research project will be self-directed by the Learner, supported by an industry mentor and academic supervisor.

Research Management Modules:

These modules aim to provide students with the fundamental skills to scope out a suitable research project, to carry out the research work and to produce and present scientific and technical outcomes, within the principles of integrity, ethics, data management and good scientific research practices.

SCHEDULE OF DELIVERY

Semester 1

- Cyber-Physical Systems & IoT *
- Database Design & Data Visualisation *

Semester 2

- Data Analytics & Machine Learning *
- Elective 1 *
- Research Integrity

Semester 3

- Applied Research Dissertation
- Research Methodologies

Semester 4

- Applied Research Dissertation
- Scientific Dissemination

* **Core Technical Modules and Elective Modules are also available to attend as stand-alone accredited modules**



MODULE TITLE**APPLIED RESEARCH DISSERTATION (THESIS)****MODULE CREDITS**

85 ECTS

MODULE LEVEL

Level 9

**MODULE
DESCRIPTION**

The learner is expected to apply an innovative approach to a complex problem while collaborating with an industrial partner in a professional manner.

On completion of this module the learner will/should be able to;

**MODULE LEARNING
OUTCOMES**

1. Identify the nature, size and scope of a problem and define appropriate methods for solving the problem.
2. Identify suitable information sources and integrate existing knowledge and practice in the identification of a solution.
3. Design and plan the implementation of a relevant industrybased solution with the minimum of guidance and support.
4. Practice and integrate effectively in an industrial work context, operating effectively with colleagues.
5. Reflect and report on relevant work activities, training and personnel development in professional practice.
6. Describe the relevant regulatory, ethical and social requirements and impacts of the proposed solution.
7. Maintain a personal diary to track progress, problems and issues that arise in the project.
8. Prepare a dissertation on the industry based project in accordance with currently accepted standards and assimilate and adopt feedback from the academic supervisors and industrial mentors.
9. Summarise, prepare, communicate and defend (in written and oral form) the outcome of the applied research project, while cognisant of issues of plagiarism, confidentiality, data protection, and other ethical issues.



MODULE TITLE		SCIENTIFIC DISSEMINATION (THESIS)
MODULE CREDITS	5 ECTS	
MODULE LEVEL	Level 9	
MODULE DESCRIPTION	The learner is expected to disseminate their research work in an appropriate format, which may include, an industry-case study, critical review or research results, suitable for publication in a conference or journal proceedings.	
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Identify the nature, size, scope and context of a relevant industry use case. 2. Synthesize, reference and critically review the background scientific and industrial literature relevant to the specific research domain. 3. Analyse a specific scientific or technical use-case, establishing an appropriate quantification of the problem statement and existing benchmarks. 4. Propose appropriate methods for solving the problem and assess the potential industry impacts 5. Present and discuss the research innovation and or workplan in an appropriate peer forum, including dissemination in appropriate conferences, seminars and workshops. 	
ASSESSMENT	100% Continuous Assessment	

MODULE TITLE		CYBER-PHYSICAL SYSTEMS & IOT (CORE TECHNICAL MODULE)
MODULE CREDITS	5 ECTS	
MODULE LEVEL	As a core technical module of Level 9 Masters in Digitalisation of Manufacturing, or as a stand-alone accredited training programme (Micro-credential).	
MODULE DESCRIPTION	This module adopts an applied learning approach to understanding embedded systems, the Internet-of-things (IoT) and the cyber-physical systems (sensors, control boards) necessary for data acquisition in industrial environments. The aim of this module is to enable the learner to programme standard ICT Boards, I/O, sensors and gateways in order to collect time-series data streams. Furthermore, the application of data stream analysis at the Board/Gateway level (edge computing) will be explored.	
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Analyse the application of cyber-physical systems, the Internet of Things and industrial networks in a relevant industrial context. 2. Specify and configure a suitable distributed embedded system for a data acquisition application in industry. 3. Program an application to acquire and log time-series data streams, with appropriate time-stamps, data cleansing and formatting. 4. Program an edge based data analysis algorithm to provide condensed information for transfer. 5. Implement an application to capture and analyse relevant real-time industry data relevant to the learners practice. 	
ASSESSMENT	100% Continuous Assessment	

MODULE TITLE	DATABASE DESIGN & DATA VISUALISATION (CORE TECHNICAL MODULE)
MODULE CREDITS	5 ECTS
MODULE LEVEL	As a core technical module of Level 9 Masters in Digitalisation of Manufacturing, or as a stand-alone accredited training programme (Micro-credential).
MODULE DESCRIPTION	This module adopts an applied learning approach to identify opportunities and work with data through the lens of the relational database model. The aim of this module is to enable the learner to interface with standard industrial systems and collect and interpret datasets for data-driven intelligence. Therefore learners will acquire the skills necessary to design and develop database systems, collect, clean, visualise and interpret data rooted in best data analysis practice.
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Analyse the application of database technologies and data visualisation in a relevant industrial context. 2. Design a database application, including data schemas and data repositories, to capture and store appropriate data streams. 3. Collect, clean, structure and transform raw data from industry systems into data repositories. 4. Implement the data definition, data manipulation and data control language components of Structured Query Language in an open source relational database implementation. 5. Represent patterns, trends and correlations through appropriate data visualisation techniques, relevant to the learners industrial practice.
ASSESSMENT	100% Continuous Assessment

MODULE TITLE	DATA ANALYTICS & MACHINE LEARNING (CORE TECHNICAL MODULE)
MODULE CREDITS	5 ECTS
MODULE LEVEL	As a core technical module of Level 9 Masters in Digitalisation of Manufacturing, or as a stand-alone accredited training programme (Micro-credential).
MODULE DESCRIPTION	This module will review the application of statistics and experimental design to applications in industry. The aim of the module is to enable the learner to program statistical, and in particular, machine learning (ML) and artificial intelligence (AI) applications, based on industrial data sets using standard mathematical tools.
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Analyse the application of computational intelligence to decision-making problems in a relevant industrial context. 2. Design an experiment to generate suitable datasets and apply statistical inference to extract valuable information. 3. Program a statistical software tool to perform time series analysis and forecasting. 4. Investigate approaches to machine learning and select and develop appropriate algorithms for a specific data stream. 5. Implement a data analytics application for decision support on an empirical data stream situated in an industrial context, relevant to the learners industrial practice.
ASSESSMENT	100% Continuous Assessment

MODULE TITLE	
INTEGRATED DATABASE SYSTEMS (ELECTIVE)	
MODULE CREDITS	5 ECTS
MODULE LEVEL	As an elective module of Level 9 Masters in Digitalisation of Manufacturing, or a stand-alone accredited training programme (Micro-credential).
MODULE DESCRIPTION	This module adopts an applied learning approach to working with data integrated across a range of industrial systems, databases, data historians and controllers. The aim of this module is to enable the learner to interface with distributed industrial systems and collect, store and interpret datasets based at the edge, locally, remotely or on the cloud. Considerations of best practice in data security, protection, data sharing through supply-chains and data archives will be explored.
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Analyse the flow of data between systems and layers, internal or external, in a relevant industrial context. 2. Design an integrated database application drawing multiple data streams from a range of industry standard sources. 3. Capture, store and analyse an appropriate data stream on a cloud application and infrastructure. 4. Implement a data sharing application, with appropriate protection, to provided standardised information across a supply chain or network. 5. Investigate the long-term archival of industrial data and information, relevant to the learners industrial practice.
ASSESSMENT	100% Continuous Assessment

MODULE TITLE	
MANUFACTURING AUTOMATION & ROBOTICS (ELECTIVE)	
MODULE CREDITS	5 ECTS
MODULE LEVEL	As an elective module of Level 9 Masters in Digitalisation of Manufacturing, or a stand-alone accredited training programme (Micro-credential).
MODULE DESCRIPTION	This module adopts an applied learning approach to understanding the application of automation systems, Programmable Logic Controllers (PLCs), Robotics, Drives and Motors in manufacturing environments. The aim of this module is to enable the learner to programme an industrial control system for reliable data acquisition and storage. Furthermore, the application of control system hierarchies and data exchange with Vision and Robotics Systems will be explored.
MODULE LEARNING OUTCOMES	<p><i>On completion of this module the learner will/should be able to;</i></p> <ol style="list-style-type: none"> 1. Analyse the application of industrial controls, motive power application and automation in a relevant industrial context. 2. Configure a distributed industrial control architecture with PLCs, Remote I/O, Drive Controllers and intelligent edge devices. 3. Programme an Industrial PLC to acquire digital and analog data and to log the data in an appropriate data historian. 4. Discuss the application of Robotics and industrial vision systems to manufacturing and industrial applications. 5. Integrate industrial data in an industry-standard data sharing standard or protocol, relevant to the learners practice.
ASSESSMENT	100% Continuous Assessment

MODULE TITLE		DIGITAL TWINS IN PRODUCTION OPERATIONS (ELECTIVE)
MODULE CREDITS	5 ECTS	
MODULE LEVEL	As an elective module of Level 9 Masters in Digitalisation of Manufacturing, or a stand-alone accredited training programme (Micro-credential).	
MODULE DESCRIPTION	<p>This module will investigate the increasing digitalisation of manufacturing, from advanced product design to production process models and the use of visualisation techniques in manufacturing support. The relevant value and application of Design Tools, Digital Twins, Simulation Models, and Augmented Reality/Virtual Reality, will be investigated.</p> <p><i>On completion of this module the learner will/should be able to;</i></p>	
MODULE LEARNING OUTCOMES	<ol style="list-style-type: none"> 1. Analyse the application of digital product design to reduce costs and increase throughput in a relevant industrial context. 2. Develop a model simulation of a production process, addressing aspects of optimisation, capacity expansion and what-if scenarios. 3. Analyse the application of a Digital Twin Design approach to improving the re-configurability of a production process. 4. Review the technologies associated with visualisation of industrial processes and discuss their relevance and effectiveness in manufacturing. 5. Evaluate, the impacts (qualitatively and quantitatively) of a manufacturing digitalisation initiative in relation to standard industry benchmarks. 	
ASSESSMENT	100% Continuous Assessment	

MODULE TITLE		RESEARCH INTEGRITY (RESEARCH MANAGEMENT MODULE)
MODULE CREDITS	5 ECTS	
MODULE LEVEL	Level 9	
MODULE DESCRIPTION	<p>This module will provide the Learner with the necessary information to enable them to behave responsibly throughout the research process. The module provides input about appropriate research management and maintaining integrity throughout the research process from the planning stages, including data collection through to compilation and dissemination of results. Topics such as: authorship and plagiarism, proper data management and storage, intellectual property, and ethical responsibilities are addressed.</p> <p><i>On completion of this module the learner will/should be able to;</i></p>	
MODULE LEARNING OUTCOMES	<ol style="list-style-type: none"> 1. Critically appraise the ethical challenges which may arise for the Learner while conducting a research project. 2. Critically reflect on strategies for dealing with complex technical and scientific environments, research data considerations, and data acquisition challenges. 3. Critically discuss local and professional policies and guidelines surrounding research integrity. 4. Demonstrate the skills necessary to recognise research misconduct and explain the procedures to be followed when misconduct is evident. 5. Evaluate the appropriate data management, open access and open-source approaches for research data management. 	
ASSESSMENT	100% Continuous Assessment	

MODULE TITLE**RESEARCH METHODOLOGIES (RESEARCH MANAGEMENT MODULE)****MODULE CREDITS**

5 ECTS

MODULE LEVEL

Level 9

**MODULE
DESCRIPTION**

This module introduces the Learners to the value of research-led innovation, and to a range of methods applicable to the professional application of research. These methods will equip students with effective critical, theoretical and analytical skills while also selecting appropriate methodologies as relevant to an identified research question.

**MODULE LEARNING
OUTCOMES**

On completion of this module the learner will/should be able to;

1. Demonstrate knowledge of relevant literature and research methodologies as applicable to the relevant research interests, and complete a structured review of prior research.
2. Evaluate a range of conceptual frameworks, with a clear rationale of their application to an identified research question/hypothesis, and in relation to broad philosophical worldviews.
3. Outline the tenets or assumptions of a paradigm and critically discuss the underlying assumptions of each paradigm.
4. Identify appropriate research methodologies, methods, and designs, for a specific research interest.
5. Extrapolate a suitable research plan with a critical reflection, structured literature review, project scope and reporting requirement for a specific research project.

ASSESSMENT

100% Continuous Assessment



Irish
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Transformative Training Solutions for the Medtech Sector





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Irish Medtech is a business sector within Ibec