CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Report of Validation Panel
for a Special Purpose, Minor or Supplemental Award

Date of Meeting: June 11th 2019

Named Award:	Certificate
Programme Title:	Certificate in Intelligent Manufacturing Systems
Award Type:	Special Purpose Award
NFQ Level:	9
Intakes Commencing:	September 2019
ECTS/ACCS Credits:	30

PANEL MEMBERS

Name / Function / External Institution OR CIT Academic Unit
Michael Guilfoyle, Pilz
Brenda Cooper, Horner APG
Ian O'Malley, Stryker
Dr. Gearóid Ó Súilleabhan, Technology Enhanced Learning, CIT (Chairperson)

PROPOSING TEAM MEMBERS

Name / Function / Academic Unit
Matt Cotterell, Head of School, School of Mechanical and Process Engineering
Dr Donna O'Shea, Head of Department (Acting), Department of Computer Science
Tim Horgan, Head of School (Acting), School of Science and Informatics
Professor Ger Kelly, Head of Department, Department of Mechanical, Biomedical, and Manufacturing Engineering
Dr Ken Bruton, Lecturer, Department of Mechanical, Biomedical, and Manufacturing Engineering
Dr Seán Lacey, Lecturer, Department of Mathematics
Dr Sean McSweeney, Lecturer, Department of Computer Science
Dr Daithi Moore, Lecturer, Department of Mechanical, Biomedical, and Manufacturing Engineering
Dr Haithem Afli, Lecturer, Department of Computer Science

BACKGROUND TO THE PROPOSED PROGRAMME

The Certificate in Intelligent Manufacturing Systems is a 30 credit special purpose award at programme level 9 which bridges the gap between the engineering operations and information technology paradigms in the manufacturing sector. Smart Manufacturing has been described as the synthesis of advanced manufacturing capabilities and digital technologies to produce highly customizable products faster, cheaper, better, and greener. A smart factory will integrate data from system-wide physical, operational, and human assets to drive manufacturing, maintenance, inventory tracking & the digitisation of operations in order to achieve this goal. The result will be more efficient and agile systems with less production downtime, and a greater ability to predict and adjust to changes in the facility or broader network leading to better positioning in the marketplace. Traditional job roles will be realigned in this context and will support new processes and functions in this merged area. New roles with new capabilities such as virtual or augmented reality and data extraction, organisation, analysis and visualization will also be required along with an agile and adaptive change management plan which ensures that employees are trained in the ever evolving new skills which will be needed to deliver these aspirations.

The programme has been specifically designed in response to industry needs for upskilling as identified by the South West Regional Skills Forum (SWRSF). The Regional Skills Forum is a Department of Education & Skills initiative bringing employers (60 companies) and education and training providers together to collaboratively develop skills across the South-West region. A key output from this forum specifically in connection with the Industry 4.0 skills competency matrix is that all functional roles (e.g. Engineering, technician, science, quality, regulatory, IT, data science) are undergoing continual evolution, driven by the new and emerging technologies. The primary evolving and emerging skillsets include Internet of Things (IoT) systems development and Integration, machine learning, data management and advanced analytics, Instrument/ sensor design, electromechanical, process optimisation and quality systems design. The programme will be delivered in a fully online mode over two semesters.

The programme is a 30 credit special purpose award comprised of 4 modules spread over 2 semesters with 15 credits delivered each semester. Each semester is comprised of two modules a 5 credit module and a 10 credit module as outlined in the table below.

Semester	Module	Credits
1	Automation with Python	5
1	Industrial Data Analysis	10

Semester	Module	Credits
2	Robotics & Autonomous Systems	5
2	Machine Prognostics	10

FINDINGS OF THE PANEL

*NOTE: In this report, the term "**Requirement**" is used to indicate an action or amendment which in the view of the Panel **must** be undertaken prior to validation and commencement of the Programme. The term "**Recommendation**" indicates an item which the Course Board (or other relevant Institute unit) should implement at the earliest stage possible, and appropriate implementation of which should be the subject of ongoing monitoring.*

On consideration of the documentation provided and discussion of the programme with the proposers, the Panel has arrived at the following Findings, Requirements and Recommendations:

## 1.	Validation Criteria

### 1.1	Is there a convincing need for the programme with a viable level of applications?

Overall Finding: Yes

Finding(s): The programme has already received approval for Springboard upskilling funding for up to 40 students for coming academic year 2019/20. The programme has also been developed in response industry needs for upskilling as identified by the South West Regional Skills Forum (SWRSF). Well placed industry panel members on the day from Pilz, Stryker, and Horner APG were able to confirm the need for and value of the programme to the workplace.

Requirement(s): None

Recommendation(s): The panel welcomed plans to develop a full masters degree in the area and felt that this larger programme would also address a skills and qualification need in the manufacturing workplace. The panel encourage the department to follow up on such plans and hope that such plans will find the support of the institute and its management.

### 1.2	Are the level and type of the proposed award appropriate?

Overall Finding: Yes

Finding(s): The panel found the proposed programme to be at the appropriate level with the appropriate number of credits for its scope and overall aim.

Requirement(s): None

Recommendation(s): None.

### 1.3	Is the learning experience of an appropriate level, standard and quality?

Overall Finding: Yes

Finding(s): The panel commend the relevance, standard and quality of the programme. The Certificate in Intelligent Manufacturing Systems represents a well-integrated balance of theory and practice combined with flexible online delivery and support to offer a coherent, workplace-relevant and educationally effective blended learning experience. Modules complement each other well and are well sequenced. The panel are satisfied the student learning experience can be supposed through CIT's existing model of online learning and its related e-learning infrastructure which provides for live learning, asynchronous communication, online assessment, virtual desktops etc.

Requirement(s): None

Recommendation(s): The panel note the predominance across all modules of Project as an assessment method. The assessment choice has good validity with the learning goals of the relevant modules and the programme as a whole but it recommended that the programme team try to ensure good variability in the operationalisation of so many projects across the duration of the programme. It is also recommended that the programme team look for opportunities for either a group project or group-based learning experiences associated with project assessment (e.g., group presentations, peer assessment, online discussion groups etc).

Other: Module specific commendations and recommendations below.

Module: Automation with Python

Commendation: Use of Python was agreed by the panel to represent a good focus as a universal language for analytics and machine learning (by contrast to, e.g., RStudio) though other languages are used on the ground in industry.

Recommendation: It was noted that each of the module's 5 learning outcomes is assessed once only. The panel suggest – but do not prescribe – that providing additional opportunities for students to evidence learning outcomes might represent a more optimal and reliable assessment regime for the module.

Module: Industrial Data Analysis

Commendation: The panel commend the focus in the module on concision and clear communication of statistical findings in a practical context.

Recommendation: The panel suggest that box plots, x-bar charts and other control charts be added to the indicative content for the module.

Module: Robotics & Autonomous Systems

Commendation: Although the module is already approved and delivered as part of CIT's Master of Science in Artificial Intelligence the panel felt it articulated well with the needs and other modules of the certificate.

Recommendation: The indicative content suggests a heavy emphasis on robotics as an application context for reinforcement learning. The panel suggests that in the module's delivery as part of the Certificate in Intelligent Manufacturing Systems other autonomous systems and applications be referenced also.

Module: Machine Prognostics

Commendation: The module is a very comprehensive and up-to-date level 9 introduction to prognostics and health monitoring (PHM) techniques and methodologies which aligns well with the philosophy of the programme in its emphasis on more intelligent and efficient approaches to manufacturing practice and systems.

Recommendation: The alignment of the final project and presentation should be made explicit in the breakdown of coursework.

Recommendation: It is advised that OEE (Overall Equipment effectiveness) and SPC (Statistical process control) be included as part of the Indicative Content for the module.

1.4 Is the programme structure logical and well designed (including procedures for access, transfer and progression)?

Overall Finding: Yes

Finding(s): The programme team have given a lot of thought to entry requirements and the entry process. The panel welcome their thoughts and ideas as well as the clarification that candidates will be screened to ensure their readiness for this challenging programme of study. The panel were also pleased to hear there have already been a number of significant queries in respect of a planned September start date.

Requirement(s): None

Recommendation(s): That the programme team would consider the type and level of experience of applicants as well as their original undergraduate qualifications. An interview process or similar is recommended for all applicants to ensure their readiness to undertake the programme.

1.5   Are the programme management structures adequate?

Overall Finding: Yes

Finding(s): The panel were reassured by details of the management structures and QA processes in place for this and other programmes in the department and institute. The model of distance online learning in CIT was furthermore thought to be one capable of supporting the kind of delivery, interaction and student experience envisaged in the design and development of the programme.

The programme will be hosted in the Department of Mechanical, Biomedical, and Manufacturing Engineering and run through the CAMMS (Centre for Advanced Manufacturing and Management Systems) a specialised CPD centre within the school which has a dedicated expertise in managing education programmes for industry-based professionals. It is thought the new programme will sit well with its current offerings in areas such as Lean Sigma, Project Management, Automation & Control, Manufacturing and Biomedical Engineering.

Requirement(s): None.

Recommendation(s): None.

1.6   Are the resource requirements reasonable?

Overall Finding: Yes

Finding(s): The programme is funded under the Springboard+ Upskilling initiative which will cover 90% of fees for up to 40 students in the initial delivery of the programme. As such no detailed costings were provided or necessary. The Panel was otherwise assured that appropriate resources in terms of staffing and facilities will be put in place when the programme is validated.

Requirement(s):

Recommendation(s):

1.7   Will the impact of the programme on the Institute be positive?

Overall Finding: Yes

Finding(s): The panel are assured the programme will have a positive impact on the Institute in terms, inter alia, of: the multidisciplinary nature of the programme which brings together a number of different individuals and departments from across the institute; the further development and confirmation of intelligent manufacturing, artificial intelligence and data analytics as core competences in the institute; the offering of an innovative level 9 online course in a topical and ever-growing field where CIT has "first mover advantage"; the linkages with industry including those industries represented on the panel on the day; the potential for further granular offerings in the area and, in time, a full masters degree and a potential stream as part of undergraduate offerings.

Requirement(s): None

Recommendation(s): None

CONCLUSION

Based on the above findings, the Panel recommends to Academic Council that the Programme be validated for five academic years, or until the next programmatic review, whichever is soonest, subject to implementation of the Requirements above, and with due regard to the Recommendations made.

Departmental response to Panel recommendations

Panel recommendations	Departmental Response
The panel welcomed plans to develop a full masters degree in the area and felt that this larger programme would also address a skills and qualification need in the manufacturing workplace. The panel encourage the department to follow up on such plans and hope that such plans will find the support of the institute and its Management.	The proposing department and programme team are committed to develop a full masters degree in this area.
The panel note the predominance across all modules of Project as an assessment method. The assessment choice has good validity with the learning goals of the relevant modules and the programme as a whole but it recommended that the programme team try to ensure good variability in the operationalisation of so many projects across the duration of the programme. It is also recommended that the programme team look for opportunities for either a group project or group-based learning experiences associated with project assessment (e.g., group presentations, peer assessment, online discussion groups etc	The proposing team will review the project based assessments to ensure variability and team based learning where appropriate.
That the programme team would consider the type and level of experience of applicants as well as their original undergraduate qualifications. An interview process or similar is recommended for all applicants to ensure their readiness to undertake the programme.	The admissions processes will be coordinated through the CAMMS centre who have extensive experience in managing diverse programme intakes.
Module Specific Recommendations	
Automation with Python: It was noted that each of the module's 5 learning outcomes is assessed once only. The panel suggest – but do not prescribe – that providing additional opportunities for students to evidence learning outcomes might represent a more optimal and reliable assessment regime for the module.	The module author will revise the assessment strategy for this module.
Industrial Data Analysis: The panel suggest that box plots, x-bar charts and other control charts be added to the indicative content for the module.	The proposing team will implement the suggested changes
Robotics and Autonomous systems: The indicative content suggests a heavy emphasis on robotics as an application context for reinforcement learning. The panel suggests that in the module's delivery as part of the Certificate in Intelligent Manufacturing Systems other autonomous systems and applications be referenced also.	The proposing team will implement the suggested changes in the relevant module.
Machine Prognostics: The alignment of the final project and presentation should be made explicit in the breakdown of coursework.	The proposing team will implement the suggested changes in the relevant module.
Machine Prognostics: It is advised that OEE (Overall Equipment effectiveness) and SPC (Statistical process control) be included as part of the Indicative Content for the module.	The proposing team will implement the suggested changes in the relevant module.