



## NEWSLETTER

### ISSUE 1

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# Intelligent Control of Interconnected Manufacturing Infrastructures (i-CNC)

Developed under the Trials Net Open Call

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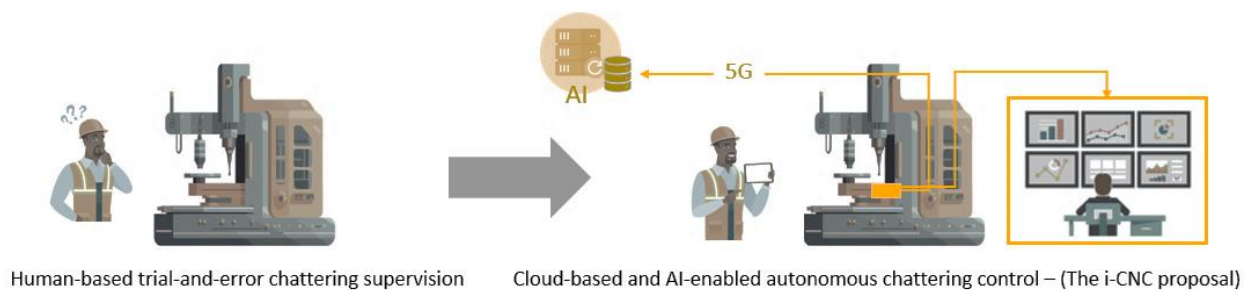
**SECTION 1: OVERVIEW OF CNC MACHINING AND KEY CHALLENGES**

**CNC**, stands for Computer Numerical Control; meaning that the movement of a machine tool is conducted through pre-programmed computer software. These CNC machines utilize tools usually in two to five axis configurations with high precision allowing the transformation of raw materials into finished products. Nowadays, Computer Aided Design (CAD) programs and Computer Aided Manufacturing (CAM), support the generation of the digital instructions needed for the CNC machining processes.

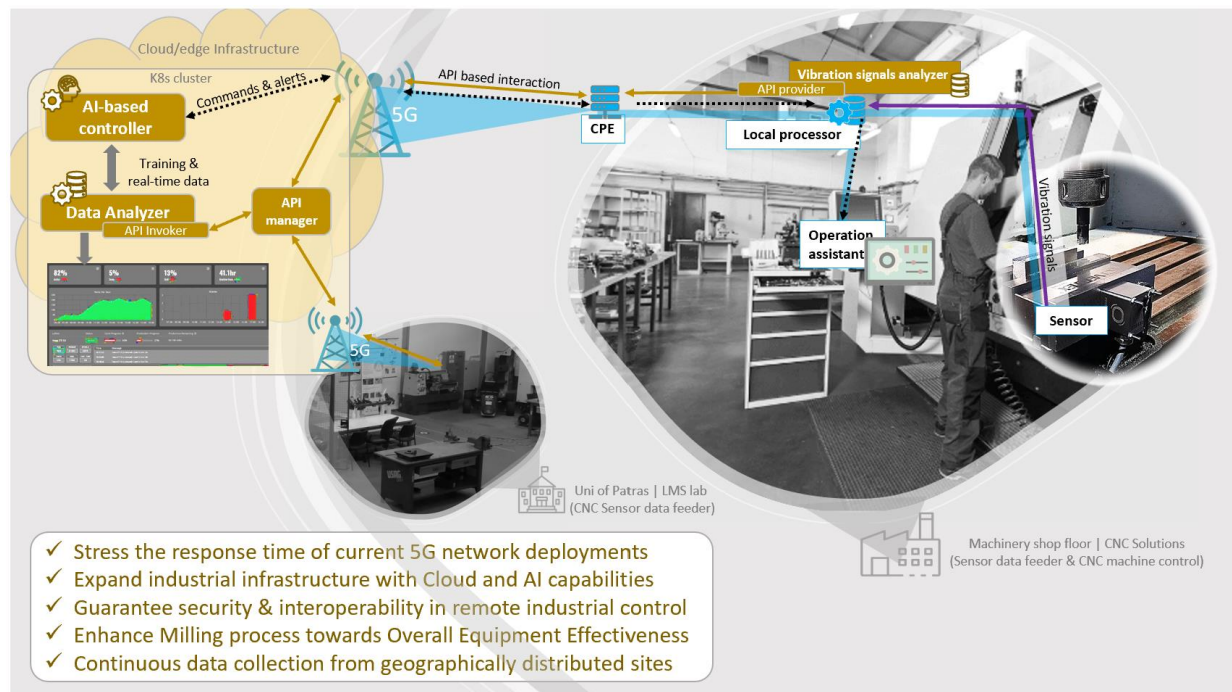


**CNC Milling:** There are three cutting technologies in CNC machining, namely drill-based, lathe-based and milling. Among them, milling has been the leading approach, since it provides exceptional flexibility, accuracy, and scalability for multitude of products in terms of geometry, materials, and sizes. Already, milling machine tools have evolved to provide more accurate and productive solutions for manufacturers.

**The Challenge of Chatter in CNC Milling:** During the CNC milling process the Chattering problem has been considered as one of the most challenging ones. “Chatter” is defined as an uncontrollable and unattenuated vibration that results in large oscillations between the workpiece and the cutting tool. It has a detrimental effect on the surface and quality of the workpiece, as well as in the health and lifetime of the machine tool components. There are multiple yet conventional and based-on-experience methods to reduce chattering, including the appropriate tool selection, workpiece adjustment, as well as machine set-up and use. However, those manual and trial-and-error approaches are not sufficient for addressing chattering in modern high-demanding machinery.



## SECTION 2: INTRODUCING THE I-CNC USE CASE



The i-CNC use case focuses on improving CNC milling by addressing the chatter problem through an end-to-end solution that replaces traditional chatter observation procedure with a cloud-based, AI-enabled monitoring system. This approach offers a non-invasive to existing infrastructures and reliable chatter detection procedure, assisting in cutting down on wasted material and downtime. The key principles of i-CNC use case:

- **5G Connectivity:** Ensures fast, reliable data transfer between geographically distributed operations.
- **AI-Powered Data Analysis:** Vibration signals are processed and classified using AI-based algorithm to predict chatter occurrence in real time.
- **Cloud-Based Scalability:** Cloud service provisioning enables scalable, remote decision-making applications, reducing the need for costly local setups.
- **Security and Interoperability:** The platform complies with industry standards for secure data exchange, ensuring compatibility across different systems.
- **Continuous Data Collection:** Distributed sites continuously contribute data for long-term analysis, supported by the CNC training center and HTEC Network.

## SECTION 3: PROJECT MILESTONES: WHERE WE STAND

During the reference period, our focus has been on tasks related to **Design, Deployment, and System Installation**. In this phase, the key objectives accomplished across the following tasks include:

- ✓ **Architectural Design and Implementation:** We have completed the initial core architectural framework and chosen technologies, establishing a solid foundation for future progress.
- ✓ **Hardware Integration:** We have integrated the required 5G network routers, sensors and data acquisition systems which are currently being tested.
- ✓ **Platform Software Development:** We have established the initial designed of key components, such as the API manager, cloud infrastructure, and essential services. The next phase is moving into development.
- ✓ **Application Software Development:** We currently developing the required functionalities and addressing the relative challenges to enable the AI-based chatter prediction in a 5G environment. Next steps involve the final deployment of the application.
- ✓ **End-to-End Data Collection, Testing, and KPI Analysis:** We have already conducted a KPI analysis, and we are in progress, with data collection and testing.



Figure 1: Alex Kakyris (FOGUS) at CNC solutions shop floor during the initial network integration activities

All these actions and steps have been systematically documented and shared with the TrialsNet project.

## SECTION 4: MEET OUR PROJECT PARTNERS

This project is a collaborative effort involving three key partners, each bringing their own expertise and experience:

**CNC Solutions:** CNC Solutions is a manufacturing company of metal components and spare parts of high precision and complexity, running for more than 20 years. During the last years CNC Solutions has realized significant investments on new contemporary high-tech CNC tool machines, on application of business software ERP system SAP, on creation of a fully equipped production control department, and on creation of a pioneering and contemporary CNC Training Center under the highest global standards. CNC Solutions satisfies the CNC manufacturing needs of many branded and extrovert companies in Greece and abroad, from various industrial sectors, such as defense, shipping, medical equipment, high-tech industries, pharmaceuticals and others. In the context of the iCNC/TrialsNet project, CNC Solutions provides CNC machines from its production line for the realization of the proposed use case, while the facilities of the Training Center will support related outreach activities and long-term knowledge transfer.

**Fogus Innovations & Services:** FOGUS Innovations & Services P.C. is a thriving SME in Greece specializing in integrating state-of-the-art technological advancements and cutting-edge research in ICT systems. Being a member of 3GPP, ETSI, SNS-IA and ELEVATE Greece, as well as a founding member of ETSI SDG OpenCAPIF, FOGUS has become integral part of the 5G/6G R&D community in Europe. The company brings to research and innovation projects vast experience in experimentation processes and performance analysis, while it holds its own networks and compute experimentation platform for IoT and 5G use cases. Committed to open science and sustainable development, FOGUS is an active partner in open source and collaborative projects. In the context of the iCNC/TrialsNet project, the key role of FOGUS is to support the evolution of the network deployment and monitoring aspects towards achieving the project objectives and evaluating the related KPIs.

**Laboratory for Manufacturing Systems & Automation, University of Patras:** The Laboratory for Manufacturing Systems and Automation (LMS) is focused on research and development in cutting edge scientific and technological fields. LMS is involved in a number of research projects funded by the CEU and European industrial partners. LMS is organized thematically into three groups, dealing with Research & Innovation, as well as with technology development. The Manufacturing Processes group investigates the use of one or more physical mechanisms to transform a material's shape and/or form towards the manufacturing of a final part. The Robotics and Automation group investigates new mechanics and control software to advance the design and operation of Flexible Manufacturing Systems. The Manufacturing Systems group is focused on the development, software implementation and use of advanced tools based on Artificial Intelligence methods for production systems planning & control and for the development of intelligent Internet-based applications addressing the enterprise-wide business activities. Particular emphasis is given to the co-operation with the European industry as well as with a number of "hi-tech" firms.

