<table>
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<tr>
<th>Topic</th>
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<tr>
<td>A</td>
<td>Measurement of the thermal efficiency/performance of a Tunnel Baking Oven for Bread</td>
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<tr>
<td>B</td>
<td>Development of Innovative Heat Exchanger</td>
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<td>C</td>
<td>Low-latency audio streaming over 5G networks</td>
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<tr>
<td>D</td>
<td>Innovative Machine Learning Methods for Wastewater Plant Monitoring</td>
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<td>E</td>
<td>Data-driven Marketing and Digital Strategy: AI-based energy consumption analysis methods and algorithms for energy efficiency and creation of added value for the services market</td>
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<tr>
<td>F</td>
<td>ML-driven data transformation for renewable power generation data model</td>
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<td>G</td>
<td>Ontology-driven support to fault diagnosis of manufacturing machines based on service mail flows and repair records</td>
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<td>Application of natural language processing technologies to clinical cases - (additional, published on 21/08/2020)</td>
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<td>AE UV curable coating for piping</td>
<td>MPR s.r.l.</td>
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<tr>
<td>BE Artificial Intelligence for Clinical Decision Support</td>
<td>Exprivia S.p.A. and EIT Digital</td>
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<td>CE Clinical Natural Language Processing and Clinical Big Data</td>
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<td>DE Distributed Coordination and Collaboration Middleware for IoT</td>
<td>Airpim s.r.l.</td>
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<td>EE Edgergenius: delivering AI analytics in the fog for retail</td>
<td>Energenius s.r.l. and EIT Digital</td>
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<tr>
<td>FE Brain-Computer Interface - additional (published on 07/07/2020)</td>
<td>g.tec medical engineering GmbH and EIT Digital</td>
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<tr>
<td>GE Research on situation aware, dynamic authorization in automotive - additional (published on 20/07/2020)</td>
<td>Huawei Technology Duesseldorf GbmH</td>
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<td>HE Cooling theory for thermoplastic materials used in SEAM (Screw Extrusion Additive Manufacturing) (additional, published on 17/08/2020)</td>
<td>CMS S.p.A.</td>
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<tr>
<td>IE Deep Learning for Predictive Agronomics (additional, published on 02/09/2020)</td>
<td>ENOGIS s.r.l.</td>
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Scholarship A

<table>
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<tr>
<th>Topic</th>
<th>Measurement of the thermal efficiency/performance of a Tunnel Baking Oven for Bread</th>
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<tr>
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<td>University of Trento in collaboration with Alitech s.r.l.</td>
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<tr>
<td>Contacts</td>
<td>Maurizio Grigiante (UniTrento)</td>
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<tr>
<td></td>
<td>Luca Bortolotti (Alitech s.r.l.)</td>
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**Synthetic description of the activity and expected research outcome**

Tunnel Baking Ovens for bread have been widely used in the food industry since the 50s of last century. There are different technological variants of these tunnel Ovens depending on the baking technology/baking medium applied. In this Doctorate program we will focus on the “heated air circulation” technology (also known as cyclothermic variant) in which hot air is the baking medium.

Whereas on the one hand the attention on energy consumption and carbon footprint is increasing and is challenging our technical knowledge and life habits, on the other hand, the oven design in our industry has not changed accordingly; based on this reasoning we actually believe that in a relatively short time the “energy factor” will become an essential competitive edge and that the legislator will catch up and define an acceptable energy benchmark for the industry and the manufacturers.

This project is aimed at defining a thermodynamic model for an industrial baking oven in stable and standard baking conditions in order to quantify the energy consumption/efficiency of the oven; the values that result from this analysis can then be considered as an “energy certification” for this type of oven. The model will also allow us to identify critical points (energetic shortfalls) to be addressed in order to minimize the energy consumption i.e. optimize the thermal efficiency of the oven.

This process will proceed in stages: at first we will identify an operating oven and the student will be instructed about the operation of the oven (how it works) and about the baking process of the dough (how it works), he will then be able to define a mathematical model with all the relevant variables and measure these variables on the field on the operating oven. Once the Model is validated it will be possible to identify all critical energy points to be addressed in order to optimize the energetic efficiency.

The final and most relevant stage of this process will be the definition, using the thus validated and optimized Model, of an estimate of the energetic efficiency of the oven in terms of energy consumption (Kw) per kg of baked product in standard conditions. Once the model will be so characterized the results will be submitted to an independent certifying organism that will eventually issue an “energy certificate” that will “accompany” this type of oven.

**Required/Preferred Candidate Skills and Competencies:** the candidate is expected to have a Master Degree in Mechanical, Civil or Energy Engineering. A sound knowledge of thermodynamics (heat transmission, CFD analysis, psychrometry) and a good understanding of fluid-dynamics (CFD analysis, fluid movement) will complete the profile. Laboratory expertise (master thesis or traineeship) in industrial-applied thermodynamics is a plus. Proficiency in English is required. Knowledge of Italian is a plus.
### Scholarship B

<table>
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<tr>
<th>Topic</th>
<th>Development of Innovative Heat Exchanger</th>
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<tr>
<td></td>
<td>University of Trento in collaboration with DAV COIL s.r.l.</td>
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</tbody>
</table>
| Contacts | **Maurizio Grigiante** (UniTrento)  
**Mario Simone Lonardi** (DAV COIL s.r.l.) |

#### Synthetic description of the activity and expected research outcome

This project aims to the implementation of two heat exchanger categories which are different in application albeit similar in their aim: increasing performance for better efficiency and lower environmental impact of processes.

Pillow Plate Heat Exchangers (PPHE): more compact, lighter, and resistant, PPHE are an alternative to shell and tube and other classic designs in the heavy industrial field. Additive Manufacturing Heat Exchangers (AMHE): Additive Manufacturing allows to obtain otherwise impossible levels of performance in compact heat exchangers, through complex geometries and unprecedented shapes.

The main objective is to develop and validate design methods for PPHE and AMHE. The modelling and consequent understanding of increasingly complex thermo-fluid dynamics systems done in PPHE research and development, will lay the foundations for AMHE development. The following Research Methodologies will be carried out in synergy with the design and production company department to better finalize the expected outputs:

- Analysis of the state-of-art of existing PPHE modelling and design procedures.
- Study and modelling of the thermodynamics and fluids dynamics of the involved devices.
- Modelling of the studied devices using FEM-CFD software
- Validation of the modelling through experimental campaigns.
- Development of design methods from the results of validated simulations and discovered correlations.
- At the end of the project two distinct design methodologies will be obtained, both founded on the generalization of the studied behaviors and correlations. To better reach the aforementioned outcomes, the project will be divided in two steps, PPHE development and AMHE development, with the latter strongly based on the knowledge built in the former.

#### Required/Preferred Candidate Skills and Competencies:

The ideal candidate should prove sufficient knowledge in the industrial engineering field with attention to thermodynamic systems. A list of preferred candidate soft and hard skills follows:

- Strong attitude to problem solving and project management.
- Strong attitude to independent thinking and decision-making capabilities.
- Knowledge of modeling of thermodynamic systems.
- Knowledge of Heat Exchangers design.
- Knowledge of ANSYS software, in particular related to thermodynamics modeling.
- Knowledge in the Powder Metallurgy field.

Previous participation in the University Formula SAE team is regarded a plus.
Scholarship C

<table>
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<tr>
<th>Topic</th>
<th>Low-latency audio streaming over 5G networks</th>
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<tr>
<td>Department of Information Engineering and Computer Science - EIT Digital</td>
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</table>
| Contacts | Luca Turchet (UniTrento)  
                      Stefano Zambon (Elk) |

**Synthetic description of the activity and expected research outcome**

Today there is a growing need of musicians for playing together in real-time from different locations over the internet. However, current solutions are unable to meet the strict requirements of imperceivable latency and high audio quality capturing nuances of the execution. Auditory feedback for live music, professional audio and high-quality teleconferencing applications pose very strict requirements on both audio quality and, especially, transmission latency. This PhD work will focus on the development of low-latency, high-quality audio and data streaming applications designed for the new generation of 5G NR URLLC (New-Radio Ultra-Reliable Low-Latency Connection) networks. The successful candidate will investigate novel Machine Learning algorithms for Error Concealment for audio packets dropped during transmission.

Scholarship D

<table>
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<tr>
<th>Topic</th>
<th>Innovative Machine Learning Methods for Wastewater Plant Monitoring</th>
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<tr>
<td>University of Trento in collaboration with ETC sustainable solutions s.r.l.</td>
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</table>
| Contacts | Farid Melgani (UniTrento)  
                      Lorenzo Rizzoli (ETC sustainable solutions s.r.l.) |

**Synthetic description of the activity and expected research outcome**

The PhD proposal is a project linked to two worlds: green economy and machine learning. The aim is to optimize water treatment with the collection, validation and analysis of data from treatment plants, generating predictive models and promoting development based on sustainability, efficiency and circularity.

The PhD candidate will investigate anomaly-detection algorithms for wastewater plants, with a particular focus on analysis of data consistency and on creation of soft sensors, combining process expert-driven knowledge and data-driven models. The objective is to develop intelligent process automation software, moving from reactive solutions to predictive models.

The impact of this project is social, related to environmental improvement of rivers, sea and lakes, financial, due to direct reduction of energy consumption and environmental, improving the quality of water at national and potentially international level within developed countries.

The PhD candidate will develop a strong background in machine learning and statistics, as well as very practical engineering skills to handle data. The strict collaboration with ETC, will provide a very deep understanding of the major application case study, i.e. optimization of water and wastewater treatment plants.

**Required/Preferred Candidate Skills and Competencies:** deep passion for analytics and data science, environmental respect and optimization of processes. Preferable technical Master’s degree.
Scholarship E

| Topic | Data-driven Marketing and Digital Strategy: AI-based energy consumption analysis methods and algorithms for energy efficiency and creation of added value for the services market |

University of Trento in collaboration with Sinapsi s.r.l.

Contacts

Andrea Passerini (UniTrento)
Stefano Rotini (Sinapsi s.r.l.)

Synthetic description of the activity and expected research outcome

SINAPSI intends to start an Industrial PhD in order to develop a suite of analysis tools capable of creating added value from energy consumption profiling users. The latter are made aware of their own energy consumption thanks to the installation of the new OPEN METER 2G (second generation). This suite of tools must include a wide use of Artificial Intelligence and Machine Learning methodologies as well as the use of NILM (Non-Intrusive Load Monitoring) algorithms and validation systems such as Blockchains. The purpose of this suite of analysis tools is to offer services to the energy market that is moving towards flexible demand-response management. These services will produce a high value in energy efficiency as well as in the rationalization of the use of energy and will offer to the end-user awareness of his own energy consumption and suggest a model of virtuous behavior.

INNOVATIVE CONTENT

- The innovative content of this project consists in having available for the first time in the history of energy distribution, real-time data on the energy flows exchanged;
- To provide the possibility to end user to have knowledge and awareness of his consumption in real-time; information provided can't be obtained in other ways and in any case without the same precision and quality.
- The real-time availability of data on the energy flows exchanged will open the way for new applications such as integration with home automation systems in the field of energy efficiency and energy consumption monitoring, as well as dynamic energy performance of the building.

Required/Preferred Candidate Skills and Competencies: The skills in energy efficiency and electrical energy are welcome. As for IT knowledge, basic knowledge on Data Modeling, Relational databases, symbolic and machine learning AI techniques are required. Good knowledge of English and Italian languages is required.
Synthetic description of the activity and expected research outcome

In the energy sector, it is very common to use naming conventions to allow a consistent and harmonized designation of the information exchanged, allowing the efficient aggregation of data for all automation, control, analysis and business intelligence systems within the energy company. This means that every component of a generation plant is uniformly designated, following a structured and precise identification system, which constitutes the base for the coherent communication between all the actors involved during the entire life cycle of a generation plant, from basic and detail design to commissioning, operation, maintenance, monitoring and decommissioning. Such identification system is often based on existing norms, following standards produced by well-known organizations such as IEC and ISO. While using an identification system has proven to be a necessity, its application is often cumbersome and prone to errors, since each denomination is composed of a precise code made of a combination of letters and numbers, difficult to memorize and easily mixed up. Thus, technological support to deal with producing and using such information is required. This PhD position will be dedicated to creating machine learning algorithms to support the actors of the involved multiutility, cleaning the company’s dataset, while automatically (or semi-automatically) classifying the existing data according to the custom classification system already in use within the company. The Utility’s dataset will be applied both as an input and for the validation of the proposed algorithms. Other than machine learning technology, we also envision opportunities for the application of ontologies to assist in solving problems of semantic interoperability between the used norms, helping to improve the identification system that is currently applied.

The candidate will have the unique opportunity to explore different domains (Energy, Big Data and Machine Learning) being directly coached by very experienced teammates. The involved PhD will work in an international environment, collaborating also with Enel Green Power, one of the main Energy Utility with worldwide presence. The candidate will work mainly from the Rovereto’s premises but with opportunities to travel abroad.

**Required/Preferred Candidate Skills and Competencies:** the candidate should possess basic knowledge on Data Modeling, Relational and No-sql databases, symbolic and machine learning AI techniques. Basic programming skills (Python, JS frameworks, ...) would complete the profile. Proficiency in English is required, basic knowledge of Italian preferable.

The intellectual property of the research results that will derive from the activities carried out by the doctoral student and, in particular, the intellectual property relative to any developed products and/or services that the Company may market is owned by the Company.
### Scholarship G

<table>
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<tr>
<th>Topic</th>
<th>Ontology-driven support to fault diagnosis of manufacturing machines based on service mail flows and repair records</th>
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<td></td>
<td>University of Trento in collaboration with Consiglio Nazionale delle Ricerche (CNR) and Adige Sys S.p.A.</td>
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</table>
| Contacts | Stefano Borgo (CNR)  
Paolo Galvagnini (Adige Sys S.p.A.) |

**Synthetic description of the activity and expected research outcome**

This research work is the result of a joint investment of ISTC-CNR Laboratory for Applied Ontology and Adige SpA. Adige is a company of BLMGroup, an Italian leading industrial group producing high-end machines to work on metallic pipes and profiles by laser-cutting, sawing and bending. Adige is located in the province of Trento, the sister company AdigeSYS is also located in the province of Trento, and the headquarter of the group, BLM, is located in Lombardy. Working together with the company's maintenance experts, the PhD candidate is expected to do an ontological analysis of the maintenance process, focusing on the diagnosis of technical malfunctioning, and leveraging on knowledge to be extracted from service mail flows and repair records. The work will include the development of a repair and diagnosis ontology in the specific domain, and an analysis of the ways such ontology, properly integrated within the broader service management system, may reduce the costs and increase the quality of the diagnosis and repair process. On the scientific side, the candidate will learn how to model industrial scenarios (with a focus on maintenance) using rigorous ontological methodologies, working side by side with mechanical engineers and ontology experts.

**Required/Preferred Candidate Skills and Competencies:** Master in mechatronics, mechanical engineering, management/logistics engineering, computer science. A B2 to C1 level in Italian Language is requested, the initial activities will be analyzing Italian texts and working with Italian collaborators.

### Scholarship H

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<tr>
<th>Topic</th>
<th>Artificial Intelligence for Digital Transformation</th>
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<td></td>
<td>Fondazione Bruno Kessler (FBK) in collaboration with Dedagroup S.p.A.</td>
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</table>
| Contacts | Raman Kazhamiakin (FBK)  
Roberto Loro (Dedagroup S.p.A.) |

**Synthetic description of the activity and expected research outcome**

Digital technologies play an ever increasing role in all aspects of human society; this induces a wide range of changes, collectively referred to as Digital Transformation, that, far from being only technological, also cover cultural, organizational, social, managerial aspects of our life. Artificial Intelligence is a key technology for digital transformation, thanks to its capability to extract information and knowledge from data; this requires the capability to open, analyze and exploit all data available on a given phenomenon, data that are often highly heterogeneous, scattered, and coming from different sources (e.g. open, sensor, free, closed, linked data). This thesis will concentrate on developing a data-driven computational framework, based on AI approaches, able to perform data analysis and prediction in the setting just described. The framework will be developed in the scope of the Digital Hub, a digital platform jointly developed by Dedagroup and Fondazione Bruno Kessler to address digital transformation in different application domains, including Public Administration, Digital Finance, Digital Industry. The validation of the framework will be performed addressing problems in these application domains, by exploiting the data sets and services integrated in the Digital Hub.
Scholarship I

<table>
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<tr>
<th>Topic</th>
<th>Formal Requirements Specification and Validation in Domain Specific Languages</th>
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Fondazione Bruno Kessler (FBK) in collaboration with Intecs Solutions S.p.A.

| Contacts | Stefano Tonetta (FBK)  
Silvia Mazzini (Intecs Solutions S.p.A.) |

Synthetic description of the activity and expected research outcome

The correct specification of requirements is a cornerstone in the design of safety-critical systems and in the assurance of safety requirements. Errors and ambiguities in the requirements are considered a fundamental problem by many industries across application domains. Rigorous techniques based on formal methods have been shown to be promising to address this problem. However, these techniques are difficult to take up at the industrial level. There is still a large gap between the information requirements and their formal counterpart. Each domain has specific ways to specify the requirements that depend also on the kind of system or component under design. Moreover, the semantic interpretation is also very dependent on the domain, which typically has some assumptions and background knowledge that are very expensive to formalize.

This thesis will focus on the development of a new open-source framework based on formal methods for the formalization and validation of domain-specific requirements. The work will support the creation of domain-specific control natural languages for requirements. Moreover, it will provide means to specify the domain-specific background knowledge and to exploit for tailored analysis engine. The framework will be validated with case studies provided by Intecs, which with its experience in diversified domains (railways, aerospace, IoT, etc) will be a suitable environment for this purpose.

Scholarship J

<table>
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<tr>
<th>Topic</th>
<th>Formal Methods for the Design of Safety Solutions in Automated Systems</th>
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Fondazione Bruno Kessler (FBK) in collaboration with Bosch

| Contacts | Stefano Tonetta (FBK)  
Peter Munk (Bosch) |

Synthetic description of the activity and expected research outcome

The assurance of safety requirements is fundamental in many safety-critical domains. In particular, in the automotive domain, the increased automation and connectivity of embedded systems demand for more rigorous analysis of their functional safety. The advances in sensor and actuator technologies enable new solutions to increase the safety and reliability of systems. At the same time, their complexity makes the assurance of such properties more and more challenging. This thesis will concentrate on developing new formal methods for the design of safety solutions in automated systems. It will investigate advances with respect to the state of the art on formal methods about the specification and verification of safety contracts, the diagnosis and prognosis of their failure, and the related diagnosability problem. The validation of the methods will be performed with case studies developed in automotive domain and based on real-world solutions developed by Bosch.
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<tr>
<th><strong>Topic</strong></th>
<th>Cultured meat from pluripotent stem cells</th>
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<tr>
<td><strong>University of Trento in collaboration with Bruno Cell s.r.l.</strong></td>
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</table>
| **Contacts** | Stefano A. M. Biressi (UniTrento)  
Luciano Conti (UniTrento)  
Stefano Lattanzi (Bruno Cell srl) |

**Synthetic description of the activity and expected research outcome**

The project involves the optimization of serum-free culturing procedures for pluripotent stem cells expansion and myogenic differentiation with the goal of in vitro meat production. The methods to be used include pluripotent stem cells maintenance, genetic engineering, molecular and cellular biology techniques, cell imaging and data analysis. Patentable protocols are expected to derive from these studies.

Key words: cultured meat, clean meat, pluripotent stem cells, skeletal muscle.


Scholarship L

<table>
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<tr>
<th>Topic</th>
<th>Application of natural language processing technologies to clinical cases - (additional, published on 21/08/2020)</th>
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<tr>
<td>Fondazione Bruno Kessler (FBK)</td>
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<tr>
<td>Contacts</td>
<td>Bernardo Magnini</td>
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**Synthetic description of the activity and expected research outcome**

A clinical case is a statement of a clinical practice, presenting the reason for a clinical visit, the description of physical exams, and the assessment of the patient’s situation. Clinical cases (e.g. discharge summaries, clinical cases published in journals, and clinical cases from medical training resources) provide a very valuable source of information for data-driven technologies aiming at predicting clinical outcomes and patient behaviors. This three-year PhD offers a unique context of a collaboration between FBK, specifically the NLP group, and a Swiss multinational healthcare company, worldwide leader in biomedical research.

The research will focus on a number of application oriented tasks, including automatic recognition of clinical entities (e.g. pathologies, symptoms, procedures, and body parts, according to standard clinical taxonomies such as ICD-9, ICD-10 and SNOMED-CT); detection of temporal information (i.e. events, time expressions and temporal relations, according to the THYME TimeML standard), and factuality information (e.g. event factuality values, assessment of the effect of negation, uncertainty and hedge expressions). Italian will be the major language of clinical cases, although technologies will be experimented on other languages.

The goal of the PhD is both to advance the state of the art for clinical case analysis for the Italian language, and to deliver prototype applications, which can be further made operative in real settings (e.g. hospitals). The candidate will have the unique opportunity to explore different domains (Natural Language Processing, Machine Learning, Health & Well-Being) being directly coached by very experienced teammates. The involved PhD will work in an international environment, collaborating with a healthcare company, with a worldwide presence. The candidate will work both at FBK (Trento) and at the abovementioned company’s premises (both in Italy and abroad).

**Required/Preferred Candidate Skills and Competencies:** The candidate should possess basic knowledge on Natural Language Processing and Machine Learning techniques (particularly deep learning architectures). Experience on biomedical data will be a plus. Basic programming skills (e.g. Python) would complete the profile. Proficiency in English is required, basic knowledge of Italian preferable.
Synthetic description of the activity and expected research outcome

In the last years, the several measures applied for environmental and health protection, have intensified the efforts researching new environmental-friendly anticorrosive coatings in the heavy industry, such as waterborne coatings, high solids coatings or powder coatings. However, the use of solventborne coatings is still dominant, even if they are the reason of volatile organic compound (VOC) emission, which are polluting and toxic.

The application of UV-curable coatings, cross-linking with UV radiation in few seconds and without the aid of temperature application, appears an innovative strategy that could meet the current needs of environmental protection, thanks to its low environmental impact. This technology differs from the traditional ones cause of its higher production efficiency, and for the low investment in the production plant, that can reduce the cost of the end product.

The technical-scientific aim of the project proposed by MPR srl, is the development of a novel corrosion protective system cross-linking by UV radiation for the piping and the heavy industry. The system provides both a new UV-curable coating formulation with outstanding performance, and an effective technology that allows the application and the cross-linking simultaneously.

This project arises from the need to innovate the production processes currently used, which are based on catalytic ovens working at temperature ranging from 80 °C to 130 °C and solventborne epoxy based coating, by resulting very polluting, energetically expensive and negatively affecting the cost of the end product.

MPR srl, to complete the project, will make use of the specific advice of the Industrial engineering department of the University of Trento, in particular, collaborating with the research team of the Prof. Flavio Deflorian, whose advice will be essential during the characterization of the coating performance developed in the MPR R&D chemical laboratory.

The development of the UV-curable coating technology to apply to metal protection is a new frontier for the knowledge and the sustainability of the corrosion protection respecting the environment, the worker involved in the process and the economical rising. This project plays a functional role for MPR srl to maintain its market position and for the industrial rising, respecting the principle of sustainability.

The intellectual property of the research results that will derive from the activities carried out by the doctoral student is owned by the Company.
PhD Executive BE

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<tr>
<th>Topic</th>
<th>Artificial Intelligence for Clinical Decision Support</th>
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<td>Exprivia S.p.A. and EIT Digital</td>
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<tr>
<td>Contacts</td>
<td>Claudio Eccher (FBK)</td>
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<td></td>
<td>Paolo Stofella (Exprivia S.p.A.)</td>
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**Synthetic description of the activity and expected research outcome**

This PhD work will design and develop a new tool able to support clinical decisions based on evidences to be activated in multiple clinical contexts and workflows. The system will exploit the information available in repositories and clinical systems to create a multidimensional view of patient, infer from this model possible consequences and suggest reactions. Inferential models will be based on predefined pathways as well as paths created by AI, machine learning and process mining algorithms adapting to the evolving patient conditions. The adoption of digital tools in health care is driven by different requirements, e.g., the need to simplify collaboration, create logs of actions for legal purposes and support clinical decisions and workflow. The use of electronic clinical information to evaluate human decisions against predefined protocols or statistically known evolution patterns is still largely underexploited. Few software tools able to support human decisions in specific clinical domains exist on the market, but no currently available solution is able to take advantage of the enormous amount of information available in the healthcare systems to extensively and transparently support clinical decisions and pathways.

This PhD thesis will study, design and implement an intelligent component, integrated in a complex clinical products solution, able to monitor every useful information to obtain two important results:

- A real-time match of patient conditions against configured pathways models able to recommend (and synchronize) actions introducing a different perspective in applications (M2M) and humans (M2H) collaboration
- A fluid and continuous enrichment of statistical and knowledge models through AI-based techniques able to identify clinical conditions and propose advices, such as recommending protocols and clinical actions, computing probabilities of the outcomes, identifying relevant adverse events, etc.

The key problems to be solved are:

- Introduce new and more specific ways to represent patient condition as the result of selected information
- Introduce new ways to represent multidimensional evolving protocols for managing clinical conditions
- Integrate Artificial Intelligence-based tools to support medical decisions
- Develop an effective human interface to allow the easy use of the above functions

The approach relies on the efficacious combination of AI and business process management techniques. The application of these techniques to the healthcare is of great interest because of the peculiarities of the domain, characterized by i) need of flexibility in the care pathway execution, (e.g., for dealing with comorbidities), ii) availability of a great amount of clinical data about the patient and similar cases, which should be exploited to learn from previous experience to modify the constraints and the sequence of future actions, and iii) the requirement to let each decision to the doctor, who must have all the information on the patient easy to read and interpret. Dealing with and solving these problems in a complex domain can advance the state of the art in the research field of combining logical reasoning, machine/deep learning and process representation and execution. Finally, the implementation of this approach in a component designed to be used in the everyday practices can open the way for the evaluation of these techniques in real clinical settings, thus giving substantial feedback to the academic research. The academic outcomes will include publications and participation in relevant academic events.

**Required/Preferred Candidate Skills and Competencies:** Master degree in Computer Science or Software engineering or Computational Biomedicine or similar. Artificial Intelligence or Data science specialization will be a preferential title as skills on: Java, Python, Postgresql, Elasticsearch, Airflow, Mirth,
Apache Spark, Apache Hadoop, Artificial Neural Networks, Image processing, Artificial intelligence algorithm, Image segmentation, Ant colony algorithm.

The employee admitted to the PhD Programme will be included in the EIT Digital Industrial Doctoral School IDSL Programme where they will receive training on aspects of entrepreneurship and innovation and have to carry out the following specific educational and research activities:

a) Participation in five Innovation & Entrepreneurship seminars organized by EIT Digital;

b) Business Development Experience, where the scientific work will be integrated into entrepreneurship and innovation activities;

c) From 3 to 6-months study or research period abroad within the research theme.

The intellectual property of the research results that will derive from the activities carried out by the doctoral student is owned by the Company.
PhD Executive CE

<table>
<thead>
<tr>
<th>Topic</th>
<th>Clinical Natural Language Processing and Clinical Big Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exprivia S.p.A. and EIT Digital</td>
<td></td>
</tr>
</tbody>
</table>
| Contacts | Alessandro Moschitti (UniTrento)  
Paolo Stofella (Exprivia S.p.A.) |

**Synthetic description of the activity and expected research outcome**

This PhD work will develop a set of innovative interactive tools for intelligent access to clinical patient information, through the integrated application of Natural Language Processing and visualization technologies.

This highly usable interactive environment will allow doctors to easily access clinical information about their patients, overcoming the serious information overload problem they are currently facing when accessing Patient Health Records.

The PhD thesis will apply NLP based information extraction technology to derive significant clinical information from textual sources, such as diagnostic reports and discharge letters, as well as other databases, and represent the extracted information using advanced visualization and infographics. In addition, Internet bot and Dialogue NLP based technologies will be employed for natural language interaction.

Specific challenges of the thesis are related in particular to the application of Information Extraction to the clinical domain, including the ability to automatically recognize and classify relevant entities, such as diagnosis, pathology, body part, therapy, and the employment of dialogue techniques in the context of medical activity.

**Required/Preferred Candidate Skills and Competencies:** Master degree in Computer Science or Software engineering or Computational Biomedicine or similar. Artificial Intelligence or Data science specialization will be a preferential title as skills on: Java, Python, Postgresql, Elasticsearch, Airflow, Mirth, Apache Spark, Apache Hadoop, Google Bert, Natural Language Processing, Artificial Neural Networks, Image processing, Artificial intelligence algorithm, Image segmentation, Ant colony algorithm

The employee admitted to the PhD Programme will be included in the EIT Digital Industrial Doctoral School IDSL Programme where they will receive training on aspects of entrepreneurship and innovation and have to carry out the following specific educational and research activities:

- d) Participation in five Innovation & Entrepreneurship seminars organized by EIT Digital;
- e) Business Development Experience, where the scientific work will be integrated into entrepreneurship and innovation activities;
- f) From 3 to 6-months study or research period abroad within the research theme.

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### Synthetic description of the activity and expected research outcome

The aim of the research is to study, design, implement and validate a middleware that hides the heterogeneity of the underlying devices, providing high-level APIs to manage and coordinate individuals as well as groups of devices.

The middleware has to cope with the dynamism of a typical IoT system not only in terms of the changing hardware but also considering other dimensions such as applications, environmental contexts, users just to name the most important ones.

The integration of the proposed middleware with existing programming languages that are widely used in IoT is also a critical issue that will be covered by the research.

**Required/Preferred Candidate Skills and Competencies:**

- Computer Science degree, Software Design,
- Coding skills, Programming Languages Design, sync/async programming, Software Patenting and
- Academic/Teaching Experience

The intellectual property of the research results that will derive from the activities carried out by the doctoral student is owned by the Company.
**PhD Executive EE**

<table>
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<tr>
<th><strong>Topic</strong></th>
<th>Edgergenius: delivering AI analytics in the fog for retail</th>
</tr>
</thead>
</table>
| **Contacts** | **Domenico Siracusa** (FBK)  
**Claudio Peroni** (Energenius s.r.l.) |

**Synthetic description of the activity and expected research outcome**

In the selection of the applicants, the following will be assessed:

- Knowledge of IoT, edge and cloud services,
- Programming skills (with Java, Javascript, Python, Go, etc.),
- Good scientific communication and writing skills in English,
- Experience in developing research software prototypes with DevOps tools,
- Ability to independently pursue his or her work,
- Ability to collaborate with others,
- Having a professional approach,
- Ability to analyse and work with complex issues.

The candidates are expected to hold an MSc degree in Mathematics, Telecommunication Engineering, Computer Science or similar fields. The candidates should have excellent grades, and well developed analytical and problem-solving skills, as well as very good skills in oral and written communication. After the qualification requirements, great emphasis will be placed on personal qualities and personal suitability.

The employee admitted to the PhD Programme will be included in the EIT Digital Industrial Doctoral School IDSL Programme where they will receive training on aspects of entrepreneurship and innovation and have to carry out the following specific educational and research activities:

a) Participation in five Innovation & Entrepreneurship seminars organized by EIT Digital;
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Brain-Computer Interface - additional (published on 07/07/2020)
g.tec medical engineering GmbH and EIT Digital

Contacts
Luca Turchet (UniTrento)
Dr. Ren Xu (g.tec medical engineering GmbH)

Synthetic description of the activity and expected research outcome
This project will develop new knowledge and a complete practical software platform to develop new interactive applications using Brain-Computer Interface. The adaptation of the interactive applications will be based on the user’s mental state, which will be classified in real-time using the electroencephalogram (EEG).

The PhD Project is not focused on the hardware side, but the software potential to process the brain signals in a more optimal way to improve Signal to Noise ratio, and extend the capacity of the algorithms to provide more advanced functions and create new applications that are not in the market yet.

Required/Preferred Candidate Skills and Competencies:
- A degree in electric engineering, computer science or similar
- Profound knowledge of C++ and C#, using Microsoft Visual Studio
- Teamwork, hands-on mentality and good communication skills in English
- Logical, structured thinking and working.
- Experience in electrical measurement and electronics (analogous and digital circuit technique)

The employee admitted to the PhD Programme will be included in the EIT Digital Industrial Doctoral School IDSL Programme where they will receive training on aspects of entrepreneurship and innovation and have to carry out the following specific educational and research activities:

a) Participation in five Innovation&Entrepreneurship seminars organized by EIT Digital;
b) Business Development Experience, where the scientific work will be integrated into entrepreneurship and innovation activities;
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PhD Executive GE

<table>
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<tr>
<th>Topic</th>
<th>Research on situation aware, dynamic authorization in automotive - additional (published on 20/07/2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huawei Technology Duesseldorf GbmH</td>
<td></td>
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</table>
| Contacts                                                             | Bruno Crispo (UniTrento)  
Theo Dimitrakos (Huawei Technologies Dusseldorf GmbH)                                      |

**Synthetic description of the activity and expected research outcome**

As the emerging smart vehicles and autonomous driving technologies are established and commoditized and the Internet of Vehicles is established, there is a need to rethink and revise how we control access to data and use of information, computation and network resources. Modern automotive requires automated control that is aware of the situation and is able to respond very quickly to rapidly changing situations while preserving safety invariants and privacy and optimizing resource utilization.

Identity and access management (IAM) models that have typically being developed for enterprise or consumer networks are insufficient to address these challenges. Enterprise IAM technologies typically either too complex and resource-demanding while consumer IAM is not designed for safety and resilience and IAM in safety-critical systems often relies on a heavily controlled industrial environment to support operations that is not suitable for consumer automotive.

The aim of this Industrial PhD is to research and develop innovative models and technologies for IAM in automotive that are high performant and lightweight and support situation-aware, dynamic authorization and inexpensive to implement at scale and fit for use in a safety-critical context.

**Industry requirements:**

- Dynamicity & continuity of access: Continuous monitoring for usage & access control of car devices and of environmental triggers such as sensor updates
- Situation aware access: resilient usage/access that responds to change & adapts to the situation
- Safety conformant authorization: Safety/risk-aware & safety conformant access control
- High performance: real-time policy evaluation & decision-making in micro-seconds
- Compliance: Comply with AutoSar, ETSI & ENISA guidance

**Technical directions:**

- Situation-aware Continuous Usage & Access Control: develop technology that continuously monitors the environment for sensorial changes, analyses behavior and adjust policy in accordance to behavioral changes while maintaining privacy and compliance with safety conditions.
- Safety-aware access policies: Reflect safety invariants, conditions and actions into policy
- Situation-aware Continuous Authentication: research technologies in automotive including passwordless authentication, behavioral authentication, continuous monitoring of presence, multi-sensor fusion and re-authentication

Research will be expected to inform and leverage Huawei innovations identification, behavioral analysis and access/usage control.

**Research challenges to be addressed include:**

**Policy model & language:**

1. How to incorporate continuous authentication and behavioral statements into authorization policies
2. How to ensure consistency and coherence of these policies
3. How to test, validate or prove correctness
Authorization technology:

1. Situation aware Continuous Authentication: How to combine change driven and iterative ABAC evaluation and enforcement with technologies for passwordless authentication technology, behavioral authentication, continuous monitoring of presence, multi-sensor fusion and re-authentication
2. Continuous Usage & Access control: How to understand behavior and sensorial change & respond to change promptly - e.g. in milli-/micro-seconds

User experience and validation:

1. How to best involve human into loop
2. How to best involve human in the decision making
3. How to ensure that security is non-intrusive in terms of user experience
4. How to ensure privacy by design (ideally eliminate need for privacy post-processing)

Required/Preferred Candidate Skills and Competencies:

- Interest/expertise in at least one of the following technology areas:
  - Dynamic authorization including extensions of Attribute-Based-Access-Control (ABAC) for IoT, mobile devices and Cloud platforms.
  - Fusion of Bayesian Networks / Deep Learning / biometrics and ABAC
- Strong development expertise in C/C++ and (ideally) Rust programming languages.
- Understanding of mobile and embedded device operating systems (e.g. Android and embedded Linux)
- Ability to combine high level architecture perspective with deep and detailed technical design/prototype work
- Interest / experience with architecting, designing and implementing new data protection technology in Mobile, IoT and Public Cloud platforms in commercial R&D and/or in products, solutions, corporate standards
- Strong Systems and Software Design skills for example with UML/FMC
- Capable to analyze complex software architectures and prioritize development tasks to maximize efficiency.
- Able to independently design, build, and maintain efficient, reusable and secure code, and to analyze existing designs and code and identify improvements.
- Ability to identify innovation opportunities, elicit requirements and contribute to feature/product development roadmaps
- Interest in working together with the R&D of Product teams in order to impart innovation into new products
- Interest in collaborative research and innovation activities with partners Huawei’s innovation ecosystem that includes R&D of top European companies and Universities.
- Excellent communication skills, team-work, self-motivation, self-organization and independent working.
- Fluent written and spoken English.
- Ability to work in Germany (Munich) and willingness to travel when required

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### PhD Executive HE

<table>
<thead>
<tr>
<th>Topic</th>
<th>Cooling theory for thermoplastic materials used in SEAM (Screw Extrusion Additive Manufacturing) (additional, published on 17/08/2020)</th>
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<tr>
<td>CMS S.p.A.</td>
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<tr>
<td>Contacts</td>
<td>Alessandro Pegoretti (UniTrento) \ Ing. Maurizio Bernini (CMS S.p.A.)</td>
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The research activity will be organized in the following steps:

1) Detailed experimental characterization of the most promising thermoplastic materials for the specific application such as PA6/CF40, PA6/CF30, PA6/CF15, PA6/GF, ABS/CF, ABS/GF, PSU/CF, PSU/GF, PESU/CF, PESU/GF, PEI/CF, PEEK/CF, PEEK/GF.

The experimental characterization will involve the following techniques:

- Differential Scanning Calorimetry (DSC) to measure the melting and crystallization temperatures (T(m) and T(c)) and the melting and crystallization enthalpies [J/g], in a wide range of heating and cooling speeds (1-50 °C/min)
- Laser Flash Analysis (LFA) to measure the thermal conductivity [W/(m⋅K)], the thermal diffusivity [mm²/s], and the specific heat [J/g⋅K] at various temperatures.
- Density in the solid state (by helium pycnometry) and in the molten state (by determining both melt mass rate and melt volume rate).

2) Modelling of the cooling process (phase transition, crystallization, glass transition) as a function of the geometrical parameters (cross section).

3) Comparison of the predictions with the experimental results obtained on a CMS prototypal 3D-printing machine.

4) Investigation of possible additives that could reduce the surface materials thermal conductivity.

**Required/Preferred Candidate Skills and Competencies:**

The preferred candidate should have a solid background in Mechanical and Materials Engineering. Basic knowledge of finite element methods is a required skill.

The intellectual property of the research results that will derive from the activities carried out by the doctoral student is owned by the Company.
This project aims at developing an AI-based predictive framework to support critical decision making in agronomics, helping to produce safer food, balancing the needs of high-quality production, sustainability and environmental health. In particular, this research will introduce and scale-up Predictive Models and applied Machine Learning solutions within an existing effort for high quality and sustainable agriculture.

The project will explore how AI services can effectively help agronomists in operative contexts, helping to bridge the gap between field work and production quality with sustainability. The research will be based on data available the ENOGIS platform, which is already available for geospatial data integration and cloud analytics at national scale, including data streams from IoT, remote sensing, production, and quality.

Notably, the research work will directly consider aspects expected to have a very high impact on the success of AI for agriculture. The project shall study and test with prototype solutions how to enable analytics of data quality and AI model validation along a continuous life cycle, thus offering model interpretation and incorporating progressive corrections of the deep learning algorithms. Collaboration with leading teams in industrial AI platforms will be implemented to derive a specific user-in-the-loop approach, with first applications in risk analysis (e.g. insurance modeling) and wine production. In addition, the project will explore how to apply these tools on data from low-cost sensors, in integration with remote sensing and open source geospatial information to accelerate the innovation of agriculture in countries and geographies where a more productive agriculture process needs to be implemented.

The intellectual property of the research results that will derive from the activities carried out by the doctoral student is owned by the Company. The release of specific software components as open source tools will however be considered, as part of a strategy to support global sustainability and best practices in agriculture.

**Required Candidate Skills and Competencies:**

1. Proven Interest /expertise in at least one of the following technology areas:
   - Deep Learning applied to Agriculture
   - Deep Learning applied to massive environmental data (e.g. Weather data)
2. Significant development expertise in Python and Python-based frameworks for Deep Learning (e.g. PyTorch)
3. Ability to combine machine learning models in large scale analytics infrastructures
4. Experience in developing client-side components for web analytics systems
5. Interest in working in interdisciplinary teams, in R&D contexts, in order to create novel solutions and derive innovation based on transdisciplinary approaches.

**Preferred Skills:**

- Competence in scientific publishing and public speaking will also be considered
- Interest and previous experience for tutoring in interdisciplinary groups
- Experience with image analysis and development of deep learning models for imaging data in agriculture or biology or medicine.
- Ability to identify innovation opportunities and interest to collaborate to the proposal of novel business initiatives
- Excellent communication skills, self-motivation, self-organization and independent working.
- Fluent written and spoken English.