Finanziato dall'Unione europea
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Call for applications for additional admission to PhD programmes of the University of Udine in the Academic Year 2022/2023, 38th cycle, under the funding of the National Recovery and Resilience Plan (PNRR) with reference to the following misures: Ministry's Decree n. 351/2022, Ministry's Decree n. 352/2022, Announcement n. 3277/2021, Ministry's Decree n. 3138/2021, Announcement n. 3265/2021, Announcement n. 341/2022.

DISCLAIMER:
The official and legally binding Call for Applications is in Italian only.
This document cannot be used for legal purposes and it is only meant to provide information in English on the Call for applications (University Chancellor's Decree n. 705 of July 27, 2022).
Please refer to the official Call for Applications published on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine.
Any changes and integrations will be made available on the above mentioned above web pages. Therefore, no personal written communication shall be provided to applicants about examinations dates, competition results and deadlines regarding the enrollment.

ART. 1 – PhD PROGRAMMES

1. The University of Udine announces a Call for applications for positions with scholarship linked to the fulfillment of specific research topics under the funding of the National Recovery and Resilience Plan (PNRR), as part of the PhD programmes activated by the University of Udine, 38th cycle:

- Accounting and Management (Table 1)
- Food and Human Health (Table 2)
- Biomedical and Biotechnological Sciences (Table 3)
- Mathematical and Physical Sciences (Table 4)
- Art History, Film Studies, Media Studies, and Music (Table 5)
- Linguistics and Literary Studies (Table 6)
- Law and Innovation in the European Legal Space (Table 7)
- Computer Science and Artificial Intelligence (Table 8)
- Industrial and Information Engineering (Table 9)
- Environmental and Energy Engineering Science (Table 10)
- Agricultural Sciences and Biotechnology (Table 11)

2. The PhD Programme positions listed in paragraph 1 last three years starting from the 1st of November 2022 and will be launched by the University of Udine only after the grant funding by the Ministry of University and Research (MUR), following the procedures provided for by the regulatory provisions:

- Ministry's Decree n. 351/2022: Mission 4, Component 1 "Strengthening the provision of education services: from nurseries to universities" – Investment 4.1 "Extension of the number of doctorates and innovative doctorates for Public Administration and cultural heritage".
- Ministry's Decree n. 352/2022: Mission 4, component 2 "From research to business" – Investiment 3.3 "Innovative doctorate programmes to meet companies' innovation needs and promote the recruitment of researchers by enterprises".
- Notice n. 3277/2021: Notice for the submission of proposals for creation and strengthening of Ecosystems for innovations.
- Ministry's Decree n. 3138/2021: Public Notice for the submission of intervention proposals to the strengthen research facilities and create "National Champions" in R&S on some Key Enabling Technologies to be funded as part of the National Recovery and Resilience Plan.
- Notice n. 3265/2021: Notice of grant funding for construction or modernisation of technological infrastructure of innovation
- Notice n. 341/2022: Public Notice for the submission of intervention proposals to create "Partnerships extended to universities, research centers, companies to fund basic research projects".

In any case, the they cannot be started after the 31st of December 2022.

3. The doctorate positions with scholarship referred to in paragraph 1 are announced on the basis of resources and according to the regulatory provisions referred to in paragraph 2. There are no positions without scholarship, therefore the PhD programme is automatically concluded in case of scholarship withdrawal.

4. The doctoral paths will guarantee the respect of the horizontal priorities and the DNSH principle (Do No Significant Harm) of the PNRR.

5. If limitations are introduced due to a sanitary or epidemiological emergency, the activities of the Ph. D. programmes could take place in a mixed modality, face to face and remotely. The methods of carrying out the activities will be communicated by the University of Udine when the programme will start.

6. In this document the titles referred to people, shown in male form only, refer indiscriminately to people of all genders.

ART. 2 – GENERAL PROVISIONS

1. This Call regulate the procedures and criteria to access to the PhD programmes listed in art. 1 with reference to the scholarships listed in Tables 1-11.

2. Tables 1-11 are annexed to this Call for Applications and are integral part of it. They indicate for each of the PhD programmes: administrative location and associated location(s) (if any); locations for training, teaching and research; coordinator; programme duration; curricula (if available); positions available and research topics; website of the PhD programme; admission requirements; documents and qualifications to be attached to the application for admission; composition of the Selection Committee; period abroad if provided (optional or mandatory); period at a third party if provided (optional or mandatory); admission procedure (conduct of examinations; evaluation criteria; tests schedules; publication date of the list of admitted applicants to the examinations and the final ranking lists).

3. If additional funding is provided under the PNRR with reference to the actions listed in art. 1 paragraph 2, the available positions indicated in Tables (1-11), may be increased with an integration at the Call for Applications and its annexes as specified in paragraph 5, without prejudice to the submission deadline for the admission to the competition mentioned in art. 6.

4. Positions available may decrease as provided in art. 1 paragraph 2 and art. 10 paragraph 2.

5. Any amendments and additions to this Call and its annexes are posted on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine.

6. Only the Italian Call for applications is equivalent to notification for all purposes, including for the purpose of notification of the examinations, if provided.

7. The submission of the application through the online procedure, as stated in art. 6, implies the acceptance by the applicant of the provisions contained in the Call for Applications and in the Internal Regulation of PhD Programmes available on the PhD website of the University of Udine.

8. Possible personal communications to applicants concerning this competition are sent only to the e-mail addresses provided during the registration process as stated in art. 6, paragraph 2.

9. The University assumes no liability for failure to receive messages due to incorrect contact details supplied by the applicant, for the failure or delay in notifying any change from the applicant and for postal or electronic problems in each phase of this competition.

Art. 3 – ADMISSION REQUIREMENTS

1. Applicants of any nationality may apply for the competition if they have one of the following academic degrees at the expiration date of the call:
a) "Laurea Specialistica" or "Laurea Magistrale" or "Laurea vecchio ordinamento[1]" or second level academic degree comparable to them;
b) foreign degree, issued by a foreign official institution, comparable in duration and level[2] to the degrees referred to in letter a), and in the foreign system allows the admission to PhD programmes.
Tables 1-11 specify for each PhD programme the type of degree required for participation in the competition and any additional requirements.

2. Applicants can participate in the competition, if they obtain their degree referred to paragraph 1 by October 31, 2022. Applicants who do not obtain the degree by October 31, 2022, will be excluded. A score less than 95/110 implies the exclusion only for the PhD Programme in Law and Innovation in the European Legal Space. Winner applicants with the degree not yet obtained are admitted and enrolled with reserve. They must certify their graduation in accordance with the procedure indicated in art. 5 paragraph 5 no later than October 31, 2022.
The documentation must be submitted by filling in the form available on the website: https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountId=universityofudine&populateSR_id=42104

3. All applicants are admitted to the competition on the condition that they meet the requirements of the Call. The University reserves the right to carry out sample checks[3] and it may exclude applicants at any time from the selection process if they fail to meet the requirements as set out in the present article, even after the PhD programmes have already begun.

Art. 4 – DEGREE OBTAINED ABROAD (art. 3 paragraph 1 letter b)

1. The suitability of the foreign degree is assessed by the Selection Committee (art. 7) for the only purpose of participating in the competition and the enrolment in the PhD programme in accordance with:
- the current legislation in Italy and in the country where the degree was issued;
- international treaties or agreements on recognition of the degrees for further studies.

The Selection Committee assesses the suitability of the foreign degree on the basis of the documentation attached during the online application for the admission to the competition (articles 5 and 6). The Selection Committee may, therefore, exclude the applicant whenever the documentation submitted does not provide sufficient evidence for the evaluation. Therefore applicants must attach all the documents in their possession relating to the degree held, in order to provide sufficient elements for the assessment to the Selection Committee.

2. Applicants with a degree obtained in a foreign university, if winners of the competition, must submit during the enrolment procedure (if they have not already submitted it during the online application), under penalty of exclusion from the PhD programme:
For foreign degrees issued in a UE country:
Diploma Supplement in English.
For foreign degrees issued in an EXTRA UE country, one of these options:
- Declaration of Local Value of the degree and the certificate regarding the degree with exams and grades. The certificate in a language different than Italian or English must be accompanied by a

[1] Degree awarded under the ante Decree of the Ministry no. 509 of November 3, 1999, modified with Decree of the Ministry no. 270 of October 22, 2004.
[2] Master of Science/Art
[3] Under Article 71 of D.P.R. December 28, 2000, no. 445

translation in one of the two languages mentioned (the translation must be legalized by the diplomatic-consular competent authority or certified by an Italian Court).
- "Statement of comparability - CIMEA" issued in accordance with the terms set on the website: www.cimea.it.
If the Diploma Supplement or the Declaration of Local Value/Statement of comparability is not available by the enrolment procedure, the applicant must demonstrate having made a request by that date and submit it as soon as possible.

Art. 5 – QUALIFICATIONS SUBJECT TO ASSESSMENT AND DOCUMENTS TO BE SUBMITTED
1. Applicants must submit the mandatory documents and qualifications specified for each PhD programme in Tables 1-11.

2. Tables 1-11 also specify optional documents and qualifications provided by each PhD programme.

3. For a correct submission of the application, applicants are invited to use the forms attached which are integral part of the Call.

4. Documents and qualifications referred to in paragraphs 1 and 2 must be submitted in Italian or English, under penalty of not evaluation. Documents and qualifications, originally in a different language, must be accompanied by a translation into Italian or English made by the applicant. Any translation into these two languages is the responsibility of the applicant. The translation of the thesis can be an extended abstract in place of the complete thesis.

5. Italian and EU applicants who present qualifications referred to states and facts attested by Public Administrations, must use a self-certification.
Non-EU citizens, legally residing in Italy, may self-certify only information that can be verified or certified by Italian public entities. They can also use a substitute statement of certification, when it is provided by an international agreement between Italy and the applicant's country.
Non-EU citizens other than those above mentioned must refer to the provisions of art. 3 paragraphs 3 and 4 of the d.P.R.445/2000[4].

6. The only documents evaluated are those the applicant has submitted within the terms and the manners specified in art. 6 within the expiration date of the Call. Documents submitted in any other way are not be subjected to evaluation.

7. Failure to submit the mandatory documents specified in Tables 1-11 means the exclusion from the selection process.

Art. 6 – APPLICATION FOR ADMISSION
1. Entries to competitions begin on **Monday August 1, 2022 at 02:00 p.m. (Italian time)** and end on **Friday September 2, 2022 at 02:00 p.m. (Italian time)**.

2. **The application for admission must be completed, under penalty of exclusion, using the online procedure** that involves two stages:
- **Stage I – Registration at the University website** (https://uniud.esse3.cineca.it): this allows the applicant to obtain a user name and password (credentials) in order to continue with the next stage[5];
- **Stage II** – **Filling out the online application** (https://uniud.esse3.cineca.it): the applicant must print out the application form at the end of Stage II, in order to retain it as proof of submitted application together with the receipt of the fees payment, as specified in paragraph 8 of this article.

[4] Under the D.P.R. December 28, 2000, n. 445 and subsequent amendments and additions.
[5] If the applicant already owns the credentials to access the reserved area (e.g.: former student of University of Udine) this step should not be considered.

3. The instructions for the registration and for the application submission are available on the PhD website of the University of Udine.

4. Documents, qualifications and publications as listed in art. 5, must be attached to the online application in electronic format (.pdf), except for the letters of reference. **Files and/or folders, compressed in RAR or ZIP format, cannot be larger than 5 MB**. The applicant can add, delete or modify the attached documents even after the conclusion of stage II, but before the expiry of the call, on **Friday September 2, 2022 at 02:00 p.m. (Italian time)**. The university administration assumes no liability if the documentation submitted is illegible as a result of damaged files or folders.

5. Every folder/file attached must be named as follows: surname of the applicant_PhD programme_document type (e.g.: McDONALD_Food and Human Health_Curriculum).

6. Letters of reference, if provided by the PhD programme (Tables 1-11), must be uploaded on the on line process by the referees at the applicant's request. During the submission of the application, the applicant must enter the email address of the referees, who will receive an email notification with the instructions to proceed for uploading the letter. Applicant and referee receive a notification about the successful upload of the letter, which will be available only for the Area Servizi per la Ricerca – Ufficio Formazione per la Ricerca and for the Selection Committee. The applicant can make a reminder to the referee and replace his/her name with another by the expiry date of the call (**Friday September 2, 2022 at 02:00 p.m. Italian time**).
The referee must upload the letter of reference before **September 4, 2022.**

7. The admission to the selection procedure is subject to the payment of euro 25,00 (as a contribution for participating in the competition). Applicants have to pay the fee by **Friday September 2, 2022.** Applicants who have not paid the above-mentioned contribution (euro 25.00) by the day before the date of the Selection Committee's preliminary meeting, will be excluded. The dates of the Selection Committee's preliminary meeting will be posted by August 31, 2022 on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine.

8. The amount as paragraph 7 is not refundable for any reason and must be paid via PagoPA service using one of the following options:
- direct access from Esse3 to one of the payment methods available in PagoPA using the data contained in the "Avviso di pagamento" (notice of Payment) issued at the end of the online application (accessing to "Student Administration Office/Payments" in the personal area of Esse3);
- payment at bank branches and receivers authorized to pay via PagoPA showing the "Avviso di pagamento" (notice of Payment) issued at the end of the online application (accessing to "Student Administration Office/Payments" in the personal area of Esse3);
- from your account with online services (if activated by the bank) or with credit card or prepaid card with IBAN. For payments by credit or prepaid card refer to the circuit related to the card, NOT to the bank issuing the card. You need to print or save the "Avviso di pagamento" (notice of Payment) to have the data required to make the payment.
Applicants who are abroad and don't have an Italian bank account can **exceptionally** make the payment on the bank account of the University of Udine at INTESA SANPAOLO: **IT59A0306912344100000046097 SWIFT/BIC BCITITMM** reason for payment "PhD competition – Applicant's Name and Surname". Only in this case, the receipt of the payment must be attached to the online application.
The payment is subject to the fees applied by the payment service provider.

9. Applicants who wish to apply for several PhD programmes should submit several applications, attaching the required documents to each one and paying the fees for each one (paragraph 7). However, the applicant cannot apply for more than one curriculum in the same PhD programme.

10. Applicants with certified disabilities or specific learning disorders, may notify during the online application (refer to paragraph 2 of this article):

- their situation attaching the certificate attesting the disability or the specific learning disorder;
- aids to conduct the examinations.

Applicants with disabilities or learning disorder, residing in foreign countries, who intend to take advantage of the measures described above, must present a certificate attesting to the state of disability or the learning disorder issued in their country of residence. The certificate has to be accompanied by a sworn translation in Italian or English language. The university bodies in charge to check the certifications verify that foreign certificate attests a condition of disability or specific learning disorder recognized by Italian legislation.

The different ways of supporting the examinations will be defined by the Selection Committee after checking the documentation submitted. In particular, for students with specific learning disorder, an additional time of 30 per cent more than the time defined for the admission test, will be granted. In case of particular gravity, additional aids may be provided.

Further information can be obtained from Direzione didattica e Servizi agli Studenti (DIDS) – Servizio studenti con disabili o dsa, tel. +39 0432 556804 - email: servizi.disabili@uniud.it, dsa@uniud.it

11. The university administration assumes no liability for information loss due to an error that has not committed, for inaccurate data given by the applicant relating to residence, mailing and email addresses and for failure or delay in notifying their change.

12. Applicants are advised not to wait until the last days before the deadline of the on line procedure. The University assumes no liability for any malfunctions due to technical problems and/or overloading of the communication line and/or application systems.

Art. 7 – SELECTION COMMITTEE

1. The Selection Committee of each PhD programme is specified in Tables 1-11.

2. Each Selection Committee, in the first meeting, appoints its own internal President and Secretary.

3. Before the evaluation of the qualifications and before the start of the examinations, the Selection Committees define the evaluation criteria and the scores assigned to the qualifications and to the examinations, taking into account the specifications set out in Tables 1-11.

4. The Selection Committee meetings can be held remotely.

5. The Selection Committee expresses the assessment of suitability with the aim of awarding scholarships indicated in art. 10, paragraph 2.

6. The Selection Committee's tasks finish with the drawing up of the reports and final ranking lists.

Art. 8 – GENERAL COMPETITION

1. The applicants' selection foresees the evaluation of the qualifications and the conduct of the examinations, in the manner and on the dates specified in Tables 1-11. Any changes or additions to the examinations schedule are posted only on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine.

2. Evaluation of qualifications and examinations are held according to the following general provisions:

a. the maximum score for overall qualifications and examinations is 100 (100/100). The examinations of the PhD programmes with widely different curricula may be diversified;

b. the maximum score for qualifications is 30 (30/100), the minimum score to be admitted to the first examination (written or oral) is stated in each table;

c. the score assigned for the examinations is 70 points (70/100). Applicants are suitable if they obtain a score equal to or greater than 49 in the examinations;

d. the final ranking list is unique and is prepared, for only eligible applicants, by adding up the scores obtained in the evaluation of the qualifications and in the examinations.

3. Applicants must show a valid identity document for admission to the examinations.

4. Applicants unable to attend the oral examination in presence at the University of Udine, due to a permanent abroad residency at the date of the examination or for valid and well-documented reasons, may request to the Selection Committee to take the oral examination remotely. This request may also be submitted to the Selection Committee later, but in any case, before the date set for the oral test. The request have to be sent using the form available on the website https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountId=universityofudine&populateSR_id=42104.
Details of the remotely oral examination are communicated to the applicants at the e-mail address entered during the registration procedure referred to art. 6 paragraph 2. The applicant must be available during the day and the timetable notified. For identification purposes, and under penalty of exclusion from the selection process, each applicant must identify itself before the interview begins, exhibiting the same identity document attached to the online application. The failure to communicate the personal address, the connection failure, the unavailability of the applicant on the day or in the established timetable or the failure exhibition of the identity document are grounds for the exclusion from the selection process. Such grounds for exclusion are not valid if the applicant, with a valid identity document, is present on the day fixed for the oral examination, with the aim to take the oral examination personally.
The University accepts no responsibility in case of technical problems that do not ensure the proper conduct of the oral examination.

5. The University reserves the right to manage the oral examination remotely if restrictions on mobility and aggregation are introduced due to health and epidemiological emergency. The University will make this procedure known on the official register (https://www.uniud.it/it/albo-ufficiale) and in the PhD website of the University of Udine. In this case, the provisions of the above paragraph 4 shall be applied, as they are compatible.

6. Oral examinations are public, including those which are conducted remotely.

Art. 9 – FINAL RANKING LIST

1. The final ranking lists are published on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine within the dates detailed for each PhD programme in Tables 1-11.

2. The university does not send out any communication to the applicants.

Art. 10 – ADMISSION TO THE PhD PROGRAMME

1. Applicants are admitted to each PhD programme according to the final ranking list order and in accordance with the provisions contained in this article.

2. The positions with scholarship are awarded to eligible applicants as stated below: according to the final ranking list and the number of positions available, if the candidate has achieved the suitability assessment established by the Commission regarding the suitability of his project and qualifications with the research topic of interest and with the criteria set out in the provisions listed in art. 1 paragraph 2.
2.1 The non-allocation of scholarships involves a reduction in the number of the positions with scholarship.
2.2 In case of equal final score and equal requirements, the preference criteria to award positions with scholarship is the economic condition of the applicant's family nucleus[6].

[6] Current legislation about the right to study, ISEE.

3. In the case of useful placement in more final ranking lists referred to different PhD programmes, the applicant must enrol in only one PhD programme.

Art. 11 – ENROLMENT

1. **Successful applicants must enrol using the appropriate online procedure, in the terms and manner which will be communicated by email, under penalty of exclusion (art. 2 paragraph 7).**

2. Enrolment to the PhD programme is subject to the payment of the amount specified in art. 14 under penalty of exclusion from the programme.

3. The amount as paragraph 2 is not refundable for any reason and the payment must be made via PagoPA service using one of the following options:
- direct access from Esse3 to one of the payment methods available in PagoPA using the data contained in the "Avviso di pagamento" (notice of Payment) issued at the end of the online application (accessing to "Student Administration Office/Payments" in the personal area of Esse3);
- payment at bank branches and receivers authorized to pay via PagoPA showing the "Avviso di pagamento" (notice of Payment) issued at the end of the online application (accessing to "Student Administration Office/Payments" in the personal area of Esse3);
- from your account with online services (if activated by the bank) or with credit card or prepaid card with IBAN. For payments by credit or prepaid card refer to the circuit related to the card, NOT to the bank issuing the card. You need to print or save the "Avviso di pagamento" (notice of Payment) to have the data required to make the payment.
Applicants who are abroad and don't have an Italian bank account can **exceptionally** make the payment on the bank account of the University of Udine at INTESA SANPAOLO: **IT59A0306912344100000046097 SWIFT/BIC BCITITMM** reason for payment "Enrolment in PhD programme".

4. Enrollment will be completed by the University of Udine only after the grant financing pursuant to art. 1 paragraph 2.

5. The amount referred to in paragraph 2 is refunded to the winning applicant if the funding is not granted by the Ministry of University and Research (MUR), following the procedures provided for by the regulatory provisions referred to in art. 1 paragraph 2.

6. Non UE Citizens must comply with the rules on visas and residence permits. A copy of the residence permit or – pending the release – the receipt of the application for the residence permit must be submitted to Area Servizi per la Ricerca – Ufficio Formazione per la Ricerca, via Mantica, 31 – 33100 Udine.

7. The university administration assumes no liability for loss of communications due to any errors that cannot be attributed to it.

Art. 12 – REPLACEMENTS

1. Applicants who do not enrol in the terms communicated pursuant to art. 11 are considered to have withdrawn. The positions that have become available, are assigned to other applicants according to the final ranking list, taking into account art. 10.

2. The list of replacement applicants is posted on the official register (https://www.uniud.it/it/albo-ufficiale) and on the PhD website of the University of Udine.

3. The replacement applicants must enrol in the terms and manner which will be communicated by email (art 2 paragraph 7), under penalty of exclusion from the programme.

4. Any further replacements positions will be communicated directly to the relevant applicants.

Art. 13 – SCHOLARSHIPS

1. Scholarships are linked to specific research topics (Tables 1-11).

2. Scholarships are awarded in accordance with art.1 and art 10.

3. The scholarships have a duration of three years, subject to the provisions of art. 20 p. 2 and art. 25 of the Internal Regulations for the PhD Programmes. Scholarships are renewed annually on condition that the PhD student has completed the program of planned activities, as verified by the Teaching Board.

4. The annual gross amount of the scholarship is specified in Tables 1-11 and is subject to the social security tax (INPS a gestione separata). The scholarship is paid on monthly basis in the following month. The amount of the scholarship is increased for research activities abroad by a maximum of 50% for a total period specified in Tables 1-11, unless additional financial resources are available. In any case, the increase is only due to periods of continuous stay and longer than 30 days.

5. The scholarship cannot be allocated to those who have already received a scholarship to attend another PhD programme or an equivalent programme.

6. The scholarship cannot be combined with research grants or other scholarships awarded for any purpose, except for those awarded by national or foreign institutions useful to integrate the abroad research activity of the PhD students. Further incompatibilities are defined by the Internal Regulation for the PhD programmes.

7. In addition to the rights and duties provided for by the relevant legislation (art. 17), in line with the provisions of the regulatory provisions (art. 1 paragraph 2), the winner accepting the scholarship:
- undertakes to carry out the planned period abroad and at the third party as specified in Tables 1-11, aware that the failure in carrying out this period results in the revocation of the scholarship.
- undertakes to submit, in the manner which will be communicated by the University of Udine and in line with the regulatory provisions listed in art. 1 paragraph 2, the research activity report, which also specifies the time commitment (divided into months at a third party, on site, abroad).
- undertakes to ensure the compliance with the obligations regarding communication and information provided for by art. 34 of Regulation (EU) 2021/241, indicating in the project documentation that the Program is funded under the PNRR, with explicit reference to the funding from the European Union and the NextGenerationEU initiative (eg using the phrase "funded from the European Union - NextGenerationEU"), reporting in the project documentation the emblem of the European Union and providing adequate dissemination and promotion of the Program, even online, both web and social, in line with the provisions of the PNRR Communication Strategy;
- is aware that is aware that the modification of the activities, the project goals and the expected results, if not previously authorized by the MUR, entails the revocation of the scholarship;
- is aware that any negative judgement of the Teaching Board and the consequent non-admission to the following year of the PhD programme, the failure to obtain the degree and the waiver to the PhD programme results in the revocation of the scholarship;
- is aware that he must comply with the principle “do not significant harm (DNSH)” to environmental objectives, pursuant to article 17 of Regulation (EU) 2020/852 and ensure consistency with the PNRR positively assessed by the ECOFIN Council Decision of July 13, 2021.
The University of Udine may therefore takes action against the beneficiary for the return of the amounts received in the event of revocation or waiver of the scholarship.

Art. 14 – ACADEMIC FEES

1. For the Academic Year 2022/2023 is foreseen the payment of maximum amount of euro 276,00:
- university contribution, euro 100,00;

- regional tax for the right to university study, from euro 120,00 to euro 160,00 (economic condition of the applicant's family nucleus[7]);
- duty stamp, euro 16,00.

The amount will be requested at the moment of the enrolment and any exemption will applied in accordance with the current legislation.

2. However, the university administration reserves to adopt different regulations for the following academic years.

Art. 15 – PERSONAL DATA

1. The personal data collected under the procedure referred to in art. 6 are necessary for the proper management of the selection procedure, for any subsequent career management and for purposes related to the management of the services provided to students during the university PhD programme. The University of Udine is the "Data Controller". At any time, you can request access, corrections and, according to the University institutional purposes, the cancellation and limitation of the processing or oppose the processing of your data. You can always submit a complaint to the Italian Authority for data protection. The complete information is available on the University of Udine website in the section "privacy" accessible from this link: https://www.uniud.it/it/it/pagine-speciali/guida/privacy

Art. 16 – HEAD OF PROCEDURE

1. The officer in charge of the proceedings is Dr. Sandra Salvador, Head of Area Servizi per la Ricerca of the University of Udine.
The PhD Office of the University of Udine is the Area Servizi per la Ricerca – Ufficio Formazione per la Ricerca, via Mantica n. 31 - 33100 Udine.

2. To request information, fill in the following forms available on the website of the University of Udine:
Information about the Call:

- https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountId=universityofudine&populateSR_id=42104

Information about Esse3:

- https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountId=universityofudine&populateSR_id=42094

Art. 17 – REFERENCE RULES

1. For matters not covered by this Call, please refer to the National legislation in the field of doctoral research mentioned in the introduction, to the Internal Regulations for the PhD programmes and to the Rules of Procedure relating to patents, the regulatory provisions listed in art. 1 paragraph 2 available on the website dedicated to the research doctorate of the University of Udine.

[7] Current legislation about the right to study, ISEE.

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TABLE 1 – PhD Programme in ACCOUNTING AND MANAGEMENT

THE PhD PROGRAMME	
Administrative location	University of Udine, Department of Economics and Statistics (DIES) - via Tomadini 30/A, 33100 Udine, ITALY (tel. +39 0432 249380)
Associated location	University of Verona (Department of Business Administration) – Via Cantarane, 24 - 37129 Verona, ITALY
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location and at the associated programme location, or in other locations of the University of Udine and Verona or in other locations which participate to the doctoral project with which the PhD programme has teaching agreements. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Filippo Zanin (filippo.zanin@uniud.it).
Programme duration	3 years
Curriculum	-
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-social-science-and-humanities/accounting-and-management https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/dies/didattica-dies/dottorati-di-ricerca/phd-accounting-and-management

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea specialistica/magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes, or during the Italian programmes before D.M. 509/99, or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 10.000 characters, spaces included, in English language).
<u>Optional</u> documents (art. 5 of the Call)	1. Letters of reference (max 2), from university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed members	Laura Chiaramonte – Full professor – University of Verona Roberta Capitello – Full professor – University of Verona Cinzia Battistella – Associate professor – University of Udine Filippo Zanin – Associate professor – University of Udine Josanco Floreani – Associate professor – University of Udine
Substitute members	Riccardo Stacchezzini - Full professor – University of Verona Eugenio Comuzzi – Full professor – University of Udine Maria Chiarvesio – Full professor – University of Udine

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TABLE 1 – PhD Programme in ACCOUNTING AND MANAGEMENT

ADMISSION

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions avilable: 2

Detailed description	*N.*	*Funding*	*Annual gross amount*	*Research topic*
Positions WITH SCHOLARSHIP: 2	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001200003	€ 16.243,00	Research topic 1.1: Measurement of efficiency and incentive regulation models for utilities in the ecological transition: water service and waste management in the new paradigm of the circular economy
	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001200003	€ 16.243,00	Research topic 1.2: Performance measurement and evaluation of digitization in the public administration sector

Competition procedure and test schedule

Evaluation of titles and oral examination.
For the evaluation of applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 21 points. The oral examination is passed with at least 49 points. The applicant is admitted to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles.
DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 12, 2022
DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 27, 2022

Foreign language that can be used for examination	English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum		*10*
	Research project		*18*
	Letters of reference		*2*
Oral examination	**As all the classes are held in English, the oral examination will take place in English.**		
Calendar of the oral examination	**Date**	**September 26, 2022**	
	Time	10:00 AM	
	How to conduct the examination	ONLINE, via M TEAMS	
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

Reaserch Topics Description

Research topic 1.1: Measurement of efficiency and incentive regulation models for utilities in the ecological transition: water service and waste management in the new paradigm of the circular economy
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Pubblic Administration

Multidisciplinarity, approach to the PA applied research and to the development of knowledge and skills as per art. 8 p. 1 of the D.M. 351/2022:
The regulation of public services is a field that intersects at least three different disciplinary fields: the economic one, the engineering one, the juridical one and the environmental one. The evolution that took place in the last quarter of a century has opened new scenarios to the role of the public sector and that of the market, magnifying their complementarity, where a more traditional view tends to consider them as antithetical terms. In modern utilities the state tends to carve out above all a role of regulator of processes that take place on the market (both industrial and financial); where the regulatory role is fundamental both to affirm the contents of the "service of general interest" and the related "public service obligations". Far from being resolved in the mere provision of functionality to citizens, the "public utility" assumes the characteristics of an industrial activity for which innovative trajectories and technological choices are of fundamental importance. Regulation cannot limit itself to seeking the correspondence of tariffs to costs and to limiting extra-profits, but must build a framework of incentives aimed at pushing the system towards increasingly ambitious goals in terms of sustainability.
The perimeter of the public service, the prerogative of public administrations and subject to regulation when provided according to industrial models, tends to assume a residual role, while the autonomous initiative of the market is responsible for achieving higher objectives. In the case

TABLE 1 – PhD Programme in ACCOUNTING AND MANAGEMENT

of waste management, for example, enhancement, recovery but also prevention can only result from the innovative effort of market operators, while the public service is responsible for "closing the circle" for all those flows of materials that are impossible to recover otherwise. Also in the water sector there is a similar problem of "decoupling" the social benefit of access to the resource from the mere growth in consumption, pushing towards circular economy models based on the reuse of waste water, on the recovery of sewage sludge, on the search for less impactful hydraulic management models in terms of large infrastructure requirements.
Central to this transition process is the trade-off between the need to ensure adequate capacity of public service networks to meet demand - where a "blackout" is a source of very high social and environmental costs - with the need to address technological supply chains and "value chains" towards a tendency to do without the public service or at least reduce needs (water, energy, disposal) by increasing energy, material and environmental efficiency.
This also requires new ways of measuring performance and identifying the very concept of efficiency.
For these reasons, it is believed that the proposed doctoral program can be said to be fully consistent with the skills referred to in art. 8 c. 1 of Ministerial Decree 351, with particular reference:
- To the first bullet point (reconstruct and interpret the legal framework of reference, national and supranational for the single policy sector, including the secondary rules and the technical / applicative instructions that necessarily integrate said regulatory framework ("specific" techniques, application guidelines, etc.);
- To the second bullet point: "participate in the government, organization and strategic direction of public administrations (both at national, regional and local level) through the implementation of innovative The Minister of University and Research 23 Funded by the Union European NextGenerationEU strategies strongly oriented towards users and the effectiveness of the actions implemented, as well as the enhancement of resources ";
- To the fifth bullet point: "strengthen the administrative capacity in relation to the formulation and design of public policies, both by developing diagnostic skills and by taking responsibility for coordinating the policy cycle with regard to the phenomenology of the possible problems in the problem definition phases and identification of solutions, decisions, implementation and evaluation

Expected aims and results, proposed research activity, methodologies and contents:
The activity is part of a multi-year research program that the proposer has been involved in for some time, aimed at the comparative analysis of the regulatory models applicable to utilities in the water and waste management sector, with the aim of promoting their efficiency and orienting its action and results towards goals that are consistent with the objectives of environmental policies, in line with the principles of sustainable management.
For this reason, the approach adopted aims to overcome a criticality present in the economic literature, where it makes use of purely quantitative output measurements (volumes supplied, quantities disposed of, etc.), risking losing sight of the qualitative component of environmental performance, and therefore to mislead the assessment of efficiency. This could also lead to the identification of inadequate regulation models, which reward cost reduction tout-court neglecting the incentive to maximize environmental performance.
The results of the research therefore intend to support the regulatory activity at national (ARERA) and local level (government bodies of the optimal territorial areas, such as AUSIR in Friuli Venezia Giulia).
The research also aims to investigate institutional and industrial organization aspects (dimensions of management areas, vertical integration, horizontal integration), as well as the space for the introduction of market mechanisms and for private economic initiative, within a framework of complementarity with public initiative
The period spent abroad will be aimed above all at the comparative analysis of the regulatory methods adopted in other countries (particularly interesting for the Italian case is the Portuguese experience, also because in this country the regulatory powers for both sectors are in the hands of the same authority).

Period abroad: 6 months (mandatory)
The doctoral programme includes a period abroad of at least 6 months
The period spent abroad will be aimed above all at the comparative analysis of the regulatory methods adopted in other countries (particularly interesting for the Italian case is the Portuguese experience, also because in this country the regulatory powers for both sectors are in the hands of the same authority).

Foreign Hosting Institution Data:
to be defined in agreement with the candidate also on the basis of the operational research program.
Possible partnerships to be confirmed with:
- Polytechnic University of Lisbon
- University of Italian Switzerland, Lugano
- Florence School of Regulation, European University Institute, Florence

Period at the company, research center or public administration: 6 months (mandatory)
The doctoral programme may include upon agreement with the candidate a period spent by the premises of a private specialized research center and/or of a regulatory authority.

Data of the hosting company, research center or public administration:
REF RICERCHE – Via Aurelio Saffi, 12, 20144 Milano.
AUSIR. Single authority for water services and waste, Friuli Venezia Giulia - Via Poscolle n. 6, 33100 Udine. This Body is the territorially competent body for the local level of the regulation of water and waste services in FVG; DIES has been collaborating with it for some time, supporting both at an operational level and with ad hoc research activities on topics of common interest

Research activity to be developed at the company/research center/public administration:

TABLE 1 – PhD Programme in ACCOUNTING AND MANAGEMENT

Refinement and completion of the Database; collaboration with researchers already involved in research programs on topics similar to those of the project; drafting of working papers aimed at the activities of the "Local Public Services Laboratory", useful tools for discussion with operators and stakeholders in the sector, including regulatory authorities

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: although it is not directly aimed at addressing issues identified as transversal priorities, the project will contribute to their achievement in an indirect way, indicating sustainable ways of supplying local environmental public services, where the concept of sustainability is also central to that of economic accessibility for the weaker social groups. It should also be borne in mind that the services covered by this project are particularly late in the South, both in the case of water (investments still lacking, inefficiencies, infringement procedures, delays in the adoption of industrial management models) and in the case of waste. , with indicators still quite far from the targets set by the "circular economy package" (landfill reduction below 10%, recycling above 65%)
- twin transitions (green and digital): (green and digital): the project aims to facilitate the green transition, suggesting incentive regulation models consistent with the objectives of the ecological transition, with particular reference to the circular economy
- Ddo not significant harm - DNSH: Due to its characteristic, the project does not have and cannot have any implications such as to generate significant damage or hinder in any way the path of ecological transition and environmental sustainability.
- Open science and FAIR Data: Although the data collected in the database developed by the proposer are partly bound by secrecy obligations, having been provided by the companies on a voluntary basis, all the research results will be fully accessible; Within the limits of the constraints imposed by those who provided the data, it is intended to openly share the dataset with the researchers concerned. The proponent, in his academic history, has always also attributed great importance to communication towards a wider audience, as evidenced by the many publications of a popular nature.

Research Topic 1.2: Performance measurement and evaluation of digitization in the public administration sector
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Pubblic Administration

Multidisciplinarity, approach to the PA applied research and to the development of knowledge and skills as per art. 8 p. 1 of the D.M. 351/2022:
The project can be defined as multidisciplinary and oriented to applied research in accordance with the aforementioned standard as:
- requires the reconstruction and interpretation of the legal framework of reference for performance management (letter a art. 8 cit.)
- tends to develop tools for improving management skills and improving administrative capacity in terms of evaluating and formulating public policies (letter a, art.8 cit);
- supports the experimentation of innovative governance tools (letter a, art.8 cit.)
- favors the transition to digital and the greater effectiveness, efficiency and cost-effectiveness of public action (letter a, article 8, cit.)
- provides for the implementation of the entire course at the University premises, except for the periods in a public administration (letter b, Article 8 cit).
- provides for periods of study and research in Public Administrations (letter c, art.8 cit.)
- ensures the student the use of adequate facilities (letter e, article 8, cit.)
- favors the exploitation of research results among the public (letter f, art.8 cit.)
- guarantees compliance with the horizontal principles of the PNRR (letter g, article 8, cit.)

Expected aims and results, proposed research activities, methodologies and contents:
The digitization of the PA represents a radical paradigm shift that has a profound impact on the nature and functioning of performance measurement systems. The relevant dimensions of performance that are influenced by digitisation are: a) the metrics used and their congruence and significance; b) the number of actors involved (both evaluated and evaluators); c) the incorporation of performance measurement systems into other operating systems and organisational processes. Furthermore, the digitization process can be understood as an enabling condition for co-production practices in the public sector. This allows to integrate two approaches in a holistic scheme: a) the measurement and evaluation of the performance of co-production practices in complex multi-stakeholder systems; b) the measurement and evaluation of the performance of digital PA services and processes. The emerging characteristics of the digital PA measurement and evaluation systems will be analyzed into the co-production processes, with particular attention to the mechanisms that are provided by the Italian legal system. The research methodology will mainly be based on the study of multiple cases. The final objective is to contribute to the theoretical debate on performance measurement in the public sector by providing empirical evidence for the efficiency of the tools application.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:
To be defined during the PhD course of study.

Period at the company, research centre or public administration: 6 months (mandatory)

Data of the hosting company, research centre or public administration: Regione Autonoma Friuli Venezia Giulia, Piazza Unità d'Italia, 1 TRIESTE

Research activity to be developed at the company/research centre/public administration: Sectoral applications will be performed at the host PA in terms of experimental development of performance management systems. The host PA will participate in defining the sectoral issues mentioned above, also indicating the specific priorities for analysis and evaluation of digitization performance.

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TABLE 1 – PhD Programme in ACCOUNTING AND MANAGEMENT

PhD Programme is congruence with the PNRR principles and specific obligations:

- Cross priorities;
- Twin transitions (green e digital);
- Do not significant harm – DNSH;
- Open science and FAIR Data. The results of the research activity and related data will be displayed ensuring access to the public in the shortest possible time and the least possible limitations, according to the principles of Open science and FAIR Data.

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

THE PhD PROGRAMME	
Administrative location	University of Udine - Department of Agricultural, Food, Environmental and Animal Sciences (DI4A) – via delle Scienze n. 206, 33100 Udine, ITALY (tel. +39 0432 558600)
Associated location	-
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Walter Baratta (walter.baratta@uniud.it)
Programme duration	3 years
Curriculum	-
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-life-science/alimenti-e-salute-umana/il-dottorato https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/di4a-old/didattica/Dottorato%20in%20Salute%20Umana/PhD%20School%20food%20and%20human%20health

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes, or during the Italian programmes before D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 10.000 characters, spaces included, in English language).
<u>Optional</u> documents (art. 5 of the Call)	1. Master thesis ("Tesi di laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call can submit an extended abstract in place of the complete thesis, in Italian or English language signed by themselves and by their thesis Supervisor (approximate limit: 25.000 characters, spaces included); 2. Publications (max 2); 3. Letters of reference (max 2), from university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed members	MONICA ANESE – Full Professor – University of Udine ROSSELLA DE MARCO – Associate Professor – University of Udine FRANCESCO CURCIO – Full Professor – University of Udine ANTONIO PAOLO BELTRAMI – Assistant Professor – University of Udine LORENZO GENNARI - Soremartec Italia Srl
Substitute members	GIUSEPPE DAMANTE – Full Professor – University of Udine CARLO TASCINI - Associate Professor – University of Udine MARIA CRISTINA NICOLI – Full Professor – University of Udine

ADMISSION
GENERAL COMPETITION (art. 8 of the Call for Applications)
Positions available: 4

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

Detailed description	*N.*	*Funding*	*Annual gross amount*	*Research topic*
Positions **WITH SCHOLARSHIP: 4**	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and Università degli Studi di Udine CUP G23C22001260003	€ 16.243,00	Research topic 1.1 - Assessment of the impact exerted by physical activity and nutritional interventions on animal models exposed to high fat high sugar diet
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Soremartec ITALIA s.r.l. CUP G23D22000750005	€ 16.243,00	Research topic 1.2 - Innovative ingredient solutions for ice-creams
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and VivaBioCell S.p.a. CUP G23D22000750005	€ 16.243,00	Research topic 1.3 - Produzione automatizzata di EVs da MSC per medicina traslazionale
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research topic 1.4 - Synthesis of smart biomolecules from natural sources

Competition procedure and test schedule			
Evaluation of titles and oral examination. For the evaluation of applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. Applicant is admitted to the oral ex examination am if his/her titles receive at least 21 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles. **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 7, 2022** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 20, 2022**			
Foreign language that can be used for examination	Italian or English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum		*10*
	Research project		*14*
	Scientific publications		*2*
	Thesis/Abstract		*2*
	Letters of reference		*2*
Oral examination	Part of the oral examination will be in English.		
Calendar of the oral examination	Date	**15 September 2022**	
	Time	9:00 AM	
	Place	Department of Agricultural, Food, Environmental and Animal Sciences (DI4A) – via Sondrio 2/A, 33100 Udine	
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

Reserch topics Description
Research Topic 1.1 - Assessment of the impact exerted by physical activity and nutritional interventions on animal models exposed to high fat high sugar diet *D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP* Consistency of the proposed research with the NPRR areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral: The PNRR, in its sixth "Health" objective, defines that the reforms and investments proposed with the Plan must "enhance the prevention and treatment capacity of the national health system for the benefit of all citizens, ensuring fair and widespread access to care, and promote the use of innovative technologies in medicine ". In particular, its second component (M6C2) indicates how innovation, research and digitization of the Health Service are a priority for the PNRR, through training, scientific research and technology transfer activities. This project, by evaluating the impact that lifestyles such as nutrition and physical activity exert on the cardiovascular system, appears perfectly in line with the priorities of the

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

PNRR. In fact, the topics covered will be precisely: evaluation of the effectiveness of measures to prevent the onset of cardiovascular diseases. During this project the candidate will have the opportunity to learn both analytical methods and the scientific research method, directly through its practical execution, under the supervision of the reference teachers and colleague Prof. Herrmann.
The project will include numerous disciplines, such as: animal physiology, histopathology, mass spectrometry, molecular and cell biology and bioinformatics. Furthermore, it will involve different sectors, such as the medical and food sectors.
As regards joining international networks, the project starts from an existing collaboration between the proponent and Prof. Markus Herrmann of the Medical University of Graz (Austria), who has already expressed his interest in hosting and co-supervising the activity of a candidate on the specific project.

Expected aims and results, proposed research activity, methodologies and contents:
Obesity associated with the consumption of an excess of carbohydrates and saturated fats is one of the main causes of type 2 diabetes, hypertension and cardiorenal syndrome. Data published by us (1) and preliminary data obtained in our laboratory, also in collaboration with Prof. Herrmann, have shown that a diet rich in fat is able to determine, in sedentary animals, cardiac remodeling, characterized by: hypertrophy, fibrosis, vascular remodeling with hyperplasia of arteriolar smooth muscle cells and cardiomyocyte apoptosis. Preliminary data collected so far seem to indicate that physical activity cannot completely prevent the alterations described.
Objectives: Therefore, the main objective of the project will be: to verify whether and what benefits moderate physical activity can exercise in the prevention of cardiac remodeling. Particular emphasis will be given to the study of the vascular and microvascular components, to possible alterations of cardiac perfusion and metabolism and to the study of pathophysiological mechanisms of damage.
The secondary objective of the project will be: to verify whether substances of natural origin, potentially usable as food supplements, are able to reduce the alterations observed in animals, in in vitro cell models.

Proposed research activity: The research will be divided into 3 phases:
1) Creation and functional analysis of an animal model exposed to a "western" diet subjected or not to moderate physical activity, in analogy to what has been done in (2). The study will be conducted in rats and is expected to include the following study groups (n = 10 usable animals per group; considering the dropouts of previous studies it will be necessary to include approximately 24 animals per group):
a. animals on a standard diet, sedentary;
b. animals on a diet high in fat and carbohydrates, sedentary;
c. animals on a standard diet, trained;
d. animals on a diet high in fat and carbohydrates, trained.
At the end of the training period (10 months), a sample of ≈5 rats will be evaluated by echocardiography to quantify the systolic and diastolic function and sacrificed. The hearts, after being weighed to assess hypertrophy, will be cut in half with a transverse section. The proximal portion will be fixed in formalin, while the more distal one will be frozen in liquid nitrogen and kept at -80 ° C until analysis. At the time of the sacrifice, a blood sample will be taken by puncture of the cardiac apex. The EDTA plasma will be frozen in liquid nitrogen and kept at -80 ° C, until analysis.
2) Multiparametric analysis of heart samples. In order to obtain the greatest amount of information possible, basic histopathological and morphometric analyzes will be performed, as well as omics analyzes on the collected tissues. In particular, we will evaluate:
a. Cardiomyocyte hypertrophy, fibrosis, vascular density (capillaries, arterioles and pericytes), cellular senescence and inflammatory cells.
b. Transcriptomic analysis of frozen hearts, followed by bioinformatics analysis, to assess whether the alterations in gene expression induced by the Western diet are partially reverted by physical activity. Functional annotation bioinformatics analyzes will help to understand the signaling pathways of interest and evaluate them later in in vitro experiments.
c. Study of the hypothalamus / pituitary / adrenal axis and the release of stress steroid hormones in LC-MS / MS, in collaboration with the University of Graz.
d. Lipidomic / metabolomic analysis by MALDI Imaging on frozen hearts will allow to associate the respective anatomical area of interest to specific metabolic alterations.
e. Hypothesis driven analyzes will be conducted to evaluate:
the. MTOR signaling. Literature data indicate that animals fed a "western" diet rich in fructose and fats develop insulin resistance, impaired glucose tolerance, impaired immune system, inflammation and alterations of the cardiovascular system. This is associated with activation of the mTOR pathway, which can be mitigated by administering rapamycin to animals (3). In our laboratory we have described how the hyperactivation of the TORC1 complex in heart failure is associated with cardiac senescence and the activation of the inflammasome (4). Therefore, we believe that this path should be carefully evaluated and that it is of particular interest to study whether physical activity attenuates the hyperactivity of mTOR or if, on the contrary, it can have an additive negative effect.
ii. Brain-heart axis. We have recently shown that the combination of a high-fat diet and psychological stress alter the BDNF-TrkB axis in mice (1). Since the stimulus to physical activity of obese animals could result in psychological stress, we believe it is of interest to evaluate the activation status of this pathway in the proposed animal model.
3) Study of food-borne factors with protective action in in vitro models of pathology. To increase the translational value of our study, we will create in vitro models of lipotoxicity using human heart cells isolated from healthy donors, starting from protocols published in the literature (5). Substances of natural origin of which we have evidence of efficacy in reducing the senescence of cardiac cells obtained from decompensated hearts (eg. Berberine, Fisetin, Resveratrol) will be tested on human cardiac vascular cells (pericytes and coronary microvascular cells) to verify their ability to reduce cellular senescence, apoptosis, activation of the inflammasome and preserving its pro-angiogenic activities.
References:
1. Agrimi J, Spalletti C, Baroni C, Keceli G, Zhu G, Caragnano A, et al. Obese mice exposed to psychosocial stress display cardiac and hippocampal dysfunction associated with local brain-derived neurotrophic factor depletion. EBioMedicine. 2019;47:384-401.
2. Semeraro MD, Almer G, Kaiser M, Zelzer S, Meinitzer A, Scharnagl H, et al. The effects of long-term moderate exercise and Western-type diet on oxidative/nitrosative stress, serum lipids and cytokines in female Sprague Dawley rats. Eur J Nutr. 2022;61(1):255-68.
3. Jia G, Aroor AR, Martinez-Lemus LA, Sowers JR. Overnutrition, mTOR signaling, and cardiovascular diseases. American journal of physiology Regulatory, integrative and comparative physiology. 2014;307(10):R1198-206.
4. Avolio E, Gianfranceschi G, Cesselli D, Caragnano A, Athanasakis E, Katare R, et al. Ex vivo molecular rejuvenation improves the therapeutic activity of senescent human cardiac stem cells in a mouse model of myocardial infarction. Stem Cells. 2014;32(9):2373-85.

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

5. Alsabeeh N, Chausse B, Kakimoto PA, Kowaltowski AJ, Shirihai O. Cell culture models of fatty acid overload: Problems and solutions. Biochim Biophys Acta Mol Cell Biol Lipids. 2018;1863(2):143-51.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:
Medical University of Graz, registered office: Medizinische Universität Graz; Auenbruggerplatz 2; 8036 Graz (Austria).
Operational headquarters: 0108 Klinisches Institut für Medizinische und Chemische Labordiagnostik; 8036 Graz (Austria), Auenbruggerplatz 15

Possible research center involved in definition of the doctoral training:
Prof. Markus Herrmann, Klinisches Institut für Medizinische und Chemische Labordiagnostik, Medical University of Graz.

Research activity to be developed at the research center:
The candidate will carry out the first phase of his/her PhD project (in vivo model of disease) at the host institution, that, in turns, will be involved in the supervision of the candidate and in the critical revision of the project results. Furthermore, the host institution will be involved in writing, reviewing and co-authoring the scientific works that will be generated as a result of the project.

PhD Programme congruence with the NRRP principles and specific obligations:

- transversal priorities: the PNRR for young people indicates as mission 4 the "strengthening of university education, with new scholarships, and the creation of new opportunities for young researchers, with the extension of research doctorates". In this regard, the program illustrated here will place the candidate at the center of an international collaborative network, providing him/her with the opportunity to learn research in a highly stimulating context. The training will take place through the supervision of the research project by both parties involved (University of Graz and University of Udine) and will allow the young researcher to start creating international professional networks whose usefulness in the professional future of young scientists is established.
- twin transitions (green and digital): the project, by promoting the sharing of knowledge and omics data generated by the project from the perspective of the FAIR Data principles, is in line with the twin green and digital transitions. In fact, sharing of the data generated by in vivo and in vitro experiments will allow independent researchers to use it for in silico experiments, thus saving the consumption of resources and reducing the environmental impact.
- do not cause significant damage - DNSH: the research activities will be carried out with a view to not creating significant environmental damage, in compliance with the provisions of Article 17 of Regulation (EU) 2020/852.
- Open science and FAIR Data: all research results will be shared in compliance with the open science principles. Results will be published ensuring open access. The data obtained from the omics analyzes will be made available to the scientific community in order to guarantee the principles of FAIR data.

Contact Professor/Researcher: Francesco Curcio

Research Topic 1.2: Innovative ingredient solutions for ice-creams
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistancy of the proposed research with the PNRR areas of interest:
The research programme is consistent with the objectives of PNRR M4C2 Investiment 3.3. In fact, it is aimed at increasing company competitiveness, though finding new and sustainable ingredients and raw materials; offering cultural growth and job opportunities to young master graduates.

Expected aims and results, proposed research activities, methodologies and contents:
Aims: 1) to select ingredients and raw materials to be used in industrial ice cream production, with nutritional added value and able to satisfy sustainability, technological, sensory and health requisites; 2) to study the performance of the selected ingredients in traditional and plant based formulations.
Research activity: Firstly, innovative and sustainable ingredients intended for industrial ice cream production will be selected on the basis of hedonistic, sensory and health requisites. In particular, protein- (also from vegetable sources), polysaccharide-, lipid-based ingredients will be considered, as well as emulsifiers and stabilizers (such as hydrocolloids). Not only available but also affordable ingredients will be considered. The ingredients will be studied for their technological functionality and attitude to be used in complex formulations, including ice cream and plant-based ice cream. In this regard, in the case of protein based ingredients from vegetable sources, conventional or unconventional treatments could be applied in order to improve their technological functionality and sensory properties. Then, the selected ingredients will be used to produce ice cream on industrial scale, by using the company plant. The products will be tested just after production and during storage under conditions simulating those generally occurring during commercialization (e.g. temperature fluctuation). In particular, the sensory profile of the formulations will be analysed and compared to that of the ice cream prepared with currently used ingredients. Moreover, the nutrients bioaccessibility will be evaluated by means of a standardized methodology simulating in vitro digestion in the adults.
Expected results: 1) identification of ingredients intended for industrial ice cream production with innovative characteristics in terms of availability, affordability, sustainability, technological performance, sensory profile and bioaccessibility; 2) industrial production of ice cream (including plant based ice cream) by using the selected innovative ingredients.

Period abroad: 12 months (mandatory)

Foreign Hosting Institution Data: University of Wageningen, The Netherland

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

Period at the company: 12 months (mandatory)

Data of the company: Soremartec ITALIA s.r.l.

Research activity to be developed at the company:

1) Selection of innovative ingredients to be used in industrial ice cream production, on the basis of current literature and industrial experience. The selection will take into account aspects relevant both to the potential technological performance of the ingredients and supply and sustainability of the production chain.
2) Study of ingredients technological functionality and their aptitude for use in complex formulations such as ice cream and plant based ice cream, which will be produced on industrial scale. In particular, ice cream performances will be evaluated in terms of overrun, melting behaviour, shrinkage, density, viscosity, air and lipid dispersion, as well as sensory properties under conditions simulating those occurring during product commercialization.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: the PNRR for young people indicates as mission 4 the "strengthening of university education, with new scholarships, and the creation of new opportunities for young researchers, with the extension of research doctorates". The proposed research programme will offer to the candidate the opportunity to work in stimulating and diversified environmental contexts (Italian university, foreign university, food industry), where the young researcher not only will acquire advanced knowledge that will enable him/her to accomplish the research aim, but also will establish relationships and collaborations at national and international level, also in a future job perspective.
- Twin transitions (green e digital): the research programme is in agreement with the twin transitions. In fact it is aimed at (a) sharing the generated knowledge within the FAIR data principles; (b) increasing the competitive potential of the industrial product, by providing innovative and sustainable solutions in the ambit of the global supply chain of ingredients and raw materials.
- Do not significant harm - DNSH: the research activities will be carried out with a view to not creating significant environmental damage, in compliance with the provisions of Article 17 of Regulation (EU) 2020/852.
- Open science and FAIR Data: research results will be shared with a view to open science and will be made available to the scientific community in order to guarantee the principles of FAIR data.

Contact Professor/Researcher: Monica Anese

Research Topic 1.3: Automated production of extracellular vesicles from mesenchymal stem cells for personalized medicine
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistancy of the proposed research with the PNRR areas of interest:
M6C2.2 Investment 2.1: Enhancement and strengthening of biomedical research of the NHS. Types of intervention: (i) the financing of Proof of Concept (PoC) projects aimed at reducing the gap between the results of the scientific research sector and the application for industrial purposes, through the preparation of prototypes for the commercialization and mitigation of potential risks - arising from any patents, licenses or barriers to entry - that could discourage market investors; (iii) funding for research programs on highly disabling diseases.

Expected aims and results, proposed research activities, methodologies and contents:
The general objective, with reference to the PNRR issues, is to achieve the Proof of Concept (PoC), at the prototype level, of a system for the automated production and isolation of extracellular vesicles (EcVs) from mesenchymal stem cells obtained from adipose tissue (AMSC). Based on the analysis and characterization of EcVs, and the mitigation of potential risks, the project will pave the way for the commercialization of innovative production systems for the treatment of osteoarthritis (OA) and other highly disabling diseases of the musculoskeletal system. The focus on the treatment of OA derives from the good knowledge of the mechanism of action (MoA), achieved by DAME-UniUD, and from the clinical and production knowledge of AMSC for the specific use, achieved by VivaBioCell (hereinafter referred to as "VBC ").

Specific objectives will be:
Activities
I) definition of the regulatory context:
i. definition of the clinical demand and identification of the therapeutic approaches that are either approved or in an advanced clinical trial phase;
ii. identification of the regulatory requirements for the collection, processing, quality control and production of EcVs for clinical use, with reference to the ISEV and ME-HaD guidelines.
II) optimization and standardization of AMSC culture protocols to be used for the production of EcVs. (POC)
i. Definition of the characteristics of AMSCs that must be satisfied in order to consider them adequate from a therapeutic point of view (eg immunophenotype, multipotentiality, cellular senescence status and secretory characteristics);
ii. Comparison of AMSC growth protocols capable of optimizing cell expansion and vesicle production, while preserving the cellular characteristics defined in point i).
III) optimization and standardization of EcVs isolation methods. (POC)
i. Definition of requests to comply with safety standards regarding microbial and viral contaminants and GxP standards (good manufacturing / good laboratory / good distribution / good clinical / good scientific practice, i.e. GMO / GLP / GDP / GSP).
ii. Comparison of EcVs isolation protocols for yield capacity, purity, ease of transfer in clinical context,
iii. Physical characterization (size) and quantification of EcVs isolated from AMSC supernatant,
iv. Flow cytometric, transcriptomic and proteomic characterization (Western Blotting, MALDI TOF / TOF) to evaluate the composition of EcVs preparations. Part of the proteomic analysis will be carried out at the University of Graz.
v. Correlation study between the characteristics of the EcVs produced by the bioreactor-expanded AMSCs that were clinically employed in the EudraCT clinical study No. 2020-005336-29 and the effectiveness of the treatment.

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

IV) Preclinical study on in vitro model and / or animal model.
i. To identify the biological activity of previously isolated EcVs, we will use a relevant in vitro model, consisting of synoviocytes and chondrocytes isolated from patients suffering from osteoarthritis undergoing knee replacement. The anti-inflammatory capacity of EcVs will be used as a readout.
ii. Once the ideal system of culture and collection of vesicles has been selected, capable of maximizing the biological effect, we will proceed (if possible) to the analysis of the anti-inflammatory capacity in vivo in a model of osteoarthritis in the small animal.
Expected results
a) definition of the regulatory context, of the requirements based on clinical inputs and of the regulatory requirements defined by ISEV and ME-HaD. The guidelines define operational procedures for the collection, processing, quality control and production of EcVs for clinical use.
b) POC: optimization and standardization of AMSC cell culture protocols used for the production of EcVs and optimization and standardization of EcVs isolation methods (POC)
c) characterization of the EcVs and validation of the methods. The validation of the characterization methods is a fundamental step and must be consistent with the regulatory context, which refers to safety standards regarding microbial and viral contaminants and GxP standards (good manufacturing / good laboratory / good distribution / good clinical / good scientific practice, i.e. GMO / GLP / GDP / GSP). The characterization of the EcVs will aim to demonstrate the correlation between the EcVs produced by the expanded AMSCs in bioreactor and used clinically in the EudraCT clinical study No. 2020-005336-29 and the effectiveness of the treatment.
d) to conduct (if feasible) a preclinical study on an animal model, designed to demonstrate the safety of using EcVs isolated from AMSC in vivo.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data (businnes name, legal and operative headquarters):
Medical University of Graz, registered office: Medizinische Universität Graz; Auenbruggerplatz 2; 8036 Graz (Austria).
Operational headquarters: 0108 Klinisches Institut für Medizinische und Chemische Labordiagnostik; 8036 Graz (Austria), Auenbruggerplatz 15

Period at the company: 12 months (mandatory)

Data of the company: VivaBioCell S.p.a., Via Del Cotonificio 127, 33100 Udine

Research activity to be developed at the company:
The general objective will be the automation of cell growth and vesicle production protocols.
Specifically, it is expected:
- a first phase for transferring the growth protocols from the research laboratory to the bioreactor
- a second phase to automate the vesicle isolation protocols starting from the supernatant generated in the bioreactor.

Activities
Evaluation of the preservation of the characteristics of MSCs after their expansion in a bioreactor.
Evaluation of the biophysical and biochemical characteristics of the vesicles produced by MSC expanded in a bioreactor.
Implementation of automated systems for the isolation of vesicles.

Expected results
It is expected:
- the transfer of the culture system from the laboratory to the bioreactor without loss of the characteristics of MSCs and without induction of their senescence,
- the maintenance of the production capacity of vesicles (with characteristics not different from those obtained in the research laboratory) by the MSC, (POC)
- the automation of the vesicle isolation system from the supernatant of MSCs. (POC)

Timing and deadlines.
The duration of the goal "transfer of the culture system and characterization of the MSCs obtained in the bioreactor" will be approximately 3 months,
The duration of the goal "maintaining the production capacity of vesicles" will be approximately 5 months,
The duration of the "automation of the vesicle isolation system" objective will be approximately 4 months.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities

the PNRR for young people indicates as mission 4 the "strengthening of university education, with new scholarships, and the creation of new opportunities for young researchers, with the extension of research doctorates". In this regard, the program illustrated here will place the candidate at the center of an international collaborative network, providing the opportunity to learn research in a highly stimulating context and in a context of technology transfer. The training will take place through the supervision of the research project by all the parties involved (VBC, University of Udine and University of Graz) and will allow the candidate to start creating international professional networks whose usefulness in the future professional of young scientists is well established.

- Climate Goal

The use of the NANT XL automatic closed system bioreactor already in the early phase of the development of therapy with EcVs aims specifically to fine-tune production processes of ATMP, usable in the clinical phase, which allow significant savings (over 95%) of energy compared to to conventional clean room production. These are the savings data compared to a 300 m2 Clean Room:

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

• kWh for 300 m2 operating 24 hours a day - continuous mode: 9,000 kWh
• Energy footprint: 1.91 tCO2e
Use of NANT 001 closed systems in low sterility area (GRADE D):
• kWh for 300 m2 operating 24 hours a day: 432kWh - 95% reduction
• Energy footprint: 0.091 tCO2e - 95% reduction.

- Goal Gender equality and protection and enhancement of young people
• VBC has always pursued the goal of gender equality and the enhancement of young people, and has launched training activities in order to obtain the UNI / PdR 125: 2022 certification for gender equality
• They are part of the Bio Group n. 6PhD, including 4 women. The direct supervision and operational coordination of this doctoral project will be entrusted to Alice PAULITTI, PhD

- Do not do significant harm - DNSH
The research activities will be carried out with a view to not creating significant environmental damage, in compliance with the provisions of Article 17 of Regulation (EU) 2020/852.

- Open science and FAIR Data
All non-proprietary research results will be shared with a view to open science and will be published ensuring open access. The data obtained from the omics analyzes will be made available to the scientific community in order to guarantee the principles of FAIR data.

Contact Professor/Researcher: Francesco Curcio

Research Topic 1.4: Synthesis of smart biomolecules from natural sources
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem

Consistancy of the proposed research with the PNRR areas of interest:
The project is in line with the "MISSION 4: education and research" of the PNRR within which the project Ecosystems for Innovation-iNEST: Interconnected North-East Innovation Ecosystem is articulated and aligns with the C2 component-from research to enterprise. The PhD student's project is part of the activities planned for the group of researchers from Udine affiliated to Spoke 7 (Smart Agrifood).
The Smart-AgriFood project is characterized by a high multidisciplinarity and the PhD student, in addition to mainly carrying out research activities in the field of molecule synthesis processes, he will collaborate with the researchers of the project providing highly qualified analytical support (with chemical, chemical-physical functional, biofunctional analysis) for the characterization of different matrices (vegetable and animal and microbial derivatives) and related extracts of interest for the project.
Expected aims and results, proposed research activities, methodologies and contents:

Abstract**:**
Biomolecules derived from plants are widely used for their therapeutic effect but are not without side effects. Very interesting approaches involve the synthesis of mimetics of biomolecules of natural origin with the aim of reducing undesirable effects, increasing metabolic stability and therapeutic efficacy by exploiting innovative processes with low environmental impact and involving the use of non-toxic reagents and solvents, limiting the formation of by-products.
The research project concerns the synthesis of biomolecules with antimicrobial activity with peptide-mimetic structure using synthesis techniques in solution and in solid phase.
The biomolecule will be bound with metal complexes that will confer a synergistic effect that will enhance the biological activity of the system. The complex will be functionalized on nanoparticles that will be obtained from waste obtained from the harvest and containing bentonite. To develop the research theme, synergies will be exploited between the research group of the University of Udine that has a strong experience in the synthesis of biologically active compounds, the University agricultural company for obtaining bentonite and the other members of the iNEST group for biological activity.
The proposed research project is in line with the PhD of "Food and human health" and involves the synthesis of biomolecules and nanomaterials, deriving from vegetable waste obtained from agri-food processing without affecting crops, through a circular economy logic. The proposed project has a strong impact both from a scientific and technological point of view, as well as on an economic and environmental one. In this research, two themes closely related to sustainability merge, namely the development of green processes with no by-products / solvents and lower energy consumption, and at the same time the use of silicon-rich agri-food waste for the synthesis of nanomaterials that can be used as nano-carriers and for drug-delivery.

Expected aims and results, proposed research activities, methodologies and contents:
The project focuses on the synthesis of biologically active molecules with peptide structure and their functionalization with nanoparticles. The nanoparticles are synthesized starting from silicon extracted from agri-food waste such as those of the harvest of which the territory of the North-East is particularly rich.
To increase the metabolic stability of biologically active compounds, heterocycles, non-natural amino acids, beta amino acids will be introduced and head-to-tail macrocyclization will be used. The products will be analyzed from a conformational point of view. The biomolecules obtained will be linked to metal complexes to increase biological activity by exploiting the synergistic effect. The system thus prepared will be functionalized on nanoparticles and will be subjected to metabolic stability tests and in vitro tests that will be carried out in collaboration with the other members of the iNEST group. The PhD student's research activity includes a first phase aimed at bibliographic analysis for the extraction of silicon and the synthesis of nanomaterial. Subsequently, the candidate will deal with the synthesis of biomolecules and their characterization. At the same time,

TABLE 2 – PhD Programme in FOOD AND HUMAN HEALTH

he will deal with the chemical-physical characterization of biomolecules extracted from the other components of the iNEST project from agri-food waste and bacterial origin and will make a comparison between the effectiveness of the synthesized molecules and that of the corresponding natural molecules extracted from selected raw materials or of microbial origin. The laboratories of University of Udine are structured for the manipulation, preparation of substances in inert atmosphere and are equipped with the instruments for the chemical characterization. The nanoparticles will be characterized by IR spectrophotometry, Dynamic Light Scattering (DLS), potential zeta.
As part of this research, the PhD student will have to report on the development of research both through internal reports and seminars and at international congresses presenting the results obtained. Finally, the results may be published and possibly patented by the University of Udine. The PhD student will acquire a series of skills related to the critical analysis of the literature, design and development of new biomolecules and nanomaterials, understanding and analysis of data, writing articles, presentation of results.

Expected results:
1) Synthesis of biologically active compounds.
2) Synthesis of new nanomaterials derived from food waste.
3) Characterization of biomolecules from food waste or microbial origin of interest to the iNEST group.
4) Biological test in collaboration with the laboratories of the iNEST group.
5) Expected results in terms of publications: 3 articles.

Methodologies and contents:
1) Synthesis in solid phase and in solution and characterization of biomolecules.
2) Synthesis of new nanomaterials and characterization by DLS, IR, zeta potential.
3) Biological assay.

Period abroad: 6 months (mandatory)

TABLE 3 – PhD Programme in BIOMEDICAL AND BIOTECHNOLOGICAL SCIENCES

THE PhD PROGRAMME	
Administrative location	University of Udine, Department of Medical Area (DAME) –via Colugna 50, 33100 Udine, ITALY (tel. +39 0432 494301).
Associated location	C.R.O. - Centro di Riferimento Oncologico (National Cancer Institute Aviano) – via Franco Gallini 2, 33081 Aviano (PN) ITALY.
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Alessandra Corazza (alessandra.corazza@uniud.it)
Programme duration	3 years
Curriculum	-
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-life-science/scienze-biomediche-e-biotecnologiche/il-dottorato https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/dame/ricerca/dottorati/biomedical-biotechnological-sciences

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND TITLES TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes or during the Italian programmes before D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 10.000 characters, spaces included).
<u>Optional</u> documents (art. 5 of the Call)	1. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call can submit an extended abstract in place of the complete thesis, in Italian or English language, signed by themselves and by their thesis Supervisor (approximate limit: 25.000 characters, spaces included); 2. Motivation letter by which the applicant explains the reasons for admission to the PhD programme, dated and signed (approximate limit: 1.000 characters, spaces included); 3. Publications (max 2); 4. Letters of reference (max 2) written by university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed Members	Carlo Pucillo – Full professor – University of Udine Giovanna Lippe – Associate Professor – University of Udine Alessandra Corazza – Associate professor – University of Udine
Substitute Members	Claudio Brancolini – Full professor – University of Udine Giulia Antoniali – Associate Professor – University of Udine Luigi Xodo – Full Professor – University of Udine

ADMISSION
GENERAL COMPETITION (art. 8 of the Call for Applications)

TABLE 3 – PhD Programme in BIOMEDICAL AND BIOTECHNOLOGICAL SCIENCES

Positions available: 1				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 1	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001290003	€ 16.243,00	Research Topic 1.1 - Investigation of the molecular mechanisms of mitochondrial transition pore formation using Nuclear Magnetic Resonance.

Competition procedure and test schedule			
Evaluation of titles and oral examination. For the evaluation of applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. Applicant is admitted to the oral examination if his/her titles receive at least 15 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles. **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 7, 2022** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 20, 2022**			
Foreign language that can be used for examination	Italian or English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae		*2*
	Scientific publications		*2*
	Thesis/Abstract		*3*
	Letters of reference		*2*
	Motivation letter for admission to the PhD programme		*2*
	Grades reported in the exams taken in the undergraduate programmes		*7*
	Masters, additional training courses, experiences abroad, etc. etc		*2*
	Research project: - Central hypothesis - Objectives - Research Design Max. 10000 characters (spaces included)		*8*
Oral examination	Part of the oral examination will be in English.		
Calendar of the oral examination	**Date**	**14-15 September 2022**	
	Time	09:00 AM	
	Place	Department of Medical Area (DAME), Seminar Room – Piazzale Kolbe 4, 33100 Udine ITALY	
	Based on the number of applicants, the oral examination may take more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

Research Topics Description

Research Topic 1.1: Investigation of the molecular mechanisms of mitochondrial transition pore formation using Nuclear Magnetic Resonance.
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP

Consistency of the proposed research with the NRRP areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral.

The study is part of the scientific-technological areas of the NRRP. The interdisciplinarity is intrinsic to the project as evidenced by the belonging of the proponents to two distinct areas. Prof. Corazza has expertise in biophysics and Nuclear Magnetic Resonance (NMR) (ERC sectors LS1_9 and PE3_16), prof. Lippe has Biochemical skills (ERC sector LS1_2). The candidate will then acquire an interdisciplinary training. The international character is ensured by the collaboration between the Biophysics group and the leading British research center in the field of molecular / structural studies of proteins. A close and consolidated collaboration between the Udine Biochemistry Laboratory and the Mitochondria Physiology Laboratory of the University of Padua led by Prof. P. Bernardi will offer further opportunities for exchange and enrichment for the candidate.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:

University College London
Division of Medicine
Wolfson Drug Discovery Unit, Centre for Amyloidosis and Acute Phase Proteins London NW3 2PF.

Possible research center involved in definition of the doctoral training:

TABLE 3 – PhD Programme in BIOMEDICAL AND BIOTECHNOLOGICAL SCIENCES

CNR Neuroscience Institute – University of Padova - Italy

Research activity to be developed at the research center:

Study of the effect of CyPD and variants on F-ATP synthase channel activity through patch-clamp measurements.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: In the announcement it will be clearly stated that the candidate will be selected regardless origin, religion, disability, age or sexual orientation.
- Twin transitions (green e digital): Digital skills will have to be developed by the candidate during the project for the treatment of large amounts of data, such as NMR data. Furthermore, intensive use of structural databases is foreseen. These skills may be spent by the candidate also in future work areas.
- do not significant harm - DNSH: The study will not affect significantly the environment. Particular attention will be paid to the conscious use of materials and online platforms will be used for scientific meetings to limit the increase of CO_2 in the environment.
- Open science and FAIR Data: Data will be published in open access journals and the NMR and structural data in the public databases BMRB (Biological Magnetic Resonance Bank) and PDB (Protein Data Bank), respectively.

Contact Professor/Researcher: Alessandra Corazza, Giovanna Lippe.

TABLE 4 – PhD Programme MATHEMATICAL AND PHYSICAL SCIENCES

THE PhD PROGRAMME	
Administrative location	University of Udine - Department of Mathematics, Computer Science and Physics (DMIF) – via delle Scienze 206, 33100 Udine, Italy (+39 0432 558400).
Associated location	-
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof.ssa Roberta Musina (roberta.musina@uniud.it)
Programme duration	3 years
Curriculum	-
Research topics	- MATHEMATICS: Algebra and Topology; Numerical analysis; Mathematical and functional analysis; Algebraic geometry; Mathematical logic; Dynamical systems; Statistics; Operation research; Mathematics for applied economics and finance. - PHYSICS: Astrophysics; Physics education; Particle physics; Advanced detection systems; Bio- and Nanosystems simulation. More details at https://www.dmif.uniud.it/dottorato/smf/collegio-docenti/
Research programs	Decided by the Teaching Board within the PhD programme Research topics.
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-physical-science-and-engineering/scienze-matematiche-e-fisiche/il-dottorato https://www.dmif.uniud.it/dottorato/smf/

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and Decree DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND TITLES TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
Compulsory documents (Art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme (with candidate's grade and highest possible grade) and certified list of the exams (with candidate's grades, average grade, highest possible grade) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes or during the Italian programmes ante D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call must submit an extended abstract in place of the complete thesis, in Italian or English language, signed by the thesis Supervisor (between 15.000 and 25.000 characters, spaces included); 5. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 5.000-10.000 characters, spaces included, in English language).
Optional documents (Art. 5 of the Call)	1. Motivation letter from the applicant explaining the reasons for admission to the PhD programme, dated and signed (between 1.500 and 2.500 characters, spaces included); 2. Publications (max 3); 3. Letters of reference (max 2) written by university professors, scientific researchers or other experts in the field (art. 6 of the Call).
All documents must be presented exclusively in PDF format, dated and signed by the candidate.	

SELECTION COMMITTEE	
Appointed Members	Dimitri Breda – Associate Professor – University of Udine Davide Liessi – Assistant Professor – University of Udine Rossana Vermiglio – Full Professor – University of Udine

TABLE 4 – PhD Programme MATHEMATICAL AND PHYSICAL SCIENCES

Alternate Members	Enrico Bozzo – Assistant Professor – University of Udine Roberta Musina – Full Professor – University of Udine

ADMISSION

GENERAL COMPETITION (art. 9 of the Call for Applications)

Positions avilable: 1				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 1	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001320003	€ 16.243,00	Research Topic 1.1 - Computational methods for analyzing the dynamics of certain diseases

Competition procedure and test schedule

Evaluation of titles and oral examination.
For the evaluation of applicants' attitude for scientific research and their basic skills before the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 15 points. The oral examination is passed with at least 49 points. The applicant is eligible for the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles.
DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 9, 2022
DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 23, 2022

Foreign language that can be used for examination	Italian or English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum and Scientific publications		*10*
	Title and average grade of exams and Thesis/Abstract		*10*
	Research project and Applicant's letters (Motivation letter + Letters of reference)		*10*
Oral examination	Interview about titles, previous career and research project also aimed at understanding the applicant's knowledge about fundamental topics in computer science, mathematics and/or physics, as well as his or her full eligibility to receive a scholarship funded by external institutions. Reading and understanding a short scientific text in English.		
Calendar of the oral examination	**Date**	**20 September 2022**	
	Time	9:00 AM	
	How to conduct the examination	The oral examination will be held online.	
	Based on the number of applicants, the oral examination may take more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

Descrizione tematiche di ricerca

Research Topic 1.1: Computational methods for analyzing the dynamics of certain diseases
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP

Consistency of the proposed research with the NRRP areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral: starting from available competences, the research proposal aims at introducing new computational methodologies for investigating the dynamics of mathematical models able to describe the evolution of diseases characterized by individual traits that, as age, immunity or socio-economical behaviors, can play a fundamental role in their treatment or transmission. Among these, the focus will be on the influence of gender, studying the adaptability of certain techniques to the case when the gender differences or the relevant social behaviors turn out to be essential in the diffusion or control of certain diseases (e.g., autoimmune diseases vs some forms of cancer, where the gender can characterize the immune system, or epidemics whose transmission can be affected as well). The goal is that of furnishing effective and suitable computational tools, easily usable in the biomedical-health compartment to monitor, predict and prevent in a context of effective planning. The subject fits within the scope of interests of PNRR "M6C2 innovation, research and digitalization of the national health service", with the goal of "strenghtening the scientific research in the biomedical and health context" through "enhancement and development of biomedical research in the NHS" (specifically, "enhancing the italian system of biomedical research, strengthening the reaction capabilities of the centers of excellence in Italy in the field of rare pathologies and fostering the technological transfer between research and enterprises" through "financing research programs or projects in the fields of rare diseases and tumors […] or on highly disabling diseases."). On the other hand the proposed research line is itself interdisciplinary, both inside the mathematical area (requiring competences in nonlinear, functional, numerical and computational analysis) and outside the latter having to interact with modeling aspects,

TABLE 4 – PhD Programme MATHEMATICAL AND PHYSICAL SCIENCES

resorting to modern approaches typical of systems biology. Furthermore, the project has an intersectorial character, being based on unavoidable and fruitful interactions with the medical-health areas and biology in general. Finally, the proposing research group is part of an international collaboration network including renowned centers in both the mathematical and biological/health-oriented applications areas (Girona, Helsinki, Manchester, Szeged, Torino,Toronto, Trento, Utrecht, Valladolid tra gli altri), and it is part of the MUR/PRIN 2020 project (No. 2020JLWP23) "Integrated Mathematical Approaches to Socio-Epidemiological Dynamics" (CUP: E15F21005420006).

Expected aims and results, proposed research activity, methodologies and contents: the objective of the current project proposal is twofold: on the one hand, the computational/numerical/analytical study of new mathematical models aimed at effectively describing the evolution of certain diseases and the influence that gender can exert on them beyond other characterizing features (as, e.g., age, immunity, spatial or geographical position); on the other hand the development of relevant computational tools that can be easily employed in the biomedical-health context, as effective means to monitoring, predicting, planning and thus preventing. The PhD program aims at forming a young candidate towards interdisciplinary, intersectorial and international research at the highest level, who can then continuously contribute to innovation in this area where mathematics interact with biology and medicine, producing at the end of the three years prototypical software that can be used as a basis for further developments. The results will be published in international journals of recognized value, in a "Open Science" and "FAIR Data" persepctive, other than being presented at the most important conferences both in the mathematical and applicative areas. The employed methodologies will range from the theoretical-modeling analysis to the numerical investigation and implementation, accompanied by suitable calibration, simulation and testing. The context offers several deepening opportunities along different research directions, also strategically directed depending on the features and skills of the candidate, thus enriching the innovation potential of the proposed thematic. The contents on which applying what above described will be concerned with mathematical models of epidemics and population dynamics to be developed on the basis of the most recent literature (including the enormous post-pandemic production), in which inserting and adapting characterizing and structural elements like, indeed, the influence of gender.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:

- YORK University, Keele Campus, 4700 Keele Street, Toronto,
- ON M3J1P3 (Canada);Universidad de Valladolid, Palacio de Santa Cruz, 47002 Valladolid (Spagna).

Possible research center involved in definition of the doctoral training:

- YORKU: LIAM – Laboratory for Industrial and Applied Mathematics
  - https://liam.lab.yorku.ca/
- UVa: Doctorate in Mathematics
  - http://escueladoctorado.uva.es/export/sites/doctorado/programas/matematicas/index.html

Research activity to be developed at the research center:

- YORKU: deepening modeling aspects and interactions with the biological-health context for model calibration based on available data;
- UVa: deepening numerical/computational aspects on models of population dynamics basde on partial differential equations.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: the current proposal is congruent with the PNRR cross priority related to young people in Italy, being their formation and occupation opportunity a clear objective.
- Twin transitions (green e digitale): the current proposal contributes to the digitalization process through the creation of comptuational tools to be employed in the biological-health area.
- do not significant harm – DNSH: the current proposal does not bring any damage to the environment.
- Open science and FAIR Data: the obtained results of the current proposal will be immediately made publicly available on international journals (open access when possible) according the the "Open Science" and "FAIR Data" principles.

Contact Professor/Researcher: Rossana Vermiglio, Dimitri Breda.

TABLE 5 – PhD Programme in ART HISTORY, FILM STUDIES, MEDIA STUDIES AND MUSIC

THE PhD PROGRAMME	
Administrative location	University of Udine, Department of Humanities and Cultural Heritage (DIUM) - vicolo Florio 2, 33100 Udine (+39 0432 556100)
Associated location	-
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Alessandro Del Puppo (alessandro.delpuppo@uniud.it)
Programme duration	3 years
Curricula	1. Art History 2. Film Studies, Media Studies, Music
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-social-science-and-humanities/storia-dellarte-cinema-media-audiovisivi-e-musica/il-dottorato https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/dium/ricerca/dottorati-di-ricerca/studi-storico-artistici-e-audiovisivi/indice

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	One of the following: English, French, German, Spanish

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes, or during the Italian programmes before D.M. 509/99, or during the foreign academic programmes; 2. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call must submit an extended abstract in place of the complete thesis, in Italian or English language, signed by themselves and by their thesis Supervisor (approximate limit 25.000 characters, spaces included); 3. Curriculum vitae et studiorum, dated and signed; 4. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 5. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 20.000 character, spaces included, in English/Italian language). The project's structure should touch upon the following questions: - Objectives; - State of the art; - Methodology; - Achievable results; - Timeline; - Bibliography.
<u>Optional</u> documents (art. 5 of the Call)	1. Motivation letter by which the applicant explains the reasons for admission to the PhD programme, dated and signed (approximate limit 2.500 characters, spaces included); 2. Publications (max 5).

SELECTION COMMITTEE	
Appointed members	Mariapia Comand – Full Professor – University of Udine Andrea Mariani– Associate Professor – University of Udine Simone Venturini – Associate Professor – University of Udine
Substitute members	Francesco Pitassio – Full Professor – University of Udine Simone Dotto – Assistant Professor – University of Udine

ADMISSION

TABLE 5 – PhD Programme in ART HISTORY, FILM STUDIES, MEDIA STUDIES AND MUSIC

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions avilable: 2				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 2	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001240003	€ 16.243,00	Research Topic 1.1 - The "historical enterprise". Audiovisual archives, amateur film collections and memories of industrial work in Friuli Venezia Giulia: mapping, enhancement of cultural heritage and digital storytelling
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.2 - Visual Storytelling and Digital Film studies for Italian film history

Competition procedure and test schedule

Evaluation of titles and oral examination.
For the evaluation of applicants' attitude for scientific research and their basic skills before the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 21 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles.
DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 9, 2022
DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 23, 2022

Foreign language that can be used for examination	Italian, English and/or French		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum		*3*
	Research project		*16*
	Scientific publications		*3*
	Thesis/Abstract		*7*
	Motivational letter for admission to the PhD programme		*1*
Oral examination	The oral examination aims at verifying the research skills of the applicants, with particular reference to the research project.		
Calendar of the oral examintion	**Date**	**20 September 2022**	
	Time	09:00 AM	
	Location	Department of Humanities and Cultural Heritage (DIUM) - Sala del lampadario, Palazzo Caiselli, vicolo Florio 2, 33100 Udine.	
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

Research Topics Description

Research Topic 1.1 - The "historical enterprise". Audiovisual archives, amateur film collections and memories of industrial work in Friuli Venezia Giulia: mapping, enhancement of cultural heritage and digital storytelling
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Cultural Heritage

Consistency of the proposed research with the topics of as per art. 9 p. 1 of M.D.351/2022:
AREA CUN 10 - Scienze dell'antichità, filologico letterarie e storico-artistiche, on the topics: Media, patrimonio e beni culturali

Expected aims and results, proposed research activities, methodologies, and contents:
The research will account for the evolution of industrial work in the Friuli region within the 1900–1960-time frame, ranging from the early years of the XX century to the post-war period and contemplating the main stages of industrialization. In particular, the research will focus both on "corporate" archival sources (especially film and audiovisual material) and on the "spontaneous" ones (amateur films and laborers' oral witnesses), with the aim to reconstruct a multifaceted story of the collective and organized work.

An interdisciplinary methodological framework will draw its tools from: 1) history of non-theatrical and useful cinema (considering non-fiction and amateur films as sources and agents of public and private stories); 2) digital humanities (using data visualization, geo-mapping and other digital methods to research and enhance archival heritage); 4) storytelling and public history (using narrative strategies to disseminate historical knowledge and archival assets to the lay audience, both in off-line and on-line exhibition contexts).
Period at the company, research center or public administration, museums, institutes of the Ministry of Culture, archives, libraries included:
6 months (mandatory)

TABLE 5 – PhD Programme in ART HISTORY, FILM STUDIES, MEDIA STUDIES AND MUSIC

Data of the hosting company, research center or public administration, museums, institutes of the Ministry of Culture, archives, libraries inscluded:
Associazione culturale "Archimede e Domenico Taverna", Largo Carlo Melzi, 2, 33100 Udine UD

Research activity to be developed at the company/research center/public administration/archives/etc.:
During the time spent at the "Archimede and Domenico Taverna" Cultural Association the PhD students will indentify the archival funds related to the history of the regional industry, encouraging the emergence of private collection and archival assets by members of Confindustria.

PhD Programme congruence with the PNRR principles and specific obligations:
- *Cross Priorities:* the proposed research program is coherent with the actions envisaged for the cross priorities 4.1 ("Youth"), particularly, with the needs to increase of youth employment, to enhance vocational training, and to reduce the gaps between school education and the job market. Outlining a cross-path between university education and professional training the program aims at balancing the skills acquired during the PhD on the needs of the company, thus easing the PhD research entry into the workforce.
- *Twin transitions (green and digital): the* focus on digital methods as tools for the retrieval and reconstruction of archival assets of business history suits the needs outlined by the PNRR transition program, allowing the acquisition of specific skills that the researcher can subsequently transfer to the advantage of the partner companies. Furthermore, the preservation, digitization and dissemination of audiovisual heritage are in line with some initiatives envisioned by the PNRR in the field of Cultural Heritage - in particular, the creation of new digital cultural services and the consolidation of an accessibility policy in archives and museums (M1.C3.1 - Cultural heritage for the next generation; M1.C3.4 - Cultural and creative industry 4.0)
- *Do Not Significant Harm - DNSH:* Research activities meet the criteria of minimal / insignificant impact according to the DNSH principles as applied to Mission 1 - "Digitalization, innovation, competitiveness, culture and tourism" (investments in professional training) and to Mission 4 - Component 1 "Education and Research" (investments in technological transition, training in digital tools)
Open science and FAIR Data: the collection and systematization of the considered archival corpora entails in itself a contribution to the principles of findability, accessibility, interoperability and reusability that govern FAIR Data policies, all the more significant when related to corporate and private archives which are usually hardly accessible to researchers. To reinforce this line of openness, the PhD programme encourage a scientific publication in an international or national A-tier journal in Gold Open Access format.

Contact Professor/Researcher: Mariapia Comand

Research Topic 1.2: Visual Storytelling and Digital Film studies for Italian film history
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem

Description: The path of research must combine the area of Film/media Studies, with specific attention to the history of Italian cinema, with the methods of management, visualization and divulgation that digital technologies permit. To this end, the candidate will be called upon to delve into the field of digital film studies, intended as a correlation between traditional film studies and the new infrastructures, environments, digital studies applications, and research valorization, particularly in the direction of Visual storytelling and Data visualization.

Period abroad: 6 months (optional)

TABLE 6 – PhD Programme in LINGUISTICS AND LITERATURE

THE PHD PROGRAMME	
Administrative location	University of Udine, Department of Languages and Literatures, Communication, Education and Society (DILL) - Palazzo Antonini - Via Petracco, 8 – Udine 33100 (ph. +39 0432 556750).
Associated location	University of Trieste (Department of Law, Language, Interpreting and Translation Studies; Department of Humanities) - Piazzale Europa 1, 34127 Trieste.
Locations of lectures, seminars, and research activities	Lectures, seminars and research activities will be held at the Universities of Udine and Trieste. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Leonardo Buonomo (buonomo@units.it)
Programme duration	3 years
Curricula	1. Foreign Literatures; 2. Linguistics, Translation, Interpretation; 3. Italian Studies.
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-social-science-and-humanities/studi-linguistici-e-letterari https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/dill/content/ricerca/dottorato-di-ricerca

ADMISSION REQUIREMENTS	
Degree required	Italian "Laurea Magistrale/MA degree" (ex DM 270/04): LM-5 in Archival and Library Studies; LM-14 in Modern Philology; LM-15 in Classical Philology, Literature and History; LM-37 in Modern European and American Languages and Literatures; LM-38 in Modern Languages for International Communication and Cooperation; LM-39 in Linguistics; LM-78 in Philosophical Sciences; LM-94 in Specialized Translation and Interpreting; LM-85bis five-year degree in Primary Education. Italian "Laurea" (prior to DM 509/99) or Italian Laurea specialistica (ex DM 509/1999) equivalent to the MA degrees mentioned above (in accordance to DI 9/07/2009). For foreign degrees and titles: see articles 3 and 4 of the Call for applications.
Knowledge of the following foreign language	French.

APPLICATION REQUIREMENTS	
Mandatory Documents (art. 5 of the Call)	1. Proof of BA and MA degree (refer to art. 5 paragraph 5 of the Call) and transcripts of records from all universities attended prior to the application, including degrees conferred prior to the implementation of the Bologna process (i.e. prior to D.M. 509/99) and degrees obtained abroad; 2. Curriculum Vitae, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (maximum 10.000 characters, spaces included, in Italian or English language); 5. A copy of the candidate's thesis submitted in fulfilment of the master's degree. Applicants who have not graduated before the application deadline must submit an extended abstract in place of the complete thesis, in Italian or English Language, signed by themselves and by their thesis supervisor (min 15,000 - max 25,000 characters, spaces included).
Optional documents (art. 5 of the Call)	1 Publications (max 2);

SELECTION COMMITTEE	
Appointed members	Alessandra Ferraro – Full Professor – University of Udine Fabio Regattin – Assistant Professor – University of Udine Francesca Todesco – Associate Professor – University of Udine
Substitute members	Nadine Celotti – Full Professor – University of Trieste Loredana Trovato – Associate Professor – University of Trieste

ADMISSION

TABLE 6 – PhD Programme in LINGUISTICS AND LITERATURE

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions available: 1				
Detailed description	***N.***	***Funding institution***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 1	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001230003	€ 16.243,00	Research Topic 1.1 – Text and Iconography in the editions of Charles Perrault's Fairy Tales: an Inter-Media Database

Competition procedure and test schedule

Evaluation of application materials, written and oral examination.
For the evaluation of the applicants' aptitude for research and study, the Selection Committee can assign up to 100 points to each candidate:
- max 30 points for the evaluation of the candidates' application materials: CV, research project, publications and MA thesis (or thesis abstract);
- max 70 points for the oral examination.

The applicant is admitted to the oral examination if his/her application materials receive at least 21 points. Applicants are considered eligible for the PhD programme if they receive at least 49 points in the written and oral examination combined. Only for eligible applicants, the points assigned to the application materials will be added to the points obtained in the oral examination.

THE LIST OF CANDIDATES ADMITTED TO THE ORAL EXAMINATION WILL BE MADE PUBLIC NO LATER THAN: 7 September, 2022
THE FINAL RANKING LIST OF APPLICANTS WILL BE MADE PUBLIC NO LATER THAN: 27 September, 2022

Language in which the exam can be taken	Italian		
Criteria for the evaluation of CVs, research projects, publications, and thesis *The Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae		*6*
	Research project		*14*
	Publications		*5*
	Thesis/Abstract		*5*
Oral examination	The oral examination will consist of a discussion of the candidate's research project. The oral examination will also include a conversation in French.		
Oral examination schedule	**Date**	**14 September 2022**	
	Time	12:00 PM	
	Location	The oral examination will be held in person at the following address: Centro di Cultura Canadese, Università di Udine, via Petracco, 8, Udine.	
	Depending on the number of applicants, the oral examination may take more than one day. Applicants must produce a valid ID for admission to the oral examination.		

Research Topics Description

Research Topic 1.1: Text and Iconography in the editions of Charles Perrault's Fairy Tales: an Inter-Media Database
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Cultural Heritage

Pertinence of the research proposal to the topics listed in the Ministerial Decree n. 351/2022, Art.9, c.1.
The research project is consistent with the topics pertaining to Area 10, namely Media, Cultural Heritage and Assets; the project is to be completed within the duration of the PhD program, inclusive of class attendance, research and assessment, at the administrative and operational locations of the Universities of Udine and Trieste; it requires an overall period of study and research abroad of at least six months; it ensures that the PhD candidate be given access to qualified and specialized facilities in order to conduct study and research activities; it facilitates the promotion of research results and ensures the protection of intellectual property, guaranteeing public access to research results and data (in the shortest possible amount of time and with a minimum of limitations, according to the "Open science" and "FAIR data" principles; it guarantees respect for PNRR's principles of horizontal communication.

Expected objectives and results, description of the research proposal, methodology and contents:
The analysis of the illustrations of the various editions of the *contes* will trace the evolution of the iconography of the *contes de fées* from the end of the 17th to the mid-19th century. It will also establish the role and autonomy of the illustrations within the history and economy of Perrault's fairy tales, and provide an interpretation or re-interpretation of the texts. These systematic analyses will also satisfy the current need for research pertaining to the tales' sources and will thus help to reconstruct Europe's literary and cultural *milieux*.

In addition, a comparative analysis of illustrated editions will highlight paradigmatic relations and discrepancies between the different representations of the same fairy-tale episodes, thus shedding light on the intricacies of the social dynamics at play from the late 17th to the mid-19th century. Given the large number of publishers covered by the project, it will be possible to highlight their distinctive approach to the texts they printed by paying particular attention to both the cultural and social aspects of their products. The examination of these aspects might well provide answers to social questions that remain relevant to this day.

TABLE 6 – PhD Programme in LINGUISTICS AND LITERATURE

Moreover, the study of the relationship between text and image will call attention to both the diversity of, and the affinity between, the two modes of expression, thus connecting these two artistic forms. Both modes of expression will be shown to contribute to the success of the narrative, by offering two harmonious – or discordant – vehicles of representation, intended to create a "medium" that stimulates the reader/viewer's imagination.

Finally, the creation of an online database will constitute an example of the kind of technological innovations that can enhance the humanities. Accordingly, the project will explore new ways to promote and enjoy our cultural heritage: it will be accessible, inclusive and innovative, thus responding to the current demand for the digitalization of documentary holdings.

Different methodological approaches will be employed, drawing upon both *soft and hard sciences*, thus reinforcing the interdisciplinary, multidisciplinary and multi-area nature of the project. In particular, the analysis of iconography and the relationship between text and image will be based on the experimental work conducted by the *Centre interdisciplinaire d'étude des littératures* of the University of Aix-Marseille, including the concepts of «scène, plan et dispositif» and «l'entre-deux» developed, respectively, by Stéphane Lojkine and Benoît Tane between 2000 and 2015. The textual and semiotic analysis of sources will draw upon Greimasian and Bremondian principles as well as Propp's narratology. The project will also tap into studies on textual rhetoric and the semiology of images, availing itself of the latest investigations on the "visual turn", as well as those of Marc Soriano, among others, regarding Perrault and his tales.

Duration of research work to be done abroad: 6 months (mandatory)

Information on the foreign host entity: Aix-Marseille Université, établissement public national à caractère scientifique, culturel et professionnel; Jardin du Pharo, 58 boulevard Charles Livon - 13284 Marseille Cedex 07, France;
operational headquarters CIELAM - Centre interdisciplinaire d'étude des littératures d'Aix-Marseille, Maison de la Recherche, 29 avenue Robert Schuman - 13621 Aix-en-Provence, France.

Duration of the PhD Candidate's internship at a company, research centre or a Public Administration facility, including museums, institutes of the Ministry for Culture, archives, and libraries**:** 6 months (mandatory).

Information on the company, research centre or Public Adminstration facility where the research activity will be conducted, including museums, institutes of the Ministry for Culture, libraries:
Biblioteca di Aix-en-Provence
legal headquarters: Bibliothèque Méjanes, Cité du livre, 13100 Aix-en-Provence Francia
operational headquarters: Bibliothèque patrimoniale et archives municipales Michel-Vovelle 25, allée de Philadephie, 13100 Aix-en-Provence Francia, and other libraries.

Research activity to be conducted at a company or in a research centre/a Public Administration facility/an archive/ etc.: bibliographic and iconographic research.

Pertinence of the PhD program with the specific principles and obligations of PNNR:

- transversal priorities: the transversal, multidisciplinary and multi-area character of the program is of the utmost importance and is what distinguishes it.
- twin transitions (green and digital): the corpus at the center of the project is already accessible online, which ensures its digital and green nature, in that it will not require travel or transportation, nor the production of hard-copy material.
- Do no significant harm – DNSH: the project will not do any significant harm to the environment, because the facilities in which it will be conducted are public buildings which meet European and national standards.
- Open science and FAIR Data: the results of the project will be made public and available to the public at large through the creation of an inclusive and participatory community which will dispense with barriers and promote the democratic right to access information.

Supervising professor: Alessandra Ferraro

TABLE 7 – PhD Programme in LAW AND INNOVATION IN THE EUROPEAN LEGAL SPACE

THE PHD PROGRAMME	
Administrative location	University of Udine, Department of Legal Science (DISG), via Treppo 18, 33100 Udine, ITALY (tel. +39 0432 249520)
Associated location	University of Trieste (Department of Legal, Language, Interpreting and Translation studies) - piazzale Europa 1, 34127 Trieste, ITALY
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof.ssa Laura Montanari (laura.montanari@uniud.it)
Programme duration	3 years
Curricula	1. Private and Economic Area: (IUS/01 Private Law, IUS/02 Comparative Private Law, IUS/03 Agrarian Law, IUS/04 Commercial Law, IUS/06 Maritime Law, IUS/07 Labour Law, IUS/18 Roman Law) 2. Public Area: (IUS/08 Constitutional Law, IUS/10 Administrative Law, IUS/21 Comparative Public Law, IUS/13 International Law, IUS/14 European Law, IUS/12 Tax Law, IUS/15 Civil Procedure; IUS/17 Criminal Law, IUS/16 Criminal Procedure)
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-social-science-and-humanities/diritto-per-linnovazione-dello-spazio-giuridico-europeo/il-dottorato/diritto-per-linnovazione-nello-spazio-giuridico-europeo https://disg.uniud.it/ricerca/dottorato-in-diritto-per-linnovazione-nello-spazio-giuridico-europeo

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
Compulsory documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and mark degree. Applicants with qualification not yet obtained must submit certification or self-certification (as art. 5 paragraph 5 of the Call) of the academic degree needed for admission to the PhD programme and list of exams (list of exams: single score, average score and maximum score); 2. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 3. A research project, dated and signed, developed in accordance with the description of one of the four research topics listed in the Table and the related scientific domains (SSD) (IUS/04, IUS/06 and IUS/21) which highlights the contribution that the applicant can offer to the development of the same topic (approximate limit 10,000 characters, spaces included, in English language).
Optional documents (art. 5 of the Call)	-

SELECTION COMMITTEE	
Appointed members	Prof.ssa Elena D'Orlando – Full Professor – University of Udine Prof. Vittorio Giorgi – Full Professor – University of Udine Prof. Daniele Casciano – Associate Professor – University of Udine
Substitute members	Prof.ssa Laura Montanari – Full Professor – University of Udine Dott.ssa Linda Miotto – Associate Professor – University of Udine Prof. Alfredo Antonini – Full Professor – University of Udine

ADMISSION

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions available: 4				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***

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Positions WITH SCHOLARSHIP: 4	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001210003	€ 16.243,00	Research Topic 1.1 - Regional autonomy and economic development instruments
	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001210003	€ 16.243,00	Research Topic 1.2 - Cross-border conversion: legal mobility of companies in the digital age and the ecological transition
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.3 - Digitalisation of transport documents and smart contracts; technical and legal issues and prospects of development for the transport and logistics chain
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.4 - Tangible and Intangible Cultural Heritage: the Case of Ecomuseums

Competition procedure and test schedule		
Evaluation of qualifications and oral examinations. For the evaluation of applicants' attitude for scientific research and their knowledge to develop the topic of interest, the Selection Committee can attribute up to 100 points to each applicant: at most 30 points to the qualifications and at most 70 points to the oral examination. The applicant is admitted to the interview if he/she scores at least 21 points for the qualifications. The oral examination is passed by scoring at least 49 points. The applicant is eligible for the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the qualifications. Enrolment in the PhD programme for winner applicants with not yet obtained degree will be possible only if the degree mark obtained is equal or greater than 95/110 (see art. 3 paragraph 2 of the Call). **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 7, 2022.** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 20, 2022.**		
Foreign language that can be used for examinations	Italian or English	
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Graduation mark: from 95 to 99 from 100 to 101 *from 102 to 104* *105* *106* *107* *108* *109* *110 and 110 cum laude* For applicants with not yet obtained degree only the average of the exams regarding the academic title needed to access to the PhD programme will be evaluated: *from 25 to 25,99* *from 26 to 26,99* *from 27 to 27,99* *from 28 to 28,99* *from 29 to 29,99* *30 and 30 cum laude*	 *1 points* *3 points* *4 points* *5 points* *6 points* *7 points* *8 points* *9 points* *10 points* *1 points* *4 points* *6 points* *8 points* *9 points* *10 points*
	Research project	*20 points*

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Oral examination	The oral examination could be carried out in Italian or in English. It will consist of a discussion about the to the Research project ad general topic referred to the scientific domain (SSD): selected. The interview will be evaluated according to the following criteria: level of knowledge of the themes of the proposed project; critical presentation skills; suitable use of legal language. The oral examiantion will also assess the knowledge of English language.	
Calendar of the oral examination	**Date**	**September 12, 2022**
	Time	2:30 PM
	Place	The oral examination will be held online (MS Teams)
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid identification document for admission to the oral examination.	

Research Topics Description

Research Topic 1.1: Regional autonomy and economic development instruments (IUS/21)
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Pubblic Administration

Multidisciplinarity, approach to the PA applied research and to the development of knowledge and skills as per art. 8 p. 1 of the D.M. 351/2022:
The legal framework in the field of public contracts is characterised by a significant complexity, deriving from the coexistence of supranational, state and regional sources, which can be appreciated both in the domestic system and in a comparative perspective (with specific reference to the European area). In this context, the purpose of the research is to contribute to the definition of the scope and limits within which the regional level of government can pursue public policies and equip itself with corresponding regulatory instruments.

The research activity will also contribute to identifying tools for assessing the action and organisation of the regional and local PA in the phases of planning, awarding and execution of public contracts, in order to foster the improvement of the regulatory framework at the regional level and the adoption of strategies aimed at achieving more efficient and citizen-oriented results and the valorisation of resources.
The presence of the PhD student within the regional administrative structure for a period of six months will be able to fit into the policy cycle relating to the subject under consideration and the research will be able to provide support in the stages of identifying problems and the most effective solutions to solve them.

The digital transition also plays a strategic role in the topic analysed: the digitalisation profiles of public evidence procedures are evolving and will be the subject of appropriate analysis.

The multidisciplinarity of the programme emerges from the joint use of different methodical approaches. First of all, the legal approach and, specifically, that of public law, aimed at studying current legislation, case law and legal scholars' papers, also using a comparative method. Secondly, the perspectives of science of administration and of public management will be considered, aiming at the empirical verification of the functioning of the system at regional level, through the use of economic-statistical data and policy proposals.

Expected aims and results, proposed research activities, methodologies and contents.

Proposed research activities:
The research aims to investigate the space enjoyed by the autonomy of a Region with a special statute, such as Friuli Venezia Giulia, in the regulation of public contracts, a crucial and strategic area of public intervention in the economy, which is often the subject of conflicts of competence between State and the Regions.
From this perspective, the research also aims to investigate the legal solutions implemented in other Regions with a special statute as well as in other European legal systems (in particular in the French and German legal systems), in order to compare the criticalities and advantages of the choices made in each of them and to highlight those that appear most suitable for ensuring the legal certainty of the regulatory framework on the subject, the simplification and efficiency of the procedures, and the increase in the use of innovative and collaborative contractual figures (such as public-private partnerships and innovation partnerships).

Methodologies:
The analysis of the division of legislative and administrative competences at national level and of the regulations on public contracts is carried out using the legal method, starting from the regulatory reconstruction and proceeding to the study of constitutional and administrative case law and the contributions of legal scholars. The analysis of administrative practice at the regional level is carried out on the basis of documentation and information gathered from the region, especially during the research period at the PA. In this case, specific contributions from other disciplines (e.g. science of administration, public management) may also be helpful. The research and systematisation of foreign regulations are carried out using comparative methodology, also assessing their effective application.

Expected aims and results:
The objective of the research is to clarify the possibilities of legislative and administrative intervention for the Friuli Venezia Giulia Region in the field of public contracts and to outline the possible regulatory and administrative solutions to be adopted, in order to ensure the following objectives: legal certainty and the consequent reduction of litigation; regulatory simplification, given the possibility of adopting an organic regional regulation of public contracts, in a uniform manner for the three sectors of works, services and supplies, in compliance with statutory limits, European regulations and in accordance with the indications provided by constitutional case law; operability and efficiency of the sector. In a

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comparative perspective, the regulations in force in other Regions with special statutes and in the main European legal systems characterised by the presence of constitutionally guaranteed territorial autonomies will be analysed.
Regional and local authorities, moreover, will be able to benefit from the results of the research in order to rethink the discipline of administrative procedures in thies field and, consequently, the administrative organisation.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:
University of Saarland, Saarland University Campus, 66123 Saarbrücken, Germany.

Period at the company, research center or public administration: 6 months (mandatory)

Data of the hosting company, research center or public administration:
Autonomous Region Friuli Venezia Giulia, piazza Unità d'Italia 1 Trieste – Direzione centrale infrastrutture e territorio, Udine - Via Sabbadini, 31

Research activity to be developed at the company/research center/public administration:
This period aims to pursue the following purposes
- to focus on the main problems encountered by the Region and local authorities in relation to public procurement procedures;
- to identify the solutions that could be implemented also on the basis of the information given by the administration;
- to come into direct contact with the administrative procedures involved in the research topic.

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: 1. Youth and 2. Gender equity: the research highlights the new skills needed by PA to improve the effectiveness of administrative action, making it possible to devise training and recruitment paths that enhance the contribution of young people and women. 3. Territorial imbalances: regulatory improvement in relation to the acquisition of goods and services by the PA is necessary for the realisation of infrastructures suitable for overcoming territorial gaps.

- Twin transitions (green e digitale): The regulation of public contracts is strategic for both objectives. The digitisation of PA is one of the main instruments of innovation in the field of public contracts, of which the PhD candidate will be able to assess room for improvement or extension at regional level. Regional legislative and/or administrative powers pursue the objective of protecting the environment and regional ecosystems when selecting offers and executing the contract.
- do not significant harm - DNSH: The research activity is mainly carried out with the aid of bibliographic material, which can be accessed in the library or by means of IT tools, and therefore has a very limited environmental impact.
- Open science and FAIR Data: Many of the leading scientific journals in the scientific field interested by the project are online and in open access. PhD students will be encouraged to publish in such journals in order to ensure maximum accessibility and dissemination of their research work.

Contact Professor/Researcher: Elena D'Orlando

Research Topic 1.2: Cross-border conversion: legal mobility of companies in the digital age and the ecological transition (IUS/04)
D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) – Pubblic Administration

Multidisciplinarity, approach to the PA applied research and to the development of knowledge and skills as per art. 8 p. 1 of the D.M. 351/2022:

The recent regulations on public contracts and procurements, introducing in the award procedures the theme of compliance with social and environmental sustainability requirements, integrate an incentive for European companies to remodulate their systems not only of production, but also of governance, until considering the change of the *lex societatis* through cross-border conversions. Indeed, one of the issues that European company law will face in the near future is the integration of intra-European mobility of companies with the current turning point on environmental sustainability, which opens up new global perspectives for interaction not only between private enterprises but also between them and public administrations, which are in turn to entrust the execution of works, the provision of products or the provision of services, including on the basis of their ability to combine economic growth and environmental protection.

The theme of the digital and environmental transition requires research that considers public and European company law together, united by the equal desire to lay the legal foundations for a system in which "doing business" is more dynamic and competitive, both in the private market and in public procurement, for economic growth that is compatible with environmental protection. Deemed the fundamental role played by public procurement in the national and European economy, it seems to be of central importance to avoid "downward" environmental regulatory arbitrage countering the exit and entry of companies that want to enjoy less stringent environmental regulations, and indirectly promoting environmental awareness. At the same time, it can operate in the opposite direction with respect to the harmonization, laying the foundations for an "upward" environmental regulatory arbitrage, aimed at attracting foreign companies not for the lower degree of environmental regulation, but for the best degree of environmental protection that the legal system recognizes.

It is also appropriate to highlight how a digitalized system, which simplifies bureaucracy, can be one of the main reasons for a cross-border conversion towards Italy, in general, and more specifically by the most virtuous companies in environmental protection, with a view to an intra-European mobility that promotes sustainability.

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Expected aims and results, proposed research activities, methodologies and contents:

Proposed research activities: Enjoying the economic, legal and social advantages in the European single market involves moving towards a system of "doing business" more flexible, also from the point of view of the *lex societatis*. Indeed, if business goals require a legal and environmental context that is more in line with new needs, companies must be guaranteed the right to change their legal system without interruption about their legal personality, also with a perspective to participate to European public procurements focused on eco-sustainability objectives. Directive 2019/2121 promotes these purposes, being intended to ensure a European harmonization on the transformative phenomenon, through a single procedure and specific safeguards for those subjects most exposed to the risks of the operation.
In this perspective, a joint reading with Directive 2019/1151/EU on the digitalization of European company law may be of interest, in the light of which cross-border conversions can be facilitated both from the point of view of the formation of the company and from the point of view of registration, links to the BRIS system.
At the same time, in the field of cross-border conversion, the theme of environmental sustainability involves several issues: from the correct information on the environmental impact (as regulated by the proposal for Directive 2021/0104/COD), to the emersion of abusive phenomena of "environmental tourism", and to the "green" financing of extraordinary operations of this nature.
These different profiles are combined in the environmental interest, that is necessary to investigate what position and what protection can and should obtain – in our and in other European legal systems – alongside and with respect to the concepts of social interest, shareholders and creditors, as well as in relation to the concept of public interest, in the perspective of a new horizontal subsidiarity that engage public administrations and private companies in a common support for the purpose of sustainability.

Methodologies: The research will have to analyze a "model" operation such as the cross-border conversion of an Italian company to the Kingdom of Spain. The Iberian country is one of the preferred destinations in the European context, thanks to the presence of some advantageous procedural aspects (e.g. with regard to the effectiveness of share capital) and the predecessor regulation (one of the first in the EU, contained in Ley 3/2009) on the transfer of the registered seat abroad (assumption of cross-border transformation).
From a methodological point of view, the research will also have to be carried out with particular attention to operational aspects, as well as purely scientific ones: analysis of the impact of the project under a long-term perspective, empirical measurement, application of scientific paradigms and models. The research path must include the analysis of practical cases, weighed against the considerations present in the most recent jurisprudential rulings both at national and European level; all in comparison with the main doctrinal views spread in the context of EU.

Expected aims and results: The proposed research is oriented:
- to identify, within the framework of intra-European mobility of companies, recently regulated, a procedure for cross-border conversion that is compatible with the new digital business model and sustainable with the "green" enterprise system, enhancing the role of the PA;
- to promote the spread, in the legal environment, of a positive revaluation of the cross-border conversion operation - to date hampered by the interpretation of the rules of many European legal systems - as a functional tool to make participation in public contracts more competitive;
- to encourage the implementation of a sustainable public procurement model, focused on achieving a balance between the intra-European mobility of enterprises and the three pillars, economic, social and environmental, at all stages of the award process.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data:
Universidad Complutense de Madrid, *Facultad de Derecho*, in Madrid, or at *Instituto de Empresa*, *IE Law School*, in Madrid.

Period at the company, research center or public administration: 6 months (mandatory)

Data of the hosting company, research center or public administration:
CODOGNOTTO Italia S.p.A., Via Calnuova, 18 – 31040 – Salgareda (TV), Italy.

Research activity to be developed at the company/research center/public administration:

The main research activities will be aimed at developing the purposes of the educational project and, in particular, will consist in a study of the national and foreign disciplines applicable to the concrete cases submitted by the Company, in order to assess and implement, in particular, cross-border conversion operations, by comparing them with alternative legal and economic solutions, and by considering the drafting of clauses to be included in social, shareholders' and contractual agreements, including with regard to the ecological and digital transition, and with a view to participation in public procurement procedures.
Enriched by knowledge of negotiating practices, including international ones, and at the same time by an understanding of the assessments and needs expressed by companies in the election of the seat and the type of company, the comparative study of disciplines could better outline the conditions for making digitization and environmental sustainability effective in a European dimension. In particular, the research identified as being of interest could be carried out, based on the critical comparison between practical cases and the jurisprudential and doctrinal, as well as regulatory, guidelines being outlined in the Union context.

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: to identify a cross-border transformative process that can be implemented mainly through a digitized system, which is adequately compatible with the role of the PA, with the benefit of bridging the structural inequalities in our legal system with regard to access to the business world, with a view to a path of internationalization at the intra-European level.
Mainly, the advantages that can be drawn from such a set discipline regard: the decrease of the procedural costs, therefore encouraging the start-ups, the small and microenterprises; the speed and practicality, to the advantage of the younger entrepreneurial generations, wishing of a more

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accessible world of business; the absence of the necessity of the constant physical presence of the entrepreneur, thus favoring especially female entrepreneurs, that they can be free to embark on a path of competitive enterprise without having to give up projects on the family; and finally, the enhancement of the Italian territory, encouraging the creation of digital infrastructures in the Southern to enable companies located in that area to exploit the opportunities of corporate mobility, and to attract conversions of foreign companies to the Southern, with the benefit of reducing the economic and industrial competitive gap of that territory.
- Twin transitions (green and digital): the object of the research, involving digital issues, aims to promote a transition that effectively includes digitized procedures as a structural element of corporate life. At the same time, by weighing up the transformative procedure of eco-sustainability, the ecological perspective is promoted, and its developments in economic terms, as an unavoidable component of the enterprise, acting as a requirement for admission and compatibility to the new European single market.
- Do No Significant Harm - DNSH: through digitization and over all the calibration of the transformative process, in the sense of binding the success and effectiveness of the operation, with compatibility to the needs of "zero environmental impact". The aim of the research will be to stem phenomena in which the desire to circumvent environmental regulations is the main reason for intra-European mobility.
- Open science and FAIR Data: the research should be accompanied by the publication of some contributions in scientific reviews of national relevance, preferably (at least one) open science.

Contact Professor/Researcher: Vittorio Giorgi

Research Topic 1.3: Digitalisation of transport documents and smart contracts; technical and legal issues and prospects of development for the transport and logistics chain (IUS/06)
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem

Expected aims and results, proposed research activities, methodologies and contents:

Proposed research activities: In an international context characterised by a generalised insecurity and instability of the supply chains, a wildly swinging trend and a decline in demand, growing needs in terms of automation and use of advanced production techniques (to a large extent based on artificial intelligence solutions, connectivity and data analytics abilities), a crucial role played by swift, fully-integrated and sustainable logistics and mobility systems, the completion of the green and digital transition is an absolute priority.
Indeed, digitalisation has assumed a crucial role in every economic and social context. This is all the more true in the context of the transport sector, where the advent of information and communication technologies (ICT) has contributed to the overall operational efficiency of the supply chain and has radically changed the methods of providing services.
An area in which ICT can bring multiple benefits is that relating to transport documentation: the use of electronic transport documents is, in fact, able to facilitate the containment of management costs, speed up administrative processes, reduce the environmental impact, facilitate the sharing of information in real time, avoid the problems associated with the loss, destruction or theft of paper documents. However, the dissemination of electronic documentation in the transport sector is still not adequately developed due to bottlenecks determined by factors such as the absence of an organic discipline on the subject, the lack of a uniform technical framework as to the platforms used, the potential vulnerability of the latter with respect to unauthorised accesses and accidents. Particular problems, in this context, arise with reference to the main document devoted to the carriage of goods by sea, the bill of lading, taking into account the critical issues that the dematerialisation implies in relation to its characteristics as a document of title of the goods carried, capable of circulating and being negotiated for the purpose of transferring the goods themselves.
The research aims at examining these issues and identifying the existing regulatory gaps, on both a private and a public law level, for the full equation of electronic transport documents to their paper counterparts, within the context of the domestic, international-uniform and European legal systems, in order to make proposals for overcoming such obstacles that fit with the framework laid down by the recent adoption of Regulation (EU) No. 2020/1056 on eFTI (electronic freight transport information).
The technical-regulatory issues relating to the implementation of smart contracts and the perspective of the creation of NFT (non-fungible tokens) in the transport and logistics sectors will also be addressed.

Methodologies: The research methodology will be primarily based on the mapping and subsequent analysis of the legislation on digital transport documents and smart contracts in force at a national, European and international level – both from a comparative perspective with reference to the solutions adopted in other legal systems, and with regard to uniform law conventions on the subject regulating or in any case recognising the use of electronic transport documents (e.g. Montreal Convention of 1999; Rules of Rotterdam; Additional e-CMR Protocol of 2008) – as well as on the examination of the courts' decisions and the positions of scholars developed in this regard.
The legal method will be married up with an approach aimed at identifying and framing the critical issues and possible obstacles that enterprises and economic operators face with reference to the digitalisation of transport and logistics: in this perspective, an empirical investigation will be undergone involving public and private stakeholders that operate within the socio-economic local and regional system in order to assess the extent to which electronic transport documents are currently employed, the type of systems and platforms used and the problems related to this.

Expected aims and results: The aim of the research is to identify which legislative interventions and contractual praxis could be implemented in order to promote the digitalisation of the transport chain, with a view to developing advanced and sustainable logistics services, functionally integrated with other economic sectors, with specific regard to the manufacturing one.
In particular, moving from the reconnaissance of the issues that specifically affect the ecosystem of the Italian North-Eastern regions, the research purports:

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- to outline the possible solutions that, at a legal level, can be adopted to overcome the existing technical-regulatory bottlenecks that hinder the full and widespread affirmation of digital transport documents, with specific reference to the transfer and circulation of the bill of lading and of other similar documents of title;
- to explore the potential of IT technologies based on Distributed Registers in the integration of IT infrastructures in use in the transport and logistics sector, in particular through the implementation of smart contracts and NFT (non-fungible tokens).

Period abroad: 6 months (optional)

Foreign Hosting Institution Data:
To be defined during the PhD programme of study.

Contact Professor/Researcher: Daniele Casciano

Research Topic 1.4: Tangible and Intangible Cultural Heritage: the Case of Ecomuseums (IUS/21)
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem

Expected aims and results, proposed research activities, methodologies and contents:

Proposed research activities: The mountain as a complex anthropic and natural ecosystem is an extraordinary laboratory for innovation in ecosystem management and for developing strategies, models, and tools that, under an appropriate regulatory framework, promote local development and, in particular, assuring the presence of humans with a good quality of life. The mountains are a privileged place for the development of the tangible and intangible cultural heritage that has in fact led to an original civilisation, the Alpine civilisation, which combines tradition and innovation. The mountain offers awareness of the need for new potentialities, experimenting specific keys to interpret the social network, the institutions governing the territory and public and private organizations interested in the cultural heritage.
In this context, also in the light of the general goals of the Ecosystem for Innovation, one of the 11 funded under the PNNR, a legal approach to cultural development is of fundamental importance, taking into account the national framework, both of the State (Cultural Heritage and Landscape Code) and the Regions (regional sectoral laws, intersecting the valorisation of cultural heritage, local museums and the protection of the environment and territory), but also the indications emerging both at European level (e.g. the Faro Convention, the European Convention for the Protection of Archaeological Heritage, and the 2000 European Landscape Convention) and international level (UNESCO Conventions on Intangible Heritage). Special attention should be paid to processes directly involving local communities, in particular in the establishment of ecomuseums and local ethnographic museums, but also private collections of testimonies of tradition.
The ecomuseum is at the same time a museum form, an institution, a process and a project of local development, a pact with which a community commits to take care of a territory, a museum without walls and barriers in any sense. It can be described as a cultural reality with tasks of conservation, documentation, and valorisation of heritage within a territorial, political and social context, aiming at social integration and local development.
The research aims to investigate, within the above-mentioned context, the regulation of local museums and in particular ecomuseums in mountain areas, taking into account the administrative and management aspects, as well as the public and private actors involved.
In this perspective, the research will examine the solutions adopted in Friuli Venezia Giulia (where seven active ecomuseums have been established under regional law L. R. 10/2006, now abrogated, and the subsequent modifications, in particular L.R. 23/2015, *Regional law on cultural heritage*: https://www.ccm.it/it/16122/Rete-Ecomusei-FVG) and in the other Italian mountain Regions, particularly the Regions and Provinces of the Spoke reference area, as well as those currently under discussion at a national level. Furthermore, considering the origin and development of the ecomuseum, the research will analyse other European legal systems, first and foremost the French one, in order to assess criticalities and advantages and identify a good regulatory framework and best practices, aimed at procedural simplification and efficiency.

Methodologies: The first step of the research will be the reconstruction of the current regulatory framework, considering also the constitutional and administrative case law and legal doctrine. Secondly, the comparative method will be used to draw indications from the frameworks of other Countries, considering the diffusion of the ecomuseum model since the 1970s, due to its role as an economic source and as an active territorial presidium at local level. Third, the intersection of the object of the research with social phenomena makes it appropriate to consider some contributions from the social sciences, for example, in analysing the participatory processes that characterise these experiences. Finally, the discussion with the institutions of the Friuli Venezia Giulia Region will provide an opportunity to verify the collected data and assess the effectiveness of the adopted solutions.

Expected aims and results: The main objective of the research is to build a reference framework for local museums and ecomuseums of the mountain areas of the territories involved in the Spoke and in particular the Friuli Venezia Giulia Region. In particular, the aim is to identify the contents and procedures for the establishment of new museums and ecomuseums in the mountain area, being innovative, valuable, and functional to the local governance. On the other hand, the research activity will also help to identify tools for monitoring over time the administrative action and organisation. The Regions and local authorities will benefit from the results of the research in order to develop policies for the conservation, protection and enhancement of heritage in the ecomuseum context.

Period abroad: 6 months (optional)

TABLE 7 – PhD Programme in LAW AND INNOVATION IN THE EUROPEAN LEGAL SPACE

Foreign Hosting Institution Data:
To be defined during the PhD programme of study.

Contact Professor/Researcher: Laura Montanari

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

THE PhD PROGRAMME	
Administrative Location	University of Udine - Department of Mathematics, Computer Science and Physics (DMIF) – via delle Scienze 206, 33100 Udine, Italy (+39 0432 558400).
Associated Location	Fondazione Bruno Kessler – 77 via Santa Croce, 38122 Trento (TN), Italy
Location for Training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Federico Fontana – University of Udine (coordinatore.iai@liste.uniud.it)
Programme duration	3 years
Curriculum	-
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-physical-science-and-engineering/informatica-e-intelligenza-artificiale/il-dottorato https://www.dmif.uniud.it/dottorato/iai/ https://phd.fbk.eu/https://phd.fbk.eu/

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea Specialistica/Magistrale (ex DM 509/1999 and Decree DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND TITLES TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
Compulsory documents (Art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme (with candidate's grade and highest possible grade) and officially certified list of the exams (with candidate's grades, average grade, highest possible grade) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes or during the Italian programmes ante D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call must submit an extended abstract in place of the complete thesis, in Italian or English language, signed by the thesis Supervisor (between 15.000 and 25.000 characters, spaces included); 5. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (between 5.000 and 10.000 characters, spaces included, in English language); 6. Motivation letter from the Applicant explaining the reasons for admission to the PhD programme, dated and signed (between 1.500 and 2.500 characters, spaces included) 7. A statement concerning the choice of research topic(s).
Optional documents (Art. 5 of the Call)	1. Publications (max 3); 2. Recommendation letters (max 2) written by university professors, scientific researchers or other experts in the specific research topics (art. 6 of the Call).
All titles must be presented exclusively in PDF format, dated and signed by the candidate.	

SELECTION COMMITTEE	
Appointed Members	Agostino Dovier – Full Professor – University of Udine Giuseppe Serra – Associate Professor – University of Udine Fabio Buttussi – Assistant Professor – University of Udine Massimiliano Anziutti – External Expert – beanTech S.R.L. Matteo Chini – External Expert – Ferriere Nord S.p.A. Andrea Dalla Torre – External Expert – u-blox Italia S.p.A. Fabio Poiesi – External Expert – Fondazione Bruno Kessler Marco Ometto – External Expert – Danieli Automation S.p.A. Andrea Soranzio – External Expert – INSIEL S.p.A.
Alternate Members	Gian Luca Foresti – Full Professor – University of Udine Christian Micheloni – Full Professor – University di Udine Angelo Montanari – Full Professor – University of Udine Federico Fontana – associate professor – University of Udine

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

	Marino Miculan – associate professor – Università di Udine Carla Maria Modena – external expert – Fondazione Bruno Kessler.

ADMISSION

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions available: 10				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 10	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001270003	€ 16.243,00	Research Topic 1.1 - Extended reality and metaverse to train complex abilities
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and beanTech S.R.L. CUP G23D22000760005	€ 16.243,00	Research Topic 1.2 - Artificial intelligence solutions and algorithm application to industrial streaming data
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Danieli Automation Spa CUP G23D22000760005	€ 16.243,00	Research Topic 1.3 - Model implementation of the Intelligent factory in a steel manufacturing industry context with specific regard to principles, algorithms, models and methods for the anticipatory detection of events perturbing the production conditions, and related mechanisms for optimal recovery of normal process conditions
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Ferriere Nord SpA CUP G23D22000760005	€ 16.243,00	Research Topic 1.4 – Development, support and integration process of artificial intelligence systems in the Ferriere Nord steel production context
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and INSIEL - informatica per il sistema degli enti locali spa CUP G23D22000760005	€ 16.243,00	Research Topic 1.5 - Resilience of the Public Administration digital services
	1	D.D. n.3138 of 16 December 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 1.4) - National Research Centre for Agricultural Technologies (Agritech) CN00000022 CUP G23C22001100007	€ 16.243,00	Research Topic 1.6 – Deep Learning for Agriculture and Environment
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and u-blox Italia S.p.A. CUP G23D22000760005	€ 16.243,00	Research Topic 1.7 – 5G signals-based outdoor/indoor positioning

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.8 – Machine learning and Deep Learning for advanced manufacturing technologies
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.9 – Monitoring, prediction and diagnostics for advanced manufacturing technologies
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.10 – Vision and metrology techniques for advanced manufacturing

<table>
<tr><th colspan="4">Competition procedure and schedule</th></tr>
<tr><td colspan="4">Titles evaluation and oral examination.
For the evaluation of applicants' attitude for scientific research and their basic skills before the course program, the Selection Committee can attribute up to 100 points to each applicant: at most 30 points to the titles and at most 70 points to the oral examination. The applicant is admitted to the oral examination if he/she scores at least 18 points for the titles. The oral examination is passed by scoring at least 49 points. The applicant is eligible for the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles.
DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 7, 2022.
DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 23, 2022.</td></tr>
<tr><td>Foreign language that can be used for examination</td><td colspan="3">Italian or English</td></tr>
<tr><td rowspan="2">Evaluation of the titles</td><td colspan="2">Curriculum vitae et studiorum, academic title, exams and master thesis (or its abstract)</td><td>Max 18 points</td></tr>
<tr><td colspan="2">Research project, scientific publications, Applicant's motivation letter and Referees' recommendation letters</td><td>Max 12 points</td></tr>
<tr><td rowspan="2">Oral examination</td><td colspan="2">Starting score bonus</td><td>At most 2/3 of the total score obtained from the evaluation of the titles</td></tr>
<tr><td colspan="2">Interview about titles, previous career and research project also aimed at understanding the Applicant's knowledge about fundamental topics in computer science and artificial intelligence, as well as his or her full eligibility to receive, if preferred, a scholarship funded by external institutions. Reading and understanding a short scientific text in English.</td><td>Max 50 points</td></tr>
<tr><td rowspan="4">Calendar of the oral examination</td><td>Date</td><td colspan="2">21 September, 2022</td></tr>
<tr><td>Time</td><td colspan="2">9:30 AM</td></tr>
<tr><td>Place</td><td colspan="2">Department of Mathematics, Computer Science and Physics, (DMIF)
"Sala Multimediale" – via delle Scienze 206, 33100 Udine
https://www.dmif.uniud.it/il-dipartimento/sedi/</td></tr>
<tr><td colspan="3">The oral examination may take more than one day.
Applicants must exhibit a valid personal identification document for admission to the oral examination.</td></tr>
</table>

Reasearch Topics Description
Research Topic 1.1: Extended reality and metaverse to train complex abilities *D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP*

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

Coherence of the proposed research with the NRRP areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral: the proposed research is consistent with NRRP areas of interest since it contributes to the achievement of objectives set by 4 of the 6 PRRN missions:

• M1: DIGITIZATION, INNOVATION, COMPETITIVENESS, CULTURE AND TOURISM -> M1C2: DIGITIZATION, INNOVATION AND COMPETITIVENESS IN THE PRODUCTION SYSTEM. Component 2 of Mission 1 aims to strengthen the competitiveness of the production system by strengthening the rate of digitization, technological innovation and internationalization. In this context, the proposed research aims to digitize and innovate corporate training, contributing to the transition between traditional corporate training and training in eXtended Reality (XR), also considering shared training spaces in the metaverse.

• M4: EDUCATION AND RESEARCH -> M4C2 - FROM RESEARCH TO BUSINESS. Component 2 of Mission 4 has the support of innovation and technology transfer processes among its objectives. The results of the proposed research on XR and metaverse for training can have immediate repercussions on corporate training.

• M5: INCLUSION AND COHESION -> M5C1: LABOR POLICIES. Component 1 of Mission 5 has the strengthening of active labor market and vocational training policies as its objectives. XR training, possibly in shared training spaces in the metaverse, could also be applied to this type of training, making the proposed research also useful for achieving the objectives of this mission.

• M6: HEALTH -> M6C1: PROXIMITY NETWORKS, STRUCTURES AND TELEMEDICINE FOR TERRITORIAL HEALTH ASSISTANCE. Component 1 of Mission 6 has the development of advanced telemedicine solutions to support home care among its objectives, also to overcome the fragmentation and lack of homogeneity of the health services offered in an area. Given that the XR training in the proposed research concerns complex skills, including manual ones, it can be applied for the physical-cognitive rehabilitation at patients' home. Furthermore, the presence of a professional in a metaverse shared with the patient can allow to offer all patients adequate medical support, even if they are in areas far away from rehabilitation centers.

Considering interdisciplinarity within the computer science and artificial intelligence area, the topic is mainly part of two research areas, namely "Virtual reality, Serious games" and "Human-Computer interaction, Auditory-tactile interfaces", but allows for further interdisciplinary insights on issues such as knowledge representation and big data analytics. Furthermore, the theme of the proposed research is by its nature intersectoral, involving educational sciences, psychology, and rehabilitative medicine. This interdisciplinary and intersectoral nature will favor the possibility of inserting the future doctoral student in international research networks that deal with research projects with themes similar to the proposed one.

Expected aims and results, proposed research activity, methodologies and contents: the aim of the research is to study new techniques, technologies and methodologies related to XR and the metaverse to design, develop and test with users innovative software systems for training in various sectors. In line with the NRRP focus areas, application areas will include corporate training and home rehabilitation therapies. With respect to a state of the art that already shows the effectiveness of virtual reality (which is one of the possible solutions for XR) for training in various fields, the proposed research activity aims to experiment in particular the new potential offered by new interaction peripherals (which also make it possible to provide tactile feedback), by devices for augmented and mixed reality, and by the possibility of using virtual environments shared in the metaverse. Furthermore, the research activity will not only focus on the immediate effects of a single interaction in XR, but will also study the effects of its use over time, to verify whether the considered techniques, technologies and methodologies can contribute to maintaining the acquired knowledge and skills over time. To encourage use over time, particular attention should be paid to motivational aspects, introducing gamification dynamics into the designed software systems or presenting the systems themselves as serious games. The proposed software systems will integrate animated pedagogical agents or other interactive virtual characters to support users during training based on appropriate knowledge representations related to the considered sectors. The methodology for testing the developed software systems will include studies on users both in the laboratory and in the real context of use, also providing for the acquisition of large amounts of data remotely. The analysis of this data will require both the application of statistical analysis and the use of techniques for big data analytics.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: Université Côte d'Azur, Grand Château, 28 Avenue de Valrose 06103 Nice CEDEX 2. Laboratoire d'Informatique, Signaux et Systèmes de Sophia-Antipolis (I3S) - UMR7271, Université Côte d'Azur - Centre national de la recherche scientifique (CNRS), 2000, route des Lucioles - Les Algorithmes - bât. Euclide B, 06900 Sophia Antipolis – France.

Possible research center involved in definition of the doctoral training: Laboratoire d'Informatique, Signaux et Systèmes de Sophia-Antipolis (I3S) - UMR7271, Université Côte d'Azur - Centre national de la recherche scientifique (CNRS), 2000, route des Lucioles - Les Algorithmes - bât. Euclide B, 06900 Sophia Antipolis – France.

Research activity to be developed at the research center: the group that deals with discrete models for complex systems at I3S conducts research on formal methods for biological systems and has recently followed a clinical study in which data collected through serious games were used to verify and improve neurocognitive models related to degenerative diseases. In this context, the Research Center will be involved in defining the research activity well before the PhD student's period of activity abroad to jointly identify the requirements for new serious games in XR to be used for cognitive rehabilitation therapies. During the research period abroad at the Research Center, the PhD student will then have the opportunity to collect experimental data through the serious games he/she designed and to use the collected data to verify new neurocognitive models developed by the Research Center.

PhD Programme congruence with the PNRR principles and specific obligations:

- *transversal priorities:* research results will include new XR training systems that can be used to promote training even for young people, without gender discrimination; the usability of the systems on the territory, also through the metaverse, can contribute to reducing the citizenship gap in terms of access to services, with particular attention to disabled and/or elderly people who will be able to use systems at home;
- *twin transitions (green and digital):* the proposed research activity will contribute to the digital transition in the training and rehabilitation sectors;
- *do not cause significant damage - DNSH:* the proposed research activity does not cause any significant harm to the environment; in this respect, training in XR has advantages over traditional training, because some simulations that with traditional methods consume resources or may involve risks of damage to people or the environment can be simulated in XR with fewer resources and fewer risks;

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

- *open science and FAIR Data:* research results and related data will be published, where possible, according to the "Open science" and "FAIR Data" principles.

Contact Professor/Researcher: Luca Chittaro, Fabio Buttussi.

Research Topic 1.2: Artificial intelligence solutions and algorithm application to industrial streaming data
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Coherence of the proposed research with the PNRR areas of interest: The proposed research is part of the PNRR themes related to the digitization, innovation and competitiveness of the production system.

Expected aims and results, proposed research activities, methodologies and contents: The research objective of the PhD scholarship will be the study and development of Artificial Intelligence techniques aimed at the advanced inspection of three-dimensional objects with the use of robots enslaved by acquisition systems in the industrial sector. The inspection of assemblies and quality control on products with complex geometry and marked three-dimensional characteristics is one of the fields where the use of automatic systems is still struggling to take off due to the intrinsic complexity of the problem. A first goal of this research project is to study and develop systems, based on advanced Artificial Intelligence techniques, capable of supporting industrial applications capable of carrying out such controls in an automatic and robust way. The proposed project aims to develop innovative, flexible and reliable approaches for the inspection of assembled, advanced surface control of semi-finished and finished products. A second important goal of the project is the development of an integrated software architecture for the enslavement of robots to these inspection functions. The proposed project will develop a prototype automatic inspection station, where new models and algorithms based on artificial intelligence techniques will be tested and validated on real cases from the industrial world. During the first year of activity, the PhD student will deepen the state of the art on artificial intelligence techniques, with particular reference to industrial applications capable of carrying out such controls in an automatic and robust way. Also during the activities of the first year, you will acquire specific databases for the training and testing of the systems that will be developed during the activities of the doctorate. During the second year of activity you will carry out a detailed analysis of some of the most promising Artificial Intelligence techniques suitable for operating in the robotic industrial field. In particular, different automatic classification methods will be designed and implemented and some evaluative and comparative tests will be carried out between the different methods selected. During the third year, based on the results obtained from time to time, the PhD student will refine the classification techniques and define appropriate evaluation metrics for analyzing the performance of the techniques developed. Finally, the most promising algorithms will be modified / improved in the different application contexts and the final evaluation tests will be carried out. The student will undertake to prepare some scientific articles to be submitted both to national and international scientific conferences and to international scientific journals. The implementation of the project activities foresees not to cause significant damage to the environmental objectives (so-called principle of "Do No Significant Harm" (DNSH)), pursuant to article 17 of Regulation (EU) 2020/852 and as far as possible to contribute to support the horizontal principles of the PNRR.

Period abroad (mandatory): from month 12 to 18 or alternatively from month 30 to 36 based on the development of the research project, the PhD student will spend a period of study and research in an Artificial Intelligence laboratory in a University or Research Center abroad. He/she will carry out his/ her activity in the company. In this period he will deepen the state of the art of the main Artificial Intelligence methods applicable to the problem of classification in the robotic industrial field, will acquire the data necessary for the training and tests of supervised and unsupervised algorithms, developed during the first 18 months of activity. research, and will conclude the period in the company with specific evaluation tests on the different methods designed and implemented in order to select the best method or methods according to the different application contexts.

Foreign Hosting Institution Data: the foreign institution will be identified at a later time in agreement between the parties, or by the contract managers.

Period at the company (mandatory): from month 18 to 30 (for a period of one year).

Data of the company: Beantech srl, via Ivrea, 5, 33100 Udine UD.

Research activity to be developed at the company: the main objective of the research for the 12 months of stay of the PhD student at the beanTech facilities (starting from the 18th month and up to the 30th month) will be to study and develop supervised Artificial Intelligence techniques - starting from data imaging of various types - able to provide useful information for the classification of complex scenes on semi-finished or industrial products. The results can then be used by the company to create automatic inspection solutions capable of identifying anomalous situations (such as surface defects, missing or improperly assembled parts, etc.).

PhD Programme congruence with the PNRR principles and specific obligations:
- *transversal priorities:* the doctoral program is fully consistent with the specific principles and obligations of the NRP, and in particular with its transversal priorities
- *twin transitions (green and digital):* the doctoral program will take into account, as far as possible, twin transitions (green and digital)
- *do not cause significant damage - DNSH:* the implementation of the project activities foresees not to cause significant damage to the environmental objectives (so-called "Do No Significant Harm" (DNSH) principle), pursuant to Article 17 of the (EU) Regulation 2020/852
- *open science and FAIR Data:* the results obtained will be treated in accordance with the principles of Open science and FAIR Data.

Contact Professor/Researcher: Gian Luca Foresti.

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

Research Topic 1.3: Model implementation of the Intelligent factory in a steel manufacturing industry context with specific regard to principles, algorithms, models and methods for the anticipatory detection of events perturbing the production conditions, and related mechanisms for optimal recovery of normal process conditions
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Coherence of the proposed research with the PNRR areas of interest: the project concerns the large area of research and innovation "DIGITAL, INDUSTRY, AEROSPACE", intervention area "Digital transition - i4.0".

Expected aims and results, proposed research activities, methodologies and contents: the program focuses on the stabilization of industrial production processes through the recognition, in anticipation, of disturbing events such as anomalies and failures, by means of Artificial Intelligence technologies. These tasks have recently been treated, with increasing success, through the use of deep learning solutions. However, these approaches have, by their very "black-box" nature, a fundamental disadvantage: the absence of interpretability. The latter is often a fundamental requirement, as it can allow the systematic identification of cases of failure of the model of prediction and, in general, allow the discovery of information concerning the domain that has an interest that goes beyond the simple prediction task. Finally, interpretability is a key concept for promoting human-machine interaction and for making so that the models developed can constitute a valid support for the operators involved in industrial processes. In this project we therefore want to study, implement and test a solution for the detection and interpretation of anomalies on real data, during the normal running of production, able to provide interpretable results for the user. To this end, an interesting research direction concerns the integration of formal methods techniques (in particular, monitoring) with those of machine learning. In detail, the activities will be divided over the three years as follows: year 1) study of the state of the art regarding the approaches used in the areas of predictive maintenance and detection of anomalies; at the same time, study of the techniques available for the formal verification of systems, with particular attention to those aimed at "online" use, such as monitoring; year 2) extension, improvement and formalization from the theoretical point of view of a framework already implemented at a prototype level for predictive maintenance and the detection or prediction of anomalies and critical situations, capable of combining automatic learning and formal verification techniques; application of this framework on real data in a production context identified by the partner industry; comparison of the performance provided by the framework with other state of the art solutions; evaluation of the interpretability of the proposed solution; year 3) modular development of the framework mentioned in point 2, in order to make it adaptable to different usage scenarios; creation of a complete and mature software solution to be made freely available to the scientific and industrial community. Expected results: production of scientific articles on the topics addressed during the PhD course; development of a software solution capable of addressing, in an interpretable way, the problems of anomaly detection and predictive maintenance. In turn, this solution aims to lead to: an enabling and acceleration of the dissemination of techniques based on Artificial Intelligence in the context of the manufacturing industry and in particular of the steel sector; a decisive increase in the stability of production processes; a push to strengthen the digital skills of the staff through interaction with the system and the support coming from it.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: the foreign institution will be identified at a later time in agreement between the parties, or by the contract managers.

Period at the company: 18 months (mandatory).

Data of the company: Danieli Automation S.p.A., via Bonaldo Stringher 4, 33042 Buttrio (UD).

Research activity to be developed at the company: the specific objectives are as follows: 1. Definition of the representative set of events to support the lamination area of the ABS test and validation plant (Cargnacco, UD); 2. Selection of available algorithms and solutions to be adapted through modifications, or from scratch; 3. Completion of knowledge of the area system (events, validated countermeasures and conditions for further enrichment over time). Issue of documentation for use; 4. Functional validation of the Digital Twin. For Digital Twin we intend to follow the concept of "live learning model", that is, the modeling part must be studied to realize the functions of: real-time monitoring; learning and adapting models; prediction continues. The activities planned during the period in the company are as follows: 1. Definition of the classes and objects representing known perturbation events and effective countermeasures for the recovery of process stability, expected quality and efficiency (extraction of knowledge of known events) by characterizing the distinctive criteria for classifying events (recurring patterns); 2. Creation of conceptual and detailed specifications for the development of the Digital Twin of the part of the system to be used for the collection, processing and analysis of the data collected and the development and validation of modified or newly developed applications. 3. Analysis, development and functional test of the Digital Twin in the manufacturing area of Test with particular attention to the personal/machine interface and completion of the online connection of the Digital Twin to the Plant Automation System; 4. Selection and development of data analysis approaches based on advanced statistical methods and Big Data and Artificial Intelligence techniques to be applied and validated on the data of point 1. The use of existing libraries such as IBM Watson, SimuLink, Microsoft Azure environment, etc., as well as the development of innovative ad hoc solutions. A comprehensive analysis of the existing libraries will allow both to speed up project times and, above all, to adapt existing solutions to the use case and to better define the development of innovative applications; 5. Definition, execution and processing of data collection campaigns in the field using the Artificial Intelligence techniques of point 2 for the identification of new perturbative events and their characterization including possible countermeasures. The use of stochastic simulation criteria is expected to increase the working database. 6. Organization and systematization of knowledge and operational methodology for analyzing events and their management for the restoration of standard operating conditions. Specific conceptual and detailed expectations and final report on the results obtained from the analysis of the historicized data are expected. For the realization of the activities indicated in the previous sections, an 18-month commitment by the doctoral student is foreseen, divided as follows: 1. Definition of the classes and objects representing perturbative events [from the beginning collaboration, for 2 months]; 2. Conceptual and detailed specifications for the development of the Digital Twin [from the beginning of the collaboration, for 3 months]; 3. Analysis, development and functional test of the Digital Twin [from the 6th month, for 6 months]; 4. Selection and development of data analysis approaches based on advanced statistical methods and Big Data and Artificial Intelligence techniques [from the 3rd month, for 3 months]; 5. Definition, execution and processing of data collection campaigns in the field [from the 8th month to the end of the project]; 6. Organization and systematization of

TABLE 8 – PhD Programme in COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

knowledge and operational methodology for analyzing events and their management for the restoration of standard operating conditions [from the 4th month to the end of the project].

PhD Programme congruence with the PNRR principles and specific obligations:
- *transversal priorities:* the recruitment system will be sensitive to the transversal priorities of the NRP in relation to selection with respect to generational, gender and territorial equal opportunities
- *twin transitions (green and digital):* among the effects of the project there is an efficiency gain of the production process, both from the point of view of the raw materials and the energy used. In fact, the expected improvement in the management of production is aimed at reducing waste both due to critical events with direct loss of material during processing, and due to products that are qualitatively unsuitable to be put on the market, i.e. during quality control checks
- *do not cause significant damage - DNSH:* the proposed and planned activities will not cause significant harm to the environment but on the contrary are aimed at reducing harmful emissions and material waste
- *open science and FAIR Data:* non-sensitive data and algorithms not subject to patentability will be released in open-science mode.

Contact Professor/Researcher: Angelo Montanari.

Research Topic 1.4: Development, support and integration process of artificial intelligence systems in the Ferriere Nord steel production context
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Coherence of the proposed research with the PNRR areas of interest: the initiative can be traced back to two of the main themes addressed by the PNRR, i.e. Digital Transition and Ecological Transition, transversally declined in the six Missions of the Plan. With regard to the first theme of the PNRR, themes such as Artificial Intelligence and Machine Learning, advanced simulation and Big Data, environment and energy, technologies for the digital industrial transition and Transition 4.0 play a decisive role in this initiative. With regard to the Ecological Transition, the project will address issues related to the circular economy based on the reuse and improvement of waste management (ferrous scrap) and the reduction of CO2 emissions.

Expected aims and results, proposed research activities, methodologies and contents: in general, the objectives of the proposed activity focus on extending the results obtained in the scrap perimeter, but not only, extending to other areas of the steelmaking process, through the development of Artificial Intelligence and Artificial Vision tools aimed at optimising the production process, or part of it, with particular attention to both the characteristic aspects of the raw material, safety in the production context, and logistics and product and process tracking. The result of applying these Machine Vision techniques will therefore be the basis on which the ad hoc developed Machine Learning and Deep Learning algorithms will operate. All the information gathered within this context of technological and digital development will be used to increase the knowledge of the material and the production process. The aim will be the implementation of automatic classification and tracking solutions and the optimisation of processes with analysis tools based on the use of Big Data. With this in mind, an enrichment of the available data could lead to an optimisation of the smelting process in chemical terms so as to achieve better management of the blown coal and thus a potential reduction in CO2 emissions and a general reduction in the environmental impact of the processes. As part of the knowledge enhancement process for a better understanding and management of ferrous scrap for Ferriere Nord, for example, innovative laser optical measurement systems will be installed to analyse the scrap entering the plant, already inside trucks or rail cars. When the scrap is subsequently loaded into the basket that will go into the furnace, the information on the weight of each ferrous scrap outlet from the magnet will be cross-referenced with volumetric data from laser scanner systems. In this way, the density data of each type of scrap can be obtained, while enriching the already available set of information in order to optimise the sorting process. By analysing the results of the liquid steel and knowing the composition of the baskets, it will be to work out the chemical characteristics of the scrap involved. Information about the composition of the scrap, its stratification and the characterisation of the basket represent strategic elements within a steel production process. At present, the entire scrap yard is monitored by an automatic optical camera system installed both on the six gantries and at fixed locations. A dedicated IT infrastructure takes care of the automatic acquisition of all scrap movements in the fleet and through the tracking of the positioning of each crane, a first step of the complete scrap tracking paradigm is active. Based on this architecture, an Artificial Intelligence system will be developed from the collected images: as a first step, these will then be processed by Computer Vision algorithms. In synergy with the activities already planned, it is believed that the proposed project can be integrated with what is already planned to specify and extend the range of analysis of the application of Artificial Intelligence systems, integrating its activities with what will be carried out by the international partners that will develop specific project tasks. Further activities will concern potential applications of Artificial Intelligence technologies for data analysis and the development of ideally predictive tools.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: the period abroad will take place at one of the European research centres with which Ferriere Nord collaborates. These include KUNGLIGA TEKNISKA HOEGSKOLAN (Sweden, www.kth.se), VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH (Germany, www.bfi.de) and FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS (Spain, www.fcirce.es). The choice of the institution will be defined later with the student for a better framework with regard to continuity with the training activities to be carried out.

Period at the company: 18 months (mandatory).

Data of the company: Ferriere Nord – Gruppo Pittini, Zona Industriale Rivoli – 33010 Osoppo (UD).

Research activity to be developed at the company: the macro research activities to be carried out by the PhD student in the company will be i) cognitive analysis of the corporate context and existing project activities; ii)identification of possible extensions of the analysis range of the application of artificial intelligence systems in the corporate context; iii) analysis of the possibilities of integrating its activities with what is being carried out in the corporate context or in the application of new project initiatives; iv) contribute to the development of potential applications of Artificial Intelligence technologies for data analysis and the development of ideally predictive and AI-based tools to support strategic decisions; v) test and contribute to the validation of tools; vi) contribute to the promotion and dissemination of results through articles and scientific

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publications; vii) contribute to evolutionary insights. In synergy with the activities already planned, it is believed that the proposed project can be integrated with what has already been planned to specify and extend the range of analysis of the application of artificial intelligence systems, integrating its activities with what will be carried out by international partners who will develop specific project tasks. Further activities will concern potential applications of Artificial Intelligence technologies for data analysis and the development of ideally predictive tools.

PhD Programme congruence with the PNRR principles and specific obligations:
- *transversal priorities:* the recruitment system will be sensitive to the transversal priorities of the NRP in relation to selection with respect to generational, gender and territorial equal opportunities
- *twin transitions (green and digital):* develop new Machine Learning and Deep Learning solutions for computer vision to improve waste management (ferrous scrap) and reduce CO2 emissions
- *do not cause significant damage - DNSH:* the proposed and planned activities will not cause significant harm to the environment but on the contrary are aimed at reducing harmful emissions and material waste
- *open science and FAIR Data:* non-sensitive data and algorithms not subject to patentability will be released in open-science mode.

Contact Professor/Researcher*:* Christian Micheloni.

Research Topic 1.5: Resilience of the Public Administration digital services
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Coherence of the proposed research with the PNRR areas of interest: the proposed research falls within the themes of the NRP relating to digitalization and technological innovation.

Expected aims and results, proposed research activities, methodologies and contents: the PhD student's activity will develop within the framework of the training course and the regulations already prepared for all students belonging to the same doctorate. Within it, the doctoral student will obviously be able to opt for the didactic activities that are more suited to their research project, typically courses and seminars on topics of big data analysis. The research will focus on modeling innovative decision-making processes informed by data, capable of maximizing the speed, efficiency and resilience of the organizations within which the same data is produced and processed digitally. Specifically, the models developed must be guided by data (data driving) and be made compatible with processes currently adopted in real environments such as public administration bodies, in order to provide a measurable increase in the terms seen in the face of sudden changes. context such as, for example, that deriving from a cyber-attack aimed at manipulating and rendering data unusable. The research, lasting three years, will move along three main stages: a) identification of the models and, possibly within the host company, retrieval of the data to be analyzed; b) modeling of one or two prototype decision-making processes informed by pre-existing case studies available within the host company; c) definition of one or more categories of disruptive events aimed at rendering the data unusable or preventing the modeled processes d) validating the resilience of the prototypes on the data already found with respect to simulated events, and preliminary verification of the increase in efficiency of each prototype with respect to the processes in use within the host company. The research intends to consolidate a class of processes that provides for an adaptation with respect to sudden changes in environmental conditions, capable of making it possible to simultaneously instantiate solutions for the digital processing of data in the changed conditions.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: the foreign institution will be identified at a later time in agreement between the parties, or by the contract managers.

Period at the company (mandatory): the research plan during the period in the company foresees 6 months to be spent preferably but not necessarily in the period March-August 2023, in which the student will contact the business processes and the types of data on which the company wishes to validate the prototypes, and a further 6 months to spend preferably but not necessarily in the period March-August 2025, in which the same student will perform a validation process of one or two prototype models developed also on the basis of the experience gained during the first 6 months spent at the company.

Data of the company: Insiel S.p.A., via San Francesco d'Assisi 43, 34133 Trieste, Italia.

Research activity to be developed at the company: the research activity focuses on the adoption of data-driven decision-making models aimed at increasing the sustainable resilience of essential services (digital and otherwise) provided by the Public Administration and / or bodies similar to the PA. In particular, the specific objectives related to the use of cybersecurity and resilience of the digital services of the Public Administration are: i) identifying the data to be analyzed; ii) contribute to the modeling of phenomena that favor the speed of decision-making processes in the face of disruptive events; iii) use and validation of data-driven decision-making models; iv) activities, reports and documentation to be delivered. The macro-activities are: i) analysis and identification of risks and relative association with public administration services, with all the related inter-sectoral and international interdependencies; ii) contribute to the development of a "what if" analysis and risk assessment model; iii) contribute to the development of tools based on Artificial Intelligence that support strategic decisions to guarantee business continuity; iv) testing and contributing to the validation of predictive tools; v) contribute to the promotion and dissemination of results through articles and scientific publications; vi) provide ideas for further evolution of the listed macro-activities.

PhD Programme congruence with the PNRR principles and specific obligations:
- *transversal priorities:* the doctoral program is fully consistent with the specific principles and obligations of the NRP, and in particular with its transversal priorities
- *twin transitions (green and digital):* the doctoral program will take into account, as far as possible, twin transitions (green and digital)
- *do not cause significant damage - DNSH:* the implementation of the project activities foresees not to cause significant damage to the environmental objectives (so-called "Do No Significant Harm" (DNSH) principle), pursuant to Article 17 of the (EU) Regulation 2020/852

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- *open science and FAIR Data:* the results obtained will be treated in accordance with the principles of Open science and FAIR Data.

Contact Professor/Researcher: Federico Fontana (pro-tempore).

Research Topic 1.6: Deep learning for Agriculture and Environment
D.D. n.3138 of 16 December 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 1.4) - National Research Centre for Agricultural Technologies (Agritech)

Expected aims and results, proposed research activities, methodologies and contents: Design and development of Deep Learning architectures to support decision-making processes in agriculture, to monitor the environment and to identify risk factors related to climate change. The expected results from the research activity will be scientific publications in top-level journals and conferences in the field.

Period abroad: 6 months (optional).

Foreign Hosting Institution Data: if the period abroad is activated, the foreign hosting institution will be defined in due PhD activity course.

Contact Professor/Researcher*:* Giuseppe Serra.

Research Topic 1.7*:* 5G signals-based outdoor/indoor positioning
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Coherence of the proposed research with the PNRR areas of interest: the proposed research is part of the PNRR themes related to the digitization, innovation and competitiveness of the production system.

Expected aims and results, proposed research activities, methodologies and contents: the goal of the project is the development of methodologies and tools for positioning that are able to successfully exploit the signals transmitted by the 5G infrastructure in the context of seamless indoor/outdoor positioning. In the first phase, extensions to the fingerprinting techniques already exploited for the other cellular technologies will be explored. In the second phase, the use of 5G measures for the localization of a cellular receiver will be investigated by focusing on the application of machine and deep learning techniques. The expected results from the research activity are scientific publications in top-level journals and conferences in the field, and the development of system prototypes.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: the foreign hosting institution will be defined in due PhD activity course.

Period at the company: 6 months (mandatory).

Data of the company: u-blox Italia S.p.A., Via Stazione di Prosecco 15, 34010 Sgonico (TS).

Research activity to be developed at the company: the research activity carried out in the company will focus on the extraction of measurements from different types of sensors and on positioning algorithms. The company will provide all the necessary equipment and knowledge relevant to the project. Data will also be provided, from measurement and simulated campaigns, in different environments (outdoor / indoor) and in different signal propagation conditions.

PhD Programme congruence with the PNRR principles and specific obligations:
- *transversal priorities:* with reference to the horizontal principles of the PNRR (achieving the climate and digital goal, addressing and bridging gender inequalities, supporting the participation of women and young people, reducing territorial gaps), there will be outcomes in terms of efficiency of logistics and navigation, which in turn will naturally lead to a reduction in waste, both in terms of resources and time required to carry out the processes involved. As far as possible, the other cross-cutting objectives will also be promoted
- *twin transitions (green and digital):* regarding the digital transition, issues related to industry 4.0, artificial intelligence and innovation for the manufacturing industry are involved. Regarding the green transition, the most relevant themes are sustainable mobility and environmental energy
- *do not cause significant damage - DNSH:* the activities envisaged by the project will not cause any significant damage to the environment
- *open science and FAIR Data:* the activities foreseen by the project will take into account the objectives and conditions of open science and FAIR Data.

Contact Professor/Researcher: Angelo Montanari.

Research topic 1.8 - Machine learning and deep learning for advanced manufacturing technologies
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem - Green and digital transition for advanced manufacturing technologies: machine learning and deep learning

Coherence of the proposed research with the PNRR areas of interest: the proposed research stems from one PNRR-funded ecosystem (iNEST).

Expected aims and results, proposed research activities, methodologies and contents: the main goals of the project are the design, development, realization, and experimental validation of machine learning, deep learning, and data analytics models, methodologies, and tools, and their application to industrial processes of advanced manufacturing. The practical effectiveness of the developed models and tools will be verified on typical contexts such as, for instance, those of the supervision and continuous learning of industrial processes, the automatic quality control of

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digital production lines, and the predictive maintainance. The expected results from the research activity are scientific publications in top-level journals and conferences in the field, and the development of system prototypes.

Period abroad: 6 months (optional).

Foreign Hosting Institution Data (business name, legal and operative headquarters): if the period abroad is activated, the foreign hosting institution will be defined in due PhD activity course.

Contact Professor/Researcher: Gian Luca Foresti.

Research topic 1.9 Monitoring, prediction and diagnostics for advanced manufacturing technologies
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem - Green and digital transition for advanced manufacturing technologies: monitoring, prediction, and diagnosis

Coherence of the proposed research with the PNRR areas of interest: the proposed research stems from one PNRR-funded ecosystem (iNEST).

Expected aims and results, proposed research activities, methodologies and contents: the main goals of the project are the design, development, realization, and experimental validation of models, methodologies, and integrated tools, for the monitoring, prediction and diagnostics of complex industrial processes and systems in the context of advanced manufacturing. The goal of the research is to explore the integration of approaches based on the analysis of data from sensors, typical of deep learning, with symbolic monitoring techniques based on logical deduction. The goal of this research is to develop learning techniques that are more accurate and more effective, able to converge more quickly also when limited amounts of data are available. The results of this research will be experimentally evaluated within production processes from the real world. The expected results from the research activity are scientific publications in top-level journals and conferences in the field, and the development of system prototypes.

Period abroad: 6 months (optional).

Foreign Hosting Institution Data*:* if the period abroad is activated, the foreign hosting institution will be defined in due PhD activity course.

Contact Professor/Researcher*:* Alessandro Cimatti.

Research topic 1.10 - Vision and metrology techniques for advanced manufacturing
D.D. MUR 3277 of 30 December 2021 (PNRR Mission 4 Component 2 Investiment/Sub-investiment 1.5) – Project iNEST – Interconnected Nord-Est Innovation Ecosystem - Green and digital transition for advanced manufacturing technologies: vision for manipulation and quality control

Coherence of the proposed research with the PNRR areas of interest: the proposed research stems from one PNRR-funded ecosystem (iNEST).

Expected aims and results, proposed research activities, methodologies and contents: the main goals of the project are the design, development, realization, and experimental validation of integrated techniques based on 3-dimensional optical metrology and vision, for process and quality control of complex industrial processes and systems in the context of advanced manufacturing. The goal of the research is to develop modules based on artificial intelligence and metrology able to support non-repetitive operations in complex robotic scenarios, such as grasping of heterogeneous components, and to identify defects in the production process. The results of this research will be experimentally evaluated within production processes from the real world. The expected results from the research activity are scientific publications in top-level journals and conferences in the field, and the development of system prototypes.

Period abroad: 6 months (optional).

Foreign Hosting Institution Data: if the period abroad is activated, the foreign hosting institution will be defined in due PhD activity course.

Contact Professor/Researcher: Fabio Remondino.

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THE PhD PROGRAMME	
Administrative location	University of Udine, Polytechnic Department of Engineering and Architecture (DPIA) - via delle Scienze 206, 33100 Udine, ITALY (tel. +39 0432 558253)
Associated location	Institut National Polytechnique de Grenoble (France)
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. David Esseni (david.esseni@uniud.it)
Programme duration	3 years
Curricula	1. New management paradigms and fabrication technologies for competitive enterprises with low environmental impact; 2. Information and communication technology for the inclusive society; 3. Design of innovative thermo-electro-mechanical systems and development of advanced methods for the assessment of structural damage and reliability for energy saving; 4. Mechanical technologies and electronic devices for domotics, medical diagnostic and safety.
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-physical-science-and-engineering/ingegneria-industriale-e-dellinformazione/il-dottorato https://phd.diegm.uniud.it/iie-phd/

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea specialistica/magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
Compulsory documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmess or during the Italian programmes before D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate limit 10.000 characters, spaces included).
Optional documents (art. 5 of the Call)	1. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call can submit an extended abstract in place of the complete thesis, in Italian or English language, signed by themselves and by their thesis Supervisor (approximate limit: 25.000 characters, including spaces); 2. Motivational letter by which the applicant explains the reasons for admission to the PhD programme, dated and signed (approximate limit: 2.500 characters, including spaces); 3. Publications (max 2); 4. Letters of reference (max 2), from university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed members	Andrea Fusiello – Associate Professor – University of Udine Marco Sortino – Associate Professor – University of Udine Ruben Specogna – Associate Professor – University of Udine Andrea Tonello – Associate Professor – University of Udine Enrico Salvati – Adjunct Professor – Università di Udine Lauro Snidaro – Associate Professor – University of Udine Andrea Zonta – Self Group Srl
Substitute members	Stefano Filippi – Full Professor – University of Udine Roberto Rinaldo – Full Professor – University of Udine David Esseni – Full Professor – University of Udine

ADMISSION

GENERAL COMPETITION (art. 8 of the Call for Applications)

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Posti disponibili: 8				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions **WITH SCHOLARSHIP: 8**	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001280003	€ 16.243,00	Research Topic 1.1 - Structural failure modelling through advanced numerical methods.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and COMARK srl CUP G23D22000770005	€ 16.243,00	Research Topic 1.2 - Artificial intelligence applied to the analysis of images and three-dimensional point clouds
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and EMC Gems Srl CUP G23D22000770005	€ 16.243,00	Research Topic 1.3 - Design, support system, knowledge extraction da big data e manutenzione predittiva per apparecchiature industriali.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and LimaCorporate spa CUP G23D22000770005	€ 16.243,00	Research Topic 1.4 - Use of Artificial Intelligence systems to improve planning and navigation tools for orthopedic surgery.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and LimaCorporate spa CUP G23D22000770005	€ 16.243,00	Research Topic 1.5 - Data integration and workflow automation between AI-supported shoulder surgery customization medical software and manufacturing and distribution infrastructures.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and SELF GROUP srl CUP G23D22000770005	€ 16.243,00	Research Topic 1.6 - 3D printing of large metal components.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Versalis spa CUP G23D22000770005	€ 16.243,00	Research Topic 1.7 - Artificial Intelligence for the economic and environmental sustainability of thermoplastic polymer production plants.
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Way Point srl CUP G23D22000770005	€ 16.243,00	Research Topic 1.8 - Research and development of innovative visible light communication systems.

Competition procedure and test schedule		
Evaluation of titles and oral examination. For the evaluation of applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 16 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles. **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 7, 2022.** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 20, 2022.**		
Foreign language that can be used for examination	Italian or English	
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum	*10*
	Scientific publications	*5*
	Thesis/Abstract	*2*
	Letters of reference	*4*
	Motivational letter for admission to the PhD programme	*4*
	Research project	*5*

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Oral examination	The oral examination consists of an individual interview of about 15 minutes aiming to assess the applicant flair to undertake a research doctorate and to carry out the research tasks in the areas of interest for the doctorate. The interview will be assessed considering the following criteria: a) technical and scientific competence in the topics of the doctorate; b) knowledge of the state of the art for the doctorate curricula; c) mastery of English language.	
Calendar of the oral examination	**Date**	**September 15, 2022**
	Time	09:30 AM
	How to conduct the examination	The oral examination will be held online.
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination.	

Reserch Topics Description

Research Topic 1.1 - Structural failure modelling through advanced numerical methods

D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP

Consistency of the proposed research with the NRRP areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral:

The research mainly concerns digitalisation, innovation, and competitiveness in the production system.

In accordance with the plan *Transizione 4.0 (Digital Transformation)*, the project seeks to give a new incentive to the digital transition and boost the rate of innovation of Italian industries and businesses. The digital transformation governs this proposal as it focuses on the concept of digital (virtual) prototyping for structural analysis. In fact, the numerical simulation facilitates the design procedures and at the same time allows the identification of efficient and rapid design configurations, while limiting the exploitation of natural resources.

Other positive effects of the research can be found in the support for the development of microelectronics innovations and technology. In fact, the proposed research contributes itself perfectly to supporting the structural design phase of electronic components in which various multiphysics variables are involved.

The project foresees a strong cross-sectorial propensity, therefore not confined only to the scientific disciplinary sector of the PhD candidate (ING-IND/14 – Structural Integrity and Machine Design). The proposed topic is certainly of interest to other engineering sectors such as: materials science (ING-IND22), construction science (ICAR / 08), manufacturing technology and systems (ING-IND16) and applied mechanics (ING-IND13).

The interdisciplinarity is promoted by the interest of the proposal in various scientific disciplines such as mathematics, computer science and physics - these are also interested and will be involved in the project.

The proposed theme is of considerable international interest, as proven by the numerous foreign research groups operating in the sector.

Expected aims and results, proposed research activity, methodologies and contents:

The recent evolution of computers, capable of rapidly performing more and more complex simulations, has led to the development of several numerical approaches for the prediction of nucleation and propagation of cracks in engineering materials under the effect of cyclic loads (fatigue). Of particular interest is the Phase-Field method, which was conceived more than a decade ago and developed since then thanks to finite element method (FEM) platforms. Given his young age, the Phase-Field method has not been fully developed and generalised, especially in the fatigue context.

The purpose of the project presented is in fact to develop new criteria and functionalities of the Phase-Field method with particular emphasis on the aspect of mechanical fatigue, with support and validation of more mature predictive methods, e.g. XFEM, CZM. In detail, one of the objectives is to consider characteristics of the material that can compromise the estimate of the material's life, for example, the presence of residual stresses or the variability of the mechanical properties of the material at the microscopic scale. Other aspects that are envisaged in the project concern the modelling of decohesion phenomena at the interface between different materials, while remaining in the context of fatigue. Methods based on Machine Learning techniques will be taken into consideration and potentially implemented.

In addition, this project aims to acquire knowledge and adequate means to meet the needs of local companies in the design and structural monitoring of mechanical organs and systems, in order to promote their competitiveness and overcome the crisis caused by epidemic events in the last two years.

Period abroad:
6 months (mandatory)

Foreign Hosting Institution Data:
Delft University of Technology - TU Delft
Mekelweg 5, 2628 CD Delft, Paesi Bassi

Possible research center involved in definition of the doctoral training (business name, legal and operative headquarters):
Not applicable

Research activity to be developed at the research center:
Not applicable

PhD Programme congruence with the PNRR principles and specific obligations:

- **Cross priorities**:
  Gender equality: the project provides equal opportunities for candidates, regardless of their sex, race, color, ethnic or social origin.
- **Twin transitions** (green and digital):
  Green transition: The impact of the proposed research will be significant as the methodology will not be limited to niche sectors of use. In fact, it can be employed for the design of engineering products of various sectors, e.g. aerospace, automotive, marine, energy, transportation

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etc. The consequent positive impact on the exploitation of primary resources and energy will promote sustainable and lasting development over time. At the same time, it will be possible to design reliable structures, with a substantial reduction in catastrophic events caused by structural failures.

Digital transition: The use of digital predictive methods developed in the project will allow to support experimental research with reducing the costs associated with them. This process will promote the concept of digital twin in which engineering systems can be digitally represented with numerous advantages not only in terms of design but also of in-service monitoring.

- **do not significant harm - DNSH**:

  The research topic satisfies all the Do No Significant Harm (DNSH) criteria. The description of how the six ecosystem protection criteria are respected is listed below:

  1. Mitigation of climate change: the proposal not only does not foresee further increases in relation to greenhouse gas emissions, but aims to reduce them by proposing a design methodology for increasingly efficient structures from energy and structural point of view.
  2. Adaptation to climate change: Research will not negatively impact current and future climatic conditions, people or nature.
  3. Sustainable use and protection of water resources: No impact on the state of water bodies of any kind.
  4. Transition towards the circular economy, also with reference to waste reduction and recycling: The project increases neither directly nor indirectly the use of natural resources, and thus it does not increase the production of waste. The project itself aims to reduce the exploitation of natural resources and consequent waste reduction.
  5. Prevention and reduction of air, water or subsoil pollution: No increase in pollutant emissions into the air, water or subsoil is expected.
  6. Protection and restoration of biodiversity & ecosystem: Research will not cause any damage to the current conditions and resilience of ecosystems or the conservation status of habitats and species.

- **Open science and FAIR Data**:

  The project expects the publication of results in journals that provide for *open access* publication. In particular, those journals affiliated with the Ministry of Education and the University of Udine will be privileged given that no additional costs for open access publication are expected, such as Springer Nature and Wiley. Scientific dissemination of the results will also be promoted.

Contact Professor/Researcher: Enrico Salvati

Research Topic 1.2: Artificial intelligence applied to the analysis of images and three-dimensional point clouds
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3).

Consistency of the proposed research with the PNRR areas of interest: PNRR Thematic focus: Infrastructure for sustainable mobility: Control systems and dynamic monitoring to improve motorways, bridges, viaducts and tunnels. Smart roads and digitisation of roads.

Expected aims and results, proposed research activities, methodologies and contents: The aim of the project is the realization of a system based on LiDAR and optical technology that obtains information from complex situations automatically. Compared to current camera systems, LiDAR systems provide an additional dimension in that they can detect the distance of points. Artificial intelligence (AI) techniques will be used in this area that enable object segmentation, registration and tracking. A particular focus will be in the area of 'intelligent transportaton' to study advanced road traffic monitoring systems and the monitoring of road surface conditions by integrated LiDAR/camera sensors. The expertise and developments resulting from the research activity will lead to important contributions in the new technological field of 'intelligent transportation systems'. In particular, we expect to achieve the implementation of an integrated LiDAR/camera system for road surface monitoring and to improve the performance of an existing vehicle transit detection system through the implementation of A.I. techniques and the synergic use of the two sensors. In scientific terms, we expect two or three publications in the proceedings of international conferences.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: To be defined.

Period at the company: 15 months (mandatory).

Data of the company: COMARK SRL con sede legale in strada delle Betulle 89, CAP 33030 – Campoformido (UD), Codice Fiscale 02327660300, Partita IVA 02327660300.

Research activity to be developed at the company: The aim of the project is the realization of a system based on 3D LIDAR technology that obtains information from complex situations automatically. Compared to current camera systems, LIDAR systems provide an additional dimension in that they can detect the distance of points.. In order to achieve the objectives described above, algorithms for noise elimination, recognition and tracking of objects are needed. Artificial intelligence (AI) techniques that enable segmentation, registration and implicit tracking will be used here. As a result of the project, it is expected to acquire advanced skills and a state-of-the-art 'framework' on three-dimensional vision with automatic extraction of position and motion information of vehicles and recognisable objects, with higher levels of accuracy than current systems.

PhD Programme congruence with the PNRR principles and specific obligations:
The implementation of project activities is expected to do no significant harm to environmental objectives (the 'Do No Significant Harm' (DNSH) principle), in accordance with Article 17 of Regulation (EU) 2020/852, and as far as possible to contribute to supporting the horizontal principles of the NRP.

Contact Professor/Researcher: Andrea Fusiello

Research Topic 1.3: Design, support system, knowledge extraction da big data e manutenzione predittiva per apparecchiature industriali
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest:

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The proposed research is fully consistent with mission M1C2: DIGITALIZATION, INNOVATION AND COMPETITIVENESS IN THE PRODUCTION SYSTEM, Investment 1: Transition 4.0. Specifically, the project aims to explore various applications of artificial intelligence in innovative product development and optimization (e.g., more energy-efficient and therefore green electrical equipment), digital twin models for digital transformation and virtualization of production processes, and for the development of industrial 4.0 equipment capable of advanced diagnostics and predictive maintenance.
Also compare the areas of focus in NRP 5.4.2 Digital, Industry, Aerospace - High performance computing and big data. Articulation 2: Basic and Fundamental Research in Engineering, Computer Science and Technology for HPC and Big Data ("From a software perspective, research includes: software engineering methodologies, processes, technologies and tools for the development of HPC applications; mathematical methods, algorithms and mathematical software for HPC.").
The proposed research fully enters the SNSI thematic area: smart and sustainable industry, energy and environment. In particular, the following SNSI development trajectories are involved: SN_A1 Innovative high-efficiency manufacturing processes and for industrial sustainability, specifically "Integrated product-process-system modeling for eco-efficiency optimization (energy and resources)," "Solutions for integrated maintenance, quality and logistics management for "Zero-Defect" manufacturing," "Industrial process supervision and control systems," SNSI National Thematic Areas: 5.4. 2 Intelligent and Sustainable Industry, Energy and Environment ("Rethinking the Italian business model from a green perspective: in order to be more competitive with respect to emerging countries, national companies must combine productive development with environmental sustainability and technological innovation."), SNSI Regional Areas of Specialization: 5.3.8 Intelligent Factory ("The Intelligent Factory area refers to technological solutions designed to optimize production processes also through the use of advanced ICT technologies for the virtualization of transformation processes.").

Expected aims and results, proposed research activities, methodologies and contents:
The general objective is to train the student in the applications of artificial intelligence in industrial design and industrial plant maintenance. The specific objectives are various. First, one wants to develop digital twin models for electromagnetic devices using and developing electromagnetic simulation software. Next, innovative design support system techniques will be developed in order to guide the engineer to the optimal and customized design. Finally, the most ambitious goal would be to perform knowledge extraction on the operation of electromagnetic devices. This knowledge extraction would occur from the big data produced by the electromagnetic simulation and would allow, in an automated way, to understand the relationship between various design variables in order to better understand how the product works.
Several publications in top international scientific journals and the emergence of new ideas are expected through collaboration with the company EMC Gems Srl.
The project aims to explore various applications of artificial intelligence in innovative product development and optimization, digital twin models for digital transformation and virtualization of production processes, and for the development of industrial 4.0 equipment capable of advanced diagnostics and predictive maintenance. A first activity involves developing a design support system (DSS) for the design of electrical and magnetic devices, i.e., a virtual engineering design assistant based on artificial intelligence and machine learning algorithms capable of guiding the engineer to the optimal design. Specifically, it is first intended to explore various techniques for generating a surrogate model to describe the operation of electromagnetic devices efficiently and accurately. Next, it is intended to develop techniques for spatial exploration, optimization, and information extraction (knowledge extraction, big data analytics) from a very large data set (big data) that can be generated efficiently using the surrogate model, using techniques developed in artificial intelligence. Design with virtual prototyping is both a green technique, because it reduces the need to make physical prototypes, and reduces the time for product development. It also allows product improvement through automatic optimization so as to gain competitiveness of the production system over competitors. A second activity involves the development of digital twin models, in which mathematical models dialogue with sensors and actuators to create a virtual copy of the equipment that fully mimics the behavior of the equipment in the real world. This virtual copy can be used to innovatively obtain diagnostics of the industrial equipment, with a view to achieving an intelligent machine and virtualization of the entire production process, as envisioned by the smart factory and Industry 4.0.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: The student will spend a 6-month study and research period at a foreign university or research institute. The institution will be determined later based on the development of the research activities.

Period at the company: 12 (mandatory)

Data of the company: EMC Gems Srl

Research activity to be developed at the company:
The activity to be performed in the enterprise concerns predictive maintenance. Although regular and scheduled maintenance strategies are still employed in many industrial settings, there is an increasing need to rely on monitoring based on actual operating conditions to manage machine health. Systems are increasingly complex, and wear and fatigue life estimators may not be accurate enough in order to properly schedule maintenance. This leads to the possibility of component failure resulting in health hazards to workers and economic loss due to unplanned downtime. Conversely, early maintenance forces higher downtime and waste of resources and raw materials due to the change of still-functioning components. Machine failure diagnosis concerns the study of techniques to detect, isolate, and identify machine failures based on monitoring data. In the curriculum, it is planned to use sensors along with machine learning techniques to continuously monitor the wear status of bearings and other mechanical components in order to arrive at predictive machine maintenance.

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: All activities carried out in the research program will adhere to cross-cutting priorities, related to generational, gender and territorial equal opportunities.
- Twin transitions (green e digital): All activities carried out in the research program will meet the goals set for the twin transitions (digital and green).
- do not significant harm - DNSH: All activities carried out in the research program will comply with the principle of "no significant harm" to the environment (so-called DNSH) and all other horizontal principles of the NRP.
- Open science and FAIR Data: All activities carried out in the research program will respect the principle of Open science and Open Data by ensuring that data are accessible and reusable. In order for it to be truly possible to reuse data, the production of FAIR data, that is, data that are easy to find, accessible, interoperable, and reusable, will be promoted.

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Contact Professor/Researcher: Ruben Specogna

Tematica di ricerca 1.4: Use of Artificial Intelligence systems to improve planning and navigation tools for orthopedic surgery
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest:
M4C2: FROM RESEARCH TO BUSINESS
The proposal is part of the M4C2 component "From Research to Business" of the PNRR which indicates among other objectives the need to intensify the demand for innovation by businesses and the integration of research results into the production system. In particular, the proposed research aims to enhance high-profile skills especially in relation to Artificial Intelligence topics
M1C2: DIGITIZATION, INNOVATION AND COMPETITIVENESS IN THE PRODUCTION SYSTEM
The themes of the proposal also include those of the M1C2 component "Digitization, Innovation and Competitiveness in the Production System", in particular the Transition to Industry 4.0 (Investment 1) with the concept of Smart Factory in its Smart production and Smart service components.
M6: HEALTH
Lima Corporate's main production activity concerns the production of orthopedic prostheses supplied to hospitals all over the world. The object of this research aims to facilitate and improve the accuracy of implant surgery such prostheses, with consequent benefit for the health of patients.

Objectives and expected results, proposed research activity, methodologies and contents:
The objective of the project concerns the use of AI systems for the creation and improvement of digital tools in order to allow accurate planning and execution of orthopedic surgery. In addition to strengthening the existing state of planning systems, we want to introduce a further degree of flexibility, analyzing and implementing new applied AI techniques. To allow a total scalability of the approach in the face of the modification of the surgical technique and a restricted set of tools, it is necessary to search for new anatomy segmentation algorithms to obtain morphological information of the patient not currently available in the LimaCorporate segmentation and preoperative planning software currently in use. The idea is also to propose new methods to assist the surgeon with the aim of minimizing surgery times and maximizing its accuracy.
The research objective includes the following application areas:
- The definition of the rules and systems for the organization and aggregation of data and the definition of appropriate training and testing datasets of diagnostic images (e.g. x-ray , CT scans , MRI) and intraoperative navigation data deriving from the bench testing activities of SHIAB instruments, to wetlab and operating room testing.
- Training and accuracy study of AI-based models for segmentation of diagnostic images. The possibility of studying filters for the correction of inertial navigation of intraoperative data will also be marginally analyzed.
- The study of algorithms for the positioning of three-dimensional models of patient-specific instruments.

In detail, the intervention themes can be divided into:
A. Preparation of datasets for updating diagnostic image segmentation algorithms
Compared to traditional shoulder surgery systems, the system will require a new strategy of segmentation of the internal and external cortex of the patient's humerus by the pre -operative planning SW called Smart SPACE, and possibly the appropriate definition of new anatomical landmarks (reference points), automatically positioned following appropriate training. The segmentation algorithm and Statistical Shape Modeling models currently used by the Smart SPACE planning SW for the representation of the statistical variation of the population anatomies are not completely adequate for the surgical technique required. In this activity a CT Scan dataset will be manually segmented again coming from the Smart SPACE interventions carried out up to now or from equivalent databases using traditional instrumentation available to Limacorporate. This dataset, suitably categorized, will act as ground truth for the study of segmentation algorithms and for the construction of training and test sets (verification and validation). We will also consider the opportunity to build ancillary datasets based on X- rays and MRI, as well as continuous signals coming from intraoperative tools developed by Lima Corporate contextual to the preoperative planning, and the acquisition of external collections of diagnostic images to enrich those already in possession of Lima Corporate.
B. Study of 2D / 3D segmentation methods
In this activity, the experimentation strategies of the segmentation algorithms will be defined. The anatomopathological characteristics of interest will be taken into consideration for the introduction of a possible taxonomic categorization of the datasets, the application and combination of different classical and machine learning strategies for the segmentation of the anatomy and the definition of the expected accuracy scores for the algorithms for the reconstruction of the three-dimensional model of the patient's anatomy. In this phase the technical possibility of introducing data augmentation techniques of the datasets will also be investigated. Data mining methods will also be investigated to discover new, useful and accurate patterns in the data, looking for relevant information that can be correlated to a better outcome of surgery. These patterns can be further investigated against the post-operative follow-up data for the realization of predictive algorithms of the surgical result. The possibility of analyzing previously collected multimodal pre -operative data is also envisaged.
C. Training of AI models for anatomical segmentation and for the interpretation of intra or preoperative data
This activity has the aim of applying machine learning methods to the identified datasets for the correct identification of the anatomical structures under study or models for the representation of the correction of inertial navigation of intraoperative data associated with the patient's volume. Methods with proven efficacy in the segmentation of biomedical images will be compared, both supervised (e.g. Statistical Shape Models) and unsupervised (Convolutional Neural Networks), as well as heuristic methods to overcome any limitations in the different approaches will be investigated. The results obtained will be used to define the algorithms that will be implemented in the company.
D. The study of algorithms for positioning three-dimensional models of patient-specific instruments
In this activity it is planned to study methods to automatically and accurately position keypoints or significant points of a 3D model (template) with the predefined design of Limacorporate , provided by the Smart SPACE software as a guide for the surgical operation, on the reconstructed anatomy of the patient. In this case, the positioners on the shoulder blade and the humerus side can be considered. These models are currently generated by the software with insufficient accuracy and then manually reviewed for each case / patient by a process engineer. We therefore want to study the possibility of improving its creation and performance in terms of positioning and adaptability by means of artificial intelligence (AI) techniques.
The expected result for the BD points is a feasibility study, which includes the state of the art and a set of techniques proposed as a range of implementable possibilities, and one or more prototype algorithms, whose accuracy of reconstruction or adherence to the ideal model proposed

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will be tested with respect to manually generated cases, with the aim of improving the current techniques in use from the point of view of stability and accuracy and making them more efficient.

Period abroad: 6 months (mandatory)

Foreign host party data: To be defined

Period in the company: 12 months, not necessarily continuous (mandatory)

Company data: LimaCorporate spa

Research activities to be carried out in the company:
The company will provide the candidate with the necessary tools to be able to design and implement a prototype algorithm that leads to a study of reconstruction accuracy with respect to manually segmented cases.

Highlight the coherence of the doctoral program with the specific principles and obligations of the PNRR:
DIGITAL TRANSITION:
The Artificial Intelligence techniques that will be analyzed within the proposed research are aimed at the development of Artificial Intelligence algorithms able to assist in the planning and execution of orthopedic surgery. The research will therefore make it possible to adopt innovative and intelligent techniques capable of significantly exceeding the approaches currently in use.
DNSH:
The proposed research will have no environmental impact and therefore the principle of not causing significant damage to the environment will certainly be respected (Do No Significant Harm).
Open science and FAIR Data:
The results of the research carried out will be published in compliance with the indications of the National Research Program 2021-27 regarding Open science and FAIR data.

Contact Professor/Researcher: Lauro Snidaro

Tematica di ricerca 1.5: Data integration and workflow automation between AI-supported shoulder surgery customization medical software and manufacturing and distribution infrastructures
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest
M4C2: FROM RESEARCH TO BUSINESS
The proposal is part of the M4C2 component "From Research to Business" of the PNRR which indicates among the objectives the need to intensify the demand for innovation by businesses and the integration of research results into the production system. In particular, the proposed research aims to enhance high-profile skills especially in relation to the topics of Artificial Intelligence, Additive Manufacturing, Big Data Integration.
KEY ENABLING TECHNOLOGIES: AI, IoT, Cloud Computing, Cyber Physical System, Big Data Integration, Database & Web Technologies.
M1C2: DIGITIZATION, INNOVATION AND COMPETITIVENESS IN THE PRODUCTION SYSTEM
The themes of the proposal also include themes of the M1C2 component "Digitization, Innovation and Competitiveness in the Production System", in particular the Transition to Industry 4.0 (Investment 1) with the concept of Smart Factory in its Smart production and Smart service components.
M6: HEALTH
Lima Corporate's main production activity concerns the production of orthopedic prostheses supplied to hospitals all over the world. The object of the present research aims to facilitate and improve the accuracy of implant surgery such prostheses, with consequent benefit for the health of patients.

Project objectives, activity plan and expected results:
The research objectives include the following application areas:
• The definition of the rules and systems for the organization and aggregation of data and the definition of appropriate datasets for the management of patient data (eg: x-ray , CT, MRI) and of technical and production data.
• The study of the influence on automation and data management from a Make To Stock model to an Engineering to Order / Assembly To Order / Make To Order model within company information systems (Mapping by Knowledge Base, referring to corporate business).
• The study of the generation and maintenance of configuration rules for the creation of disposable and reusable instruments, customized to the specific needs of the patient and surgeon, based on knowledge capture and knowledge management systems.
• Study and design of a rule based expert system for the encoding of corporate knowledge.

In detail, the intervention themes can be divided into:

- Automation of configuration rules and packing rules
- The automation of the configuration rules will be performed in two aspects, defining the rules for managing technical data and defining the packaging rules.
- An engine will be studied and designed in order to facilitate the formalization and management of the rules that combine an implantable with an implantable, an implantable with an instrument, an instrument with a tool per task of Engineering To Order, Assembly To Order, Make To Order .

Added value deriving to the company from the realization of the project (eg. Prospects for growth in the company, employment, sector, etc.):

- the PhD student's activity will support a marked transformation of the company's consolidated business model and of the market for shoulder joint replacement surgery itself.
- The project is particularly devoted to the study and development of infrastructure and end-to-end digital integration, from the surgeon's desk to the operating room, capable of managing and automating the entire flow of data, and reviewing procedures. associated logistics, to make this service cost - effective and sustainable for the market.

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- The decrease in the strong financial exposure associated with the expansion of market shares, typical of the sector, due to the need to provide the entire range of instruments and implants on loan for use by the customer, in the face of the development of a service capable of provide on demand only the tools and prostheses necessary for a specific intervention.

Period abroad: 6 months (mandatory)

Foreign host party data: to be defined

Period in the company: 12 months not necessarily continuous (mandatory)

Company data: LimaCorporate spa

Research activities to be carried out in the company:
The PhD student's activity in the company will be focused on modeling the workflow between the various systems involved and on the development of innovative data integration techniques.

Highlight the coherence of the doctoral program with the specific principles and obligations of the PNRR:
DIGITAL TRANSFORMATION:
The Artificial Intelligence techniques that will be analyzed within the proposed research are aimed at the development of Artificial Intelligence algorithms able to assist in the planning and execution of orthopedic surgery. The research will therefore make it possible to adopt innovative and intelligent techniques capable of significantly exceeding the approaches currently in use.
DNSH:
The proposed research will have no environmental impact and therefore the principle of not causing significant damage to the environment will certainly be respected (Do No Significant Harm).
Open science and FAIR Data:
The results of the research carried out will be published in compliance with the indications of the National Research Program 2021-27 regarding Open science and FAIR data.

Contact Professor/Researcher: Lauro Snidaro

Tematica di ricerca 1.6: 3D printing of large metal components
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

General and specific objectives
The objectives of the activity are:
- Identify the most promising technologies for 3D printing large metal components (> 1 meter)
- Carry out comparative tests in order to evaluate the performance of the different technologies on pilot applications
- Optimize the production process with the most promising technologies on cases of industrial interest

Activity
The activity of the doctoral project is divided into three years.
In the first year, the candidate will perform a comparative evaluation of the technologies of 3D printing of metals for large pieces. The activity will be carried out through bibliographic research, analysis of technical-commercial documentation, participation in events and fairs. Together with this, the PhD student will perfect his preparation in the following areas: design and analysis of experiments, design for 3D printing, use of an industrial-grade 3D printer, introduction to robotics.
In the second year, applications and experiments will be carried out to validate the technical solutions identified in the first year. Detailed programming will be possible only after defining the technologies of interest and establishing relationships with suppliers or service companies. In general, the activity will involve the definition of a certain number of use cases or benchmark pieces and their production with one or more technologies. From the metrological analysis of the pieces produced it will be possible to identify defects and deformations of the components and thus derive guidelines for product and process design. Part of the activity of the second year can be carried out at a foreign institute specialized in 3D printing of metals.
The third year includes the conclusion of the experimental activities and the drafting of the doctoral thesis, together with scientific publications on the activity carried out.
In the 36 months of the doctorate there are about 12 months in the company, approximately 4 months per year, in which the doctoral student will apply the general concepts identified to use cases proposed by the company.

Expected results
In summary, the expected results of the program of activities are:
- The training of a high-profile specialized technician for the application of additive techniques to large pieces;
- Experimental results on benchmark pieces of comparative evaluation of technologies;
- Reports, state of the art, scientific publications, project reports and the final doctoral thesis.

Consistency of the programme with the PNRR
Additive manufacturing is part of the enabling technologies recognized in the National Industry 4.0 Plan, and is proposed as a key factor for overcoming the economic and social effects caused by COVID-19 and promoting the ecological, digital and resilient growth of the economy desired by the PON- Research and Innovation. Nevertheless, it fits perfectly into the programmatic scheme of the research outlined by the PNR and declined by the SNSI, not only in relation to the large areas and related areas intrinsically inherent in the manufacturing sector, but also in relation to the large areas and complementary areas, which can benefit from the substantial driving force for innovation exerted by the ability to create goods with characteristics otherwise precluded.

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Compliance with the horizontal principles of PNRR and DNSH
The implementation of the project activities provides not to cause significant damage to environmental objectives (so-called "Do No Significant Harm" (DNSH) principle), pursuant to Article 17 of Regulation (EU) 2020/852.

Period abroad: There is a mandatory period abroad of 6 months at a host institution that will be defined later.

Period in the company: A mandatory period in the company of 12 months is planned, even if not continuous, according to the experimental needs.

Company data: Self Group spa

Contact Professor/Researcher: Marco Sortino

Tematica di ricerca 1.7: Artificial Intelligence for the economic and environmental sustainability of thermoplastic polymer production plants
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest
M4C2: FROM RESEARCH TO BUSINESS
The proposal is part of the M4C2 component "From Research to Business" of the PNRR which indicates among the objectives the need to intensify the demand for innovation by businesses and the integration of research results into the production system. In particular, the proposed research aims to enhance high-profile skills especially in relation to Artificial Intelligence topics.
M1C2: DIGITIZATION, INNOVATION AND COMPETITIVENESS IN THE PRODUCTION SYSTEM
The themes of the proposal reflect the themes of the M1C2 component "Digitization, Innovation and Competitiveness in the Production System", in particular the Transition to Industry 4.0 (Investment 1) with the concept of Smart Factory in its Smart production and Smart energy components.
MISSION 4C2: NEED FOR INNOVATION AND PROMOTION OF RECRUITMENT
The themes of the proposal are also configured in the target of M4C2 "Introduction of innovative doctorates that respond to the innovation needs of companies and promote the recruitment of researchers by companies" (Investment 3.3.) With the concept of training highly specialized young people for insertion into the industrial world and strengthening of the working fabric in the context of national entrepreneurship.

Objectives and expected results, proposed research activity, methodologies and contents:
Thermoplastic polymers - such as polyolefins and styrenic polymers - are undoubtedly the most popular polymeric materials, given their notable and varied use in many end application sectors (packaging, automotive, construction, household appliances, etc.).
The production plants have characteristics common to most technological platforms:

- Large dimensions and large volumes of product to guarantee the economy of the processes (hundreds of thousands tons per year)
- Continuous productions
- Different grades of product, with transition from one grade to another always continuously
- Scheduled maintenance, which usually requires production stop
- High energy consumption, especially given the size
- Process conditions and potentially critical substances (high pressure, fossil monomers, etc.)
- High Process Data Availability (DCS)

All these characteristics clearly indicate how particularly useful is the application of new digitization approaches, which can fully exploit the availability of digitized process data to optimize operational management. The advanced control systems, where implemented, generally use first principle approaches, through the use of kinetic models of polymerization, and what can be modeled in relation to aspects connected to the heat exchange and to the efficiency of the main machines (such as, for example, gas compressors).
However, first-principles models represent an approximate and generalized version of the operational reality. The digital twin approach, and machine learning techniques in general, makes alternative solutions available, data- driven or in any case based on real process data, which allow a representation and therefore a management more responsive to the reality of the single and specific plant, with obvious and multiple advantages.
In detail, a first (non-exhaustive) list of advantages of the proposed project can already be outlined, such as:

- Production consistency in line with the expected product specifications
- Optimization of the campaign change phases in the transition phase between different product grades
- Predictive Maintenance / Asset Integrity
- Early fault

which would allow to:

- Reduce the production of non-standard products or in any case of second or third choice, with obvious economic advantages
- Consequently increase the production potential, reducing or eliminating the operational phases due to non-optimal productions
- Reduce the consumption of raw materials and energy for unexpected productions, consequently reducing the carbon intensity and consumption of fossil and environmental resources
- Reduce the occurrence of out of service or in any case production irregularities, which potentially lead to the production of waste following emergency conditions
- Reduce the frequency of scheduled stops, particularly impacting both from the point of view of production potential and for the operating cost resulting from the maintenance operations itself
- Reduce or eliminate operational emergency situations, potentially dangerous due to the emergency management of both dangerous substances and particularly severe operating conditions of pressure and / or temperature

In essence, through advanced digitalization it is possible to significantly improve operational management in terms of:

- Economic return
- Reduction of the environmental impact
- Operational safety

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In particular, in the field of machine learning, the objectives envisaged are:

1. Describe the intrinsic correlations between the production parameters linked to the specific synthesis of the finished product (model correlation analysis);
2. Identify production inefficiencies in historical series and in real time inherent to production gears (Trouble shooting and fault detection / Early fault);
3. Monitor plant capacity and quality of production intermediates (products and chemicals) and finished products (thermoplastic polymers) (predictive model);
4. Optimization of campaign changes between one production set-up and another (optimized protocol);
5. Estimation of the constants and parameters of a proprietary hard model of the reactor for the polymerization of the finished product through data analysis (Fine tuning hard model).
6. Deployment of the models obtained on the MS Azure environment, available in the company

Period abroad: 6 months (mandatory)

Foreign host party data: To be defined

Period in the company: Min 6 and Max 12 months, even if not continuous (mandatory)

Company data: Versalis spa

Research activities to be carried out in the company: At the company, the candidate will have a workstation with access to the data factory architecture, with real -time access to process data. It will also have a virtual machine available on the MS Azure ML application. It will therefore have to take care of transferring the monitoring and optimization models developed off-line, on historical data, to the MS Azure environment, in order to place the aforementioned models online with the plant data acquired in real time. It will also develop dashboards that make the results obtained with the deep learning models developed and made operational available to operational staff, in real time and continuously. For a more complete deployment activity, the candidate will be trained in the company on the main characteristics of the production process studied.

Highlight the coherence of the doctoral program with the specific principles and obligations of the PNRR:
RESPONSIBLE AND SUSTAINABLE APPROACH
Sustainability is part of every aspect of the Versalis business . This link is realized with the integration of the missions of the 17 Sustainable Development Goals of the UN 2030 Agenda. The proposal provides for the development of doctoral activities and the achievement of the objectives defined in harmony with the following SDGs:

GREEN TRANSITION:
The proposed research aims at optimizing the process and reducing the production inefficiencies of petrochemical plants with consequent savings in terms of energy and production waste. These objectives are part of the Environment and Energy theme and are in line with the principles of the Green Transition.
DIGITAL TRANSITION:
The Artificial Intelligence techniques that will be analyzed in the context of the proposed research are aimed at optimizing and automating the production processes of petrochemical plants with a direct impact on Versalis' competitive advantage .
DNSH:
The object of the research are optimization algorithms of petrochemical industrial production with the aim of bringing advantages in economic, energy and environmental terms. The principle of not causing significant damage to the environment will therefore be respected (Do No Significant Harm).
Open science and FAIR Data:
The results of the research carried out will be published in conference proceedings and scientific journals, respecting the indications of the National Research Program 2021-27 regarding Open science and FAIR data.

Contact Professor/Researcher: Lauro Snidaro

Tematica di ricerca 1.8: Research and development of innovative visible light communication systems
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: The research topic focuses on Visible Light Communication (VLC) systems and their integration into lighting systems in order to develop integrated lighting and data infrastructures. Such infrastructures enable the delivery of innovative services that require advanced connectivity. The application scenarios are those of Smart Buildings, Smart Factories, Smart Hospitals etc.. Therefore, the research topic is of relevance in the perspective of digitalization and implementation of advanced telecommunication infrastructures (5G and 6G) integrated with lighting infrastructures that are characterized by efficiency and low environmental impact. The project will yield positive spin-offs through knowledge enhancement and technological innovation in support of sustainable development, including industrial development, with a view to the realization of smart cities. It is also characterized by interdisciplinarity (engineering, computer science and partly physics and mathematics) and it specifically involves different scientific-disciplinary fields (ING-INF/03 telecommunications, ING-INF/01 electronics and ING-INF/02 electromagnetic fields). Finally, the topic is of international relevance as confirmed by the fervent research, development and standardization activities carried out by numerous research centers and companies, internationally.

TABLE 9 – PhD Programme INDUSTRIAL AND INFORMATION ENGINEERING

Expected aims and results, proposed research activities, methodologies and contents: The objective of the proposed Ph.D research is to investigate and develop innovative wireless data transmission systems that exploit visible light. Such systems can be integrated into LED lighting equipment, enabling the realization of integrated lighting and communication infrastructures. Such infrastructures are also known as Visible Light Communication (VLC) and Light Fidelity (Li-Fi). The advantages are many: possibility of realizing high-speed wireless data transmission links through modulation of lighting devices (LEDs); energy efficiency; low environmental and electromagnetic impact. VLC networks can also be used to complement other wireless and wired technologies, e.g., Wi-Fi and Ethernet. The theme is highly topical and of scientific and industrial relevance. The elements being researched are multiple and multi-sectorial. They include: communication algorithms and protocols, optoelectronic devices, signal processing, signal and data analysis also including machine learning (ML) techniques. The training activity will lead to the acquisition of skills in these technical and scientific areas.

- General objectives include: analysis of the state of the art related to VLC systems; definition of the requirements and of innovative applications that are enabled by VLC networks; implementation of experimental HW/SW devices; evaluation of achievable performance using simulation and measurement methods.
- The expected outcomes are: development of innovative VLC transmission techniques and algorithms; integration of transceiver modules into luminaires; analysis and design of the network infrastructure for data collection and transport.
- Proposed research methodologies include: performance analysis with simulation techniques; experimental development of hardware and firmware prototypes; validation with laboratory and field measurement campaigns.

Period abroad: 6 months (mandatory).

Foreign Hosting Institution Data: To be defined.

Period at the company (from 6 to 18 months): 12 months (mandatory).

Data of the company (business name, legal and operative headquarters): Way Point s.r.l. - Headquarters: Via Albere, 29/A - 37138 Verona. Operational headquarters: Via Mure, 61 – 31030 Altivole (TV).

Research activity to be developed at the company: The Ph.D. program involves conducting activities in collaboration with the company Way Point s.r.l. at its laboratories for a period of 12 months. The overall objective is to develop a feasibility study for the integration of VLC nodes into light fixtures. This will increase technical expertise and identify innovation strategies. Experimental activities will be conducted at the company in order to define system requirements and investigate aspects related to the design and implementation constraints. In particular, an analysis of the most suitable VLC/Li-Fi solutions to be integrated in luminaires will be conducted, HW/SW requirements will be defined, and achievable performance will be validated through the experimental development of prototypes.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross-cutting priorities: the project meets gender equality goals and will give equal opportunities to applicants and researchers of both sexes.
- Twin transitions (green and digital): The research topic Visible Light Communication is of relevance for the digitalization and implementation of advanced communication infrastructures integrated with lighting infrastructures (energy efficient with low environmental and electromagnetic impact). The developed methods and solutions will contribute to sustainable and long-lasting development, in fact enabling the realization of smart infrastructures and systems (Smart City, Smart Building, etc.). The development of analysis and simulation methods is perfectly aligned with the Digital Twin approach in which the system is represented digitally in order to both optimize the design process and to enable monitoring and preventive diagnostics of the system in operation.
- Do No Significant Harm - DNSH: The research top aims to: reduce the environmental impact and energy consumption of lighting and data infrastructure (climate change mitigation); not adversely impact current and future climate conditions, people, nature, or property (climate change adaptation); have no impact on the status of water bodies of any kind; promote the approach toward circular economy by studying technology to support smart systems and applications; to not increase pollutant emissions; and not cause harm and undermine the health of eco-systems.
- Open science and FAIR Data: The project targets the dissemination of results through publications in journals and conferences that are or have an open access option. Scientific dissemination activities of the results will also be promoted.

Contact Professor/Researcher: Andrea Tonello

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

THE PhD PROGRAMME	
Administrative location	University of Udine - Polytechnic Department of Engineering and Architecture (DPIA) - via delle Scienze 206, 33100 Udine, ITALY (tel. +39 0432 558253).
Associated location	-
Location for training, teaching and research activity	Teaching and other training activities will take place primarily at the administrative programme location or in other locations of the University of Udine. The research program will be developed according to the provisions of section "Research Topics description".
Coordinator	Prof. Cristian Marchioli (cristian.marchioli@uniud.it)
Programme duration	3 years
Curriculum	-
Course website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-physical-science-and-engineering/scienze-dellingegneria-energetica-e-ambientale/il-dottorato https://phd.diegm.uniud.it/eees-phd-activities/

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea specialistica/magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the Call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title needed for admission to the PhD programme and list of the exams (with grades) passed during the Italian first level (bachelor) and the Laurea Specialistica/Magistrale programmes or during the Italian programmes before D.M. 509/99 or during the foreign academic programmes; 2. Curriculum vitae et studiorum, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can provide to the development of the topic itself (approximate limit 10.000 characters, spaces included, in English language).
<u>Optional</u> documents (art. 5 of the Call)	1. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this Call can submit an extended abstract in place of the complete thesis, in Italian or English language, signed by themselves and by their thesis Supervisor (approximate limit 10.000 characters, spaces included); 2. Motivational letter, dated and signed, by which the applicant explains the reasons for admission to the PhD programme (approximate limit 2.500 characters, spaces included); 3. Publications (max 2); 4. Letters of reference (max 2), from university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed members	Lorenzo Fedrizzi – Full Professor – Università di Udine Sara Colussi – Associate Professor – Università di Udine Giovanni Cortella – Associate Professor – Università di Udine Marco Ometto – Legal Representative of Danieli Automation Spa Paola Perabò – Legal Representative of Danieli & C Spa Diego Pavan – Legal Representative of Edilvi Spa Paolo Folgarait – Legal Representative of Seamthesis Srl
Substitute members	Alex Lanzutti – Associate Professor – Università di Udine Cristian Marchioli – Associate Professor – Università di Udine

ADMISSION
GENERAL COMPETITION (art. 8 of the Call for Applications)

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Positions available: 6				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Positions WITH SCHOLARSHIP: 6	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and Università degli Studi di Udine	€ 16.243,00	Research Topic 1.1: Development of environmentally friendly and multifunctional organic coatings
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Danieli & C. Spa	€ 16.243,00	Research Topic 1.2 - Use of solid, liquid and gaseous steelmaking by-products for the development of circular economy processes
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Danieli Automation Spa	€ 16.243,00	Research Topic 1.3 - Optimisation of energy flow management in industrial microgrids with RES generation and storage systems
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Edilvi Spa	€ 16.243,00	Research Topic 1.4 - Building 4.0 Energy Improvement Interventions as part of an integrated approach
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Seamthesis Srl	€ 16.243,00	Research Topic 1.5 - Multiphysics modelling of green hydrogen embrittlement phenomena in metallic and non-metallic materials strategic for the energy and environmental transition (SMART-HY)
	1	DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST) ECS00000043 CUP G23C22001130006	€ 16.243,00	Research Topic 1.6 - Decarbonisation and CO2 valorisation processes and technologies

Competition procedure and test schedule			
Evaluation of titles and oral examination. For the evaluation of applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 21 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles. **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 12, 2022.** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 27, 2022.**			
Foreign language that can be used for examination	Italian or English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum studiorum		*10*
	Curriculum vitae		*2*
	Research Project		*6*
	Scientific publications		*2*
	Thesis/Abstract		*3*
	Letters of reference		*2*
	Motivational letter for admission to the PhD programme		*5*
Oral examination	Interview based on technical, motivational and scientific discussion.		
Calendar of the oral examination	**Date**	Thursday, September 22, 2022	
	Time	09:30 AM	
	Place	Polytechnic Department of Engineering and Architecture (DPIA), Auditorium ex-DCFA – via del Cotonificio 108 , 33100 Udine	
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination.		

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Research Topics description
Research topic 1.1: Development of environmentally friendly and multifunctional organic coatings *D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP* Consistency of the proposed research with the NRRP areas of interest and, for the scientific-technological areas, highlighting how the proposed research can promote interdisciplinarity, joining to international networks and intersectoral: The research activity aims to develop eco-sustainable, multifunctional, powder-based or liquid-based organic coatings for application on different types of substrates (ferrous and non-ferrous metals, polymeric, ceramic and composite materials). The main scientific and technological objectives of this research activity are: - Replacement of raw materials derived from fossil fuels with substances of natural origin for the production of formulations for powder or liquid-based coatings (eco-compatibility); - Promotion of a clean environment through the use of functional additives with anti-bacterial and anti-virus action and with self-cleaning capacity (multifunctionality); - Reuse of the raw material lost during the application of the coating (eco-sustainability). The structure of the research activity provides for a marked interdisciplinarity with regard to NRRP areas of interest and typical research themes of the sector ING-IND/22 (materials science and technology). In particular, the goal of developing coatings starting from substances of natural origin involves research activities concerning the structure and properties of the innovative materials developed in the project and the definition of production and transformation processes aimed at the application of coatings. The implementation of multifunctional properties inside the coatings (anti-bacterial, anti-virus, anti-stick and anti-fouling properties) is characterized by a marked multidisciplinary character as it involves experimental approaches that affect different chemical-physical properties of the raw materials considered in the research activity. The goal of reusing raw materials, with particular reference to the deposition process of powder-based coatings, requires a multidisciplinary approach with a strong involvement of the industrial partner. Finally, it should be noted that the structure of the research activity favours a marked collaboration at an international level, both with the companies involved in the research (PLT and Marlin) and with foreign universities with which collaborations are active on issues relating to the activity of the Ph.D. Research. Expected aims and results, proposed research activity, methodologies and contents: The main results expected from this research activity are: - Use of raw materials of biological origin (resins, functional additives and fillers) for the development of multifunctional organic coatings; - Introduction into the formulations of eco-sustainable additives with anti-bacterial and anti-virus action within the coatings; - Promotion of anti-stick and anti-fouling properties of coatings through the development of superhydrophobic surfaces; - Implementation of a self-cleaning effect in the coatings; - Increased resistance of coatings to cleaning cycles for applications where particularly intense cleaning regimes are required (hospital areas, pharmaceutical plants, food processing and preparation areas, areas and cells intended for storage and subject to refrigeration, reception areas, ceilings of public and private buildings). - Possibility of reuse in the deposition system of residues produced by the application of coatings (reuse of powders) in order to promote a circular economy within the powder production plant. The proposed research activity makes use of the collaboration with PLT GmbH with which the Polytechnic Department of Engineering and Architecture has been collaborating for several years on issues relating to the development of multifunctional coatings, such as in the context of MULTIPROTECT and FasTher projects. The research activity proposed in the initial phase will focus on the identification and characterization of raw materials for the definition of powder-based formulations containing resins, functional additives and fillers of natural origin. The technology of powder-based coatings offers the important advantage of almost-completely eliminating the use of organic solvents compared to conventional coating techniques. The use of natural raw materials will further increase the environmental compatibility of the coating systems developed within the PhD research. Raw materials and functional additives of natural origin will be identified by PLT GmbH. This phase of the research will require a careful evaluation of the chemical-physical characteristics of the raw materials in order to evaluate their compatibility with the electrostatic spray deposition process followed by heat treatment in the oven. In this phase of the research, a careful characterization of raw materials by means of electron microscopy (FE-SEM), atomic force microscopy, FTIR and Raman spectroscopy will be essential. Subsequently, the introduction of additives of natural origin will be evaluated in order to obtain an anti-virus and anti-bacterial action within the coatings. A first approach in this phase of the research is to replace the silver salt-based additives that currently represent the state of the art as regards the anti-bacterial and anti-virus functionality of organic coatings with compounds of natural origin (natural enzymes , extracted from tree bark). A second approach of this work, using liquid-based coatings, consists in obtaining an anti-stick and anti-fouling effect by preventing the adhesion of bacteria and micro-organisms by obtaining superhydrophobic surfaces. The research phase related to the physical approach to obtain an anti-stick and anti-fouling surface can also involve Marlin S.r.l with which a collaboration is active aimed at developing biocide-free antifouling superhydrophobic coatings for application in the nautical field (hulls, propellers and in general all objects immersed in the marine environment). A third approach, again using powder-based coatings to promote the anti-bacterial and anti-stick functionality of the coatings, consists of the implementation of a catalytic-type self-cleaning effect by exploiting titanium dioxide nanoparticles that can be activated by UV light. The multifunctional properties of the coatings will be characterized initially according to the "Qualicoat" specifications and standards for thickness, dry adhesion and natural and accelerated aging tests. The anti-bacterial functions of the coatings can be assessed according to specific regulations (ISO 22196: 2011, ISO 846: 2019, ISO 21702: 2019) also availing themselves of the collaboration with the DAME department of the University of Udine or with external laboratories. Another important aspect on which the research activity will focus concerns the durability of multifunctional coatings with reference to the need to ensure adequate resistance to even intensive cleaning cycles that can be simulated in the laboratory. During the PhD activity, the development phases of the formulations will take into account the goal of ensuring the reuse of waste from the deposition process of powder-based coatings. PLT has relevant expertise in this specific objective given the research activity conducted within the FasTher project. Period abroad: 6 months (mandatory) Foreign Hosting Institution Data: Denominazione /name: PLT GmbH Ragione sociale / business name: GmbH (S.r.l.)

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Cod Fiscale - P. IVA / VAT number: ATU72331906
Legal headquarters: Miegererstrasse 40, 9065 Ebenthal in Kärnten – Austria
Operative headquarters: Miegererstrasse 40, 9065 Ebenthal in Kärnten – Austria
Website: www.plt-powdercoatings.at

Possible research center involved in definition of the doctoral training: Not foreseen

Research activity to be developed at the research center: Not foreseen

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: the PhD project is in line with the cross priorities of the PNRR, in particular regarding young people (missions 1 and 4). All the activities related to the PhD program will guarantee strict compliance with all the regulations concerning the principle of non-discrimination (equal treatment between people, regardless of nationality, sex, race or ethnic origin, religion or beliefs, a disability, age or sexual orientation)
- Twin transitions (green e digital): the research activity object of this proposal is located in the intervention area of the green transition. The scientific and technological objectives of the PhD research, in particular the replacement of raw materials derived from fossil fuels with products of natural origin and the reuse of raw materials, contribute to the achievement of climate neutrality with a potential impact on the reduction of greenhouse gas emissions. The research activity contributes to the green transition in the organic coatings sector.
- Do not significant harm - DNSH: the expected results of the PhD activity are in line with the DNSH principle defined in Article 17 of EU Regulation 2020/852 in accordance with the indications of the PNRR, promoting the reduction of pollution and the recycling of raw materials.
- Open science and FAIR Data: In line with what is indicated in the National Research Program (PNR) 2021-2027, the research results will be published in international journals and presented at national and international conferences in order to pursue a high quality of research by the student. Any restrictions related to industrial confidentiality will be respected by ensuring public access to the results in accordance with the "Open science" and "FAIR Data" principles.

Contact Professor/Researcher: Francesco Andreatta

Research topic 1.2 Use of solid, liquid and gaseous steelmaking by-products for the development of circular economy processes.
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: The presence of quantifiable and measurable objectives consistent with the indicators provided by the NRP reference action is revealed in this doctoral track. The results will be of high potential with reference to the REACT-EU goals in terms of green economic recovery (in particular those related to CO2 emission reduction in energy intensive processes).

Expected aims and results, proposed research activities, methodologies and contents: Aim of the project is the design and development of structured multifunctional catalysts for the CO2 adsorption and subsequent hydrogenation to CH4 and/or methanol with green H2 from Renewable Energy Sources (RES), leading to recovery and valorization of CO2 from exhaust gases in high energy intensive processes.
We will work on the development of the catalytic formulation in powder form for CO2 hydrogenation and CO2 capture using specifically developed lab-scale microreactor systems. The materials will comprise multi-component catalysts, based on oxides such as ceria or perovskites, whereby high surface area CeO2 has shown promising application in the recent literature and ensures strong interaction with the supported active phase, and some perovskite oxides exhibit stable behavior under reducing-oxidizing cycles and easy functionalization through exsolution process. The addition of noble or transition metals (such as Ni, Cu, Ru or Pd) will be evaluated for CO2 hydrogenation purposes, and basic oxides for further CO2 adsorption capacity. Both traditional and innovative synthesis strategies will be employed to study the best interaction between the catalytic components.

Period abroad: For characterization purposes short periods in qualified labs will be carried out (max 6 months mandatory).

Foreign Hosting Institution Data: not yet defined.

Period at the company (from 6 to 18): At least 6 months (mandatory)

Data of the company: Danieli Officine Meccaniche S.p.A. - Legal headquarters: via Nazionale 41, 33042 Buttrio (UD)

Research activity to be developed at the company: Technical and economical assessment of the entire recovery and valorization process.

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: The PhD programme is aimed at fostering green transition and digital transformation, ensuring gender equality, enhancement of employability skills of young people, and territorial convergence.
- Twin transitions (green e digitale): The project will be in line with green transition and circular economy principles.
- do not significant harm - DNSH: The execution of the project activities will not cause significant damage to the environmental objectives (DNSH principle), pursuant to Article 17 of Regulation (EU) 2020/852)
- Open science and FAIR Data: The execution of the project activities will comply with the Open science and FAIR Data principles fostered by EU

Contact Professor/Researcher: Alessandro Trovarelli

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Research topic 1.3: Optimisation of energy flow management in industrial microgrids with RES generation and storage systems
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: According to the National Plan for Green Transition, decarbonizing energy intensive processes by extending renewable electricity production and use and by replacing fossil fuels with renewable and clean fuels is the most important challenge for the national and international community. The aim of this research is the promotion and integration of renewable energy sources in industrial processes, which in turns reduces the energy dependence of our country and increases competitiveness of energy intensive industrial sectors. In particular, this research project will focus on assessing and minimizing the carbon footprint of the steelmaking sector, specifically electric steelmaking, both in Italy and globally.

Expected aims and results, proposed research activities, methodologies and contents: The research aims to produce, test, and validate tools for sizing and managing energy flows in hybrid industrial microgrids including diverse renewable energy sources and storage systems. The following activities shall be carried out:
a. Systematic literature review aimed at characterizing non programmable renewable sources of energy which can be applied to the electric steelmaking sector, as well as different energy storage solutions.
b. Data analysis methods and models for predicting and simulating energy demand and energy supply profiles at steelmaking plants.
c. Model building of an industrial microgrid for electric steelmaking supply.
d. Energy systems optimization model conceptualization and representation including reporting.
e. Economic data (CAPEX, OPEX) collection for various technologies and industrial sites.
f. Energy system simulation model (digital twin) supporting the systems sizing for at least two case studies.
g. Georeferentiation of a sample of steelmaking plants and mapping of available renewable energy sources to match their energy requirements.
h. Energy systems optimization model development, implementation, and validation for three reference plants and for a wide range of combined energy sources and storage systems.
i. Reporting and scientific papers.
j. Set up and commissioning on pilot plant with practical experimentation in person at some steelmaking site, with remote follow up.
k. Software validation in different contexts.
l. Environmental impact assessment model development, application, validation, relevant scientific communication about generally valid results.
m. Software manual writing.
n. Thesis writing and final paper writing.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: The foreign hosting institution will be identified later, in agreement with the company and depending on the activity to be carried out while abroad.

Period at the company: 18 months (mandatory)

Data of the company: Danieli Automation Spa – Legal Headquarters: Via Bonaldo Stringher, 4, 33042 Buttrio UD

Research activity to be developed at the company: Research periods for method development and conceptualization of energy, environmental, and economic optimization models with commercial software at academic institutions will be alternated with simulation software development in Python at the company, as well as with experimentation at industrial sites and case study development at the company. In between and at the end periods devoted to writing and scientific communication will be spent at the University of Udine.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: The PhD programme is aimed at fostering green transition and digital transformation, ensuring gender equality, enhancement of employability skills of young people, and territorial convergence.
- Twin transitions (green e digitale): The project will be in line with green transition and circular economy principles.
- do not significant harm - DNSH: The execution of the project activities will not cause significant damage to the environmental objectives (DNSH principle), pursuant to Article 17 of Regulation (EU) 2020/852)
- Open science and FAIR Data: The execution of the project activities will comply with the Open science and FAIR Data principles fostered by EU

Both the program and the skills to be acquired by the students are in line with the PNRR principle of youth employment in the sectors of the European Green Deal, including renewable energy sources, transmission and distribution networks, and the hydrogen supply chain.
The research is related to the sustainable development principle and with the objective of preserving and improving environmental quality, thereby contributing to provide innovators, investors, and businesses new tools for integrating renewable energy sources into their business.
The principles of non-discrimination and equality will be steadily applied, avoiding any discrimination based on sex and sexual orientation, age, ethnic origin, disabilities, religion and personal beliefs.
Specific targets of this research project are:
- Increasing the renewable energy share supplying hard to abate industrial sectors and support to the definition of optimal management strategies;
- Supporting the selection of least cost conversion and storage technologies having minimum environmental impact and maximum benefit for CO_2 reduction.

Contact Professor/Researcher: Damiana Chinese

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Research topic 1.4: Building 4.0 Energy Improvement Interventions as part of an integrated approach
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistancy of the proposed research with the PNRR areas of interest:
Mission: Digitisation, Innovation, Competitiveness and Culture; Component: Digitisation, Innovation and Competitiveness component of the productive system
Mission: Green revolution and ecological transition; Component: Energy Efficiency and Requalification of Buildings

Expected aims and results, proposed research activities, methodologies and contents: The main aim is to create digital twins of buildings and their systems for energy conversion and production to improve energy management, with the purpose of energy saving, or optimization of energy flows within a smart grid. Such buildings will be chosen among existing residential buildings, which are considered as demo cases and supplied with monitoring systems for the most important operating variables. The comparison between expected and measured data allows validation of the models and will lead to a predictive maintenance function. All these features can be considered an advanced BEMS (Building Energy Management System). The activity is planned in various phases, whose core is the development of the dynamic simulation model regarding the building itself, its HVAC plants, photovoltaic and thermal solar collectors, geothermal heat pumps if the case, thermal and electric storage. The company will identify some demo cases among and adequately supply them with instruments to monitor the main operating variables. The model, after validation by comparison with actual data, will be used to identify the most effective control rules for the systems devoted to production, conversion and storage of energy. The expected outcome is a tool for the most effective commissioning and operation of energy production and conversion systems in buildings, with the purpose of reducing energy use and correlated emissions, while preserving the occupants' comfort. Dissemination will be focused on international journals and conferences while respecting Open Science and FAIR Data principles.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: The foreign hosting institution will be identified later, in agreement with the company and depending on the activity to be carried out while abroad.

Period at the company: 18 months (mandatory)

Data of the company: Edilvi Spa – Headquarters: Via Roma n. 164, Loc. Castrette, 31020 Villorba (TV), Italia.

Research activity to be developed at the company:
- Participation to design of buildings and their energy production and conversion systems, acquiring specific expertise
- Identification with the company of the demo cases to be monitored
- Participation to design, installation, commissioning and operation of the monitoring system; data acquisition and elaboration
- Validation of the model, its extension to various plant configurations and operating conditions

PhD Programme congruence with the PNRR principles and specific obligations:
- Cross priorities: The PhD programme is aimed at fostering green transition and digital transformation, ensuring gender equality, enhancement of employability skills of young people, and territorial convergence.
- Twin transitions (green e digitale): The project will be in line with green transition and circular economy principles.
- do not significant harm - DNSH: The execution of the project activities will not cause significant damage to the environmental objectives (DNSH principle), pursuant to Article 17 of Regulation (EU) 2020/852)
- Open science and FAIR Data: The execution of the project activities will comply with the Open science and FAIR Data principles fostered by EU

The activity is fully respectful of the horizontal principles of the NRRP, as well as of the DNSH principle (its aim is the reduction of emissions) and digital transition. Dissemination will be made respecting Open Science and FAIR Data principles

Contact Professor/Researcher: Giovanni Cortella

Research topic 1.5: Multiphysics modelling of green hydrogen embrittlement phenomena in metallic and non-metallic materials strategic for the energy and environmental transition (SMART-HY)
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: The presence of quantifiable and measurable objectives consistent with the indicators provided by the NRP reference action is revealed in this doctoral track. The results will be of high potential with reference to the REACT-EU goals in terms of green economic recovery (CO2 emission reduction in metal materials manufacturing), digital (multiphysics simulation of complex processes) and new materials.

Expected aims and results, proposed research activities, methodologies and contents: The development of innovative materials, production technologies, advanced characterization techniques on laboratory to full scale, as well as physical modeling and related experimental validation of hydrogen embrittlement mechanisms will allow the realization of efficient and reliable industrial devices both at the level of production of green hydrogen, and its transport and storage for industrial and automotive uses. Therefore, quantifiable benefits are expected in terms of durability (in operation), safety, energy efficiency (lower production cost of 1 ton of H2), associated with the progressive reduction of environmental impact related to hydrogen burning techniques (emissions, particulate matter) and its environmental and civil compatibility in general.

TABLE 10 – PhD Programme in ENVIRONMENTAL AND ENERGY ENGINEERING SCIENCE

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: Serbia (Belgrade University), Department of Mechanical Engineering; BP R&D (Leeds, UK)

Period at the company: min 6 months and max 12 months (mandatory)

Data of the company: Seamthesis Srl - Operational headquarters (if involved): Torreano di Martignacco (UD), via Bardelli, 4

Research activity to be developed at the company: Engineering activities in Metallurgy and Materials Science, process and product simulation and modeling, advanced materials characterization, Digital Manufacturing

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: The PhD programme is aimed at fostering green transition and digital transformation, ensuring gender equality, enhancement of employability skills of young people, and territorial convergence.
- Twin transitions (green e digitale): The project will be in line with green transition and circular economy principles.
- do not significant harm - DNSH: The execution of the project activities will not cause significant damage to the environmental objectives (DNSH principle), pursuant to Article 17 of Regulation (EU) 2020/852)
- Open science and FAIR Data: The execution of the project activities will comply with the Open science and FAIR Data principles fostered by EU

Contact Professor/Researcher: Lorenzo Fedrizzi

Research Topic 1.6: Decarbonisation and CO2 valorisation processes and technologies
DD 3277 del 30 dicembre 2021 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 1.5) Interconnected Nord-Est Innovation Ecosystem (iNEST)

In the field of CO2 decarbonisation and valorisation processes and technologies, the candidate will have to develop one of the two indicated sub-topics:
Sub-topic 1: Development of bi-functional materials for the capture/adsorption and catalytic conversion of CO2 to high value-added products. The materials will be developed for integration into the production chain, with a view to decarbonising industrial processes.
Sub-topic 2: Numerical-experimental analysis of heat exchange in metal foams and micro-structured geometries, in non-stationary thermal regime, for use in CO2 adsorption and hydrogenation systems for e-fuel production. Development of high-performance heat exchangers based on these technologies and study of process integration in industrial-scale plants with comparative environmental impact analysis.

Period abroad: 6 months (optional)

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

THE PhD PROGRAMME	
Administrative location	University of Udine - Department of Agricultural, Food, Environmental and Animal Sciences (DI4A) – via delle Scienze n. 206, 33100 Udine, ITALY (tel. +39 0432 558600)
Associated location	-
Location for training, teaching and research activity	Teaching and other educational activities will take place primarily at the administrative headquarters or in other locations of the University of Udine. The research program will be developed as described in the section "Research Topics description".
Coordinator	Prof. Francesco Nazzi (francesco.nazzi@uniud.it)
Programme duration	3 years
Curricula	A. Biology and plant production; B. Biology and livestock science; C. Biology of pathogens and plant protection.
Programme website	https://www.uniud.it/it/ricerca/lavorare-nella-ricerca/dottorato-ricerca/inostricorsi/area-life-science/scienze-e-biotecnologie-agrarie/il-dottorato https://www.uniud.it/it/ateneo-uniud/ateneo-uniud-organizzazione/dipartimenti/di4a/content/didattica/dottorati-di-ricerca/copy_of_PHD%20Schoole%20ASB/PhD%20School%20Agricultural%20Science%20and%20Biotechnology

ADMISSION REQUIREMENTS	
Required degree	Italian Laurea (before DM 509/99) or Italian Laurea specialistica/magistrale (ex DM 509/1999 and DM 270/04). Foreign degrees and titles: refer to art. 3 and 4 of the call.
Knowledge of the following foreign language	English

DOCUMENTS AND QUALIFICATIONS TO BE ATTACHED TO THE APPLICATION FOR ADMISSION	
<u>Compulsory</u> documents (art. 5 of the Call)	1. Certification or self-certification (refer to art. 5 paragraph 5 of the Call) of the academic title required for admission to the PhD programme and list of the exams (with grades) passed during the Italian Laurea Specialistica/Magistrale programme or during the Italian programmes before D.M. 509/99 or during the foreign academic programmes; 2. *Curriculum vitae et studiorum*, dated and signed; 3. Copy of a valid identity document (citizens of countries not belonging to the European Union will provide a copy of a valid passport, comprehensive of the pages containing the holder's photo, personal details, passport number, date and place of issue, date of expiry); 4. A research project, dated and signed, developed in accordance with the topic of interest, which highlights the contribution that the candidate can offer to the development of the topic itself (approximate length of the research project, in English, spaces included: 10.000 characters).
<u>Optional</u> documents (art. 5 of the Call)	1. Master thesis ("Tesi di Laurea") associated to the degree/title providing access to the PhD programme. Applicants who are not graduated on the expiration date of this call can submit an extended abstract in place of the complete thesis, in Italian or English language, signed by themselves and by their thesis Supervisor (approximate limit: 25.000 characters, spaces included); 2. Publications (max 2); 3. Letters of reference (max 2), from university professors, scientific researchers or other experts in the field (art. 6 of the Call).

SELECTION COMMITTEE	
Appointed members	Fabio Marroni – Associate Professor – University of Udine Giuseppe Stradaioli – Full Professor – University of Udine Mirco Corazzin – Associate Professor – University of Udine Elisa Petrussa – Assistant Professor – University of Udine Pierantonio Boldrin – Tecnozoo S.P.A.
Substitute members	Enrico Braidot – Associate Professor – University of Udine

ADMISSION

GENERAL COMPETITION (art. 8 of the Call for Applications)

Positions available: 4				
Detailed description	***N.***	***Funding***	***Annual gross amount***	***Research Topic***
Posti CON BORSA: 4	1	D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience	€ 16.243,00	Topic 1.1 - Eco-physiological response of agro-systems to water stress: new

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

		Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) and University of Udine CUP G23C22001310003		perspectives for the use of remote sensing and upscaling tools for the effective management of water resources in agriculture
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and IGA Technology Services srl CUP G23D22000780005	€ 16.243,00	Topic 1.2 - De novo genome assembly for functional diversity analysis
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and TECNOZOO S.P.A CUP G23D22000780005	€ 16.243,00	Topic 1.3 - Carbon-based alternative approach for the reduction of antimicrobial use in the bovine uterine infection therapy
	1	D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3) and Tenuta Marianis srl CUP G23D22000780005	€ 16.243,00	Topic 1.4 - Feed efficiency and sustainability of Italian Simmental (PRI) dairy cows

Competition procedure and test schedule			
Evaluation of titles and oral examination. For the evaluation of the applicants' attitude for scientific research and their basic skills to tackle the course program, the Selection Committee can attribute up to 100 points to each applicant: max 30 points to the titles and max 70 points to the oral examination. The applicant is admitted to the oral examination if his/her titles receive at least 21 points. The oral examination is passed with at least 49 points. The applicant is eligible to the PhD programme if he/she passes the oral examination. Only for eligible applicants, the points attained in in the oral examination will be added to the points of the titles. **DATE FOR THE PUBLICATION OF ADMITTED APPLICANTS TO THE ORAL EXAMINATION: within September 13, 2022.** **DATE FOR THE PUBLICATION OF THE FINAL RANKING LIST: within September 27, 2022.**			
Foreign language that can be used for examination	Italian or English		
Evaluation Criteria of qualifications *During the preliminary meeting the Selection Committee may establish sub-criteria for the evaluation*	Curriculum vitae et studiorum		10
	Research project		10
	Scientific publications		2
	Thesis/Abstract		6
	Letters of reference		2
Oral examination	The oral examination is based on a discussion on the scientific titles submitted and includes an evaluation of English language knowledge.		
Calendar of the oral examination	**Date**	**September 23, 2022**	
	Time	9:00 AM	
	Place	Department of Agricultural, Food, Environmental and Animal Sciences (DI4A), Cereals room – via delle Scienze n. 206, 33100 Udine, ITALY	
	Based on the number of applicants, the oral examination may take place in more than one day. Applicants must exhibit a valid ID for admission to the oral examination		

Descrizione tematiche di ricerca
Research Topic 1.1: Eco-physiological response of agro-systems to water stress: new perspectives for the use of remote sensing and upscaling tools for the effective management of water resources in agriculture *D.M. 351 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 1 Investment/Sub-investment 4.1) - Research NRRP* Consistency of the proposed research with the NRRP areas of interest, highlighting, for the scientific-technological areas, how the proposed research can promote interdisciplinarity, facilitate the joining to international networks and promote intersectoral approaches: the project aims to promote a multidisciplinary approach that integrates basic biological disciplines with agronomic and innovative applicative aspects of remote sensing in agroecosystems, in order to find solutions that guarantee adaptation and resilience to climate change and the risks of drought, health emergencies, soil depletion, with a view to environmental sustainability. The educational project also aims to promote exchange and collaboration activities with national and European research institutions, in synergy with the areas of interest of the PNRR and the European Green Deal and in

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

alignment with the objectives of Horizon Europe-Cluster 6 and PNR 2021-27, declined in the main objectives of the sustainable improvement of primary productions and improvement of knowledge and management of agricultural and forest systems.

The research activity aims to promote actions in the context of the M2C2 (Sustainable Agriculture and Circular Economy) and M2C4 (Protection of the territory and water resource) missions of the PNRR. Alos, within the PNRR, the University of Udine is a member of the National Center for Agricultural Technologies (Agritech), whose main objective is promoting the development of innovative technologies in the agricultural sector, to improve the quantity and quality of production, ensuring a sustainable path of adaptation to climate change.

Expected aims and results, proposed research activity, methods and contents: climate change is one of the greatest environmental challenges of our time with far-reaching consequences on many manufacturing activities, including agriculture. Future forecasts indicate that drought conditions, combined with an increase in temperatures, will become increasingly frequent, causing a negative impact on agro-ecosystems, affecting crop productivity both directly, based on the acclimatization capacity of crops, and indirectly, by acting on the biotic interactions between crops and other organisms present in agroecosystems. For example, drought induced by climate change can alter numerous ecosystem services by favoring pests and highly competitive weed plant species. There are many studies that have analyzed the effects of the water regime on annual and perennial crops, highlighting the effects and consequences at different ecological scales. On the other hand, the opportunities to extend the effects on the biological and physiological processes involved in field conditions and at different ecological scales (from the individual to the landscape) remain less explored. In this context, the study at different scales of investigation and the use of remote sensing tools (multispectral images from satellites or drones) can provide new perspectives for interpreting the connection between the individual's response and the entire agro-ecosystem (upscaling).

Aims: the proposed educational project involves a multidisciplinary approach and the use of new technological tools with the aim of monitoring the response of agroecosystems to water stress at different spatial scales, in order to optimize the use of water resources and improve the understanding of interaction between plant and other organisms and biotic factors of the agroecosystem.

Expected results: the project is expected to favor the preparation of forecasting models and innovative solutions for the sustainable use of water resources, with a view to improving the resilience of agro-systems in response to climate change and mitigation of related risks. Furthermore, the candidate is expected to produce a solid scientific output within the research topic of the educational project, represented by several articles published in high-impact journals in the sector.

Proposed activity: the educational project will be structured on several levels, including both studies and experiments carried out in the open field in collaboration with national research centers, and in a controlled environment at the foreign host institution. The research will aim to investigate the mechanisms that guide the response of primary crops in relation to environmental stress, with particular regard to the water resource and nutritional status of the soil, to both establish a link between the physiological and morphological response of the plant and the common tools of remote sensing at different survey scales, and connect the individual to the entire agro-system aiming to extend the results at a territorial level.

Methods and contents: the project will require the candidate to be able to design and carry out experimental activities, both in the open field and in a controlled environment, ability to use statistical analysis and bioinformatics tools, to acquire the knowledge of the basics of remote sensing and skills in the experimental scientific approach, ability to interact with the different operators and research realities involved in the collaborative activities of the project, acquisition of skills in the scientific writing of reports and publications in international journals and communication skills in the dissemination and dissemination of the results obtained.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: TIMAC AGRO International, 27 av. Franklin Roosevelt B.P. 70158 F - 35408 Saint-Malo

Possible research center involved in definition of the doctoral training: Servizio fitosanitario e chimico, ricerca, sperimentazione e assistenza tecnica, Agenzia regionale per lo sviluppo rurale, (ERSA FVG), Pozzuolo del Friuli (UD)

Research activity to be carried out by the research center: as part of the educational project, specific experimental activities will be planned in collaboration with ERSA, included in the theme of monitoring the eco-physiological responses of primary crops to water scarcity and interaction with nutritional status, the development of phytopathogens and any competition from plant weed species. This activity will allow the candidate to be directly involved in experimental activities in the open field, with the participation of a network of regional agricultural enterprises collaborating with ERSA.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: the project meets the requirements of transversal priorities envisaged by the PNRR, in relation to equal generation, gender and territorial opportunities.
- Twin transitions (green and digital): the research project also deals with aspects and issues included in the areas of digital and ecological transition, exploiting new innovative remote sensing technologies suitable for environmental monitoring and indicator assessment, describing the response of primary crops to the climate crisis and environmental degradation, in relation to the other biotic factors involved in the agro-ecosystem.
- do not significant harm - DNSH: the educational project does not cause significant damage to the six main environmental objectives identified in the European Green Deal agreement, as it aims to find innovative strategies to promote the resilience of agroecosystems to climate change, with a view to sustainable use of irrigation management.
- *Open science* and *FAIR Data*: the educational project aims to ensure that research results and access to individual data and metadata are open to the public and freely usable, in line with the principles of *Open Science* and *FAIR Data*.

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

Contact Professors: Elisa Petrussa, Enrico Braidot.

Research Topic 1.2: De novo genome assembly for functional diversity analysis

D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: Sustainable agriculture and biodiversity. The project will investigate biodiversity using structural and comparative genomics, leveraging the most recent sequencing technologies and providing the opportunity of a full functional genomics analysis. These approaches will also be available in the field of genetic improvement in agriculture, thanks to a detailed analysis of genic and regulatory elements carrying traits important for yield, sustainability and the defense of biodiversity.

Expected aims and results, proposed research activities, methods and contents: the project aim is the development and validation of analysis methods for de novo assembly of genomes using long reads. The project will identify the systems providing the higher accuracy in genome reconstruction, using cross validation approaches based on simulations or on available high quality reference genomes. To this aim, publicly available data and newly generated data will be used.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: the foreign hosting institution will be determined at the beginning of the PhD project, in agreement with the PhD student.

Period by the company: 12 (mandatory)

Data of the company: IGA Technology Services srl

Research activity to be carried out by the company:

1) Evaluation of base-calling algorithms, to optimize the process of raw sequences generation, maximizing the accuracy for the studied species.

2) Implementation of a workflow for annotation of assembled genomes (gene prediction and functional annotation of genes).

3) Search for available tools or development of novel tools for comparative analysis of genomes for inter- and intra-specific comparisons.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: the project will facilitate promotion of youth professional development (Giovani).
- Twin transitions (green and digital): being the project a bioinformatics project it is in itself characterized by high digital potential. In addition, a core research topic of the project involves species important for biodiversity and this makes the project well centered in the green transition
- do not significant harm - DNSH: not only the project will not cause significant harm (no interventions on the environment are expected), but it will generate knowledge that will be used in the future to improve the environmental conditions.
- Open science and FAIR Data: generated data and software tools will be made publicly available in accordance with FAIR Data and open science principles.

Contact Professor: Fabio Marroni

Research Topic 1.3: Carbon-based alternative approach for the reduction of antimicrobial use in the bovine uterine infection therapy
D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)
Consistency of the proposed research with the PNRR areas of interest: Health, and economic, social and institutional resilience - Health care, both for humans (reducing the use of antimicrobials in animals and the spread of bacteria resistant to antimicrobials that can be transmitted to humans) and for animals by promoting new preventive strategies for the treatment of dairy cow disease. Smart, sustainable and inclusive growth – Sustainability, the project acts both on the reduction of the environmental impact due to antimicrobial residues and on the loss of productive efficiency of the farms, improving the environmental impact (reduction of waste due to sick and reformed animals) and sustainability economics of companies.

Expected aims and results, proposed research activities, methods and contents: the aim of the project is to evaluate the efficacy of an innovative carbon-based absorbent suspension administered by intrauterine infusion, as an alternative to antibiotic therapy in cattle suffering from postpartum uterine infections. The experimental design will include N = 200 multiparous cows (parity ≥ 2), affected by postpartum uterine infection, with muco-purulent vaginal discharge, homogeneous for parity, body condition score (BCS) and type of parturition (absence of dystocia). A group of healthy animals from the same herd will be included for comparison, this group will consist of all healthy dairy cows remaining in the herd. Enrolled animals, with clinical symptoms, will be divided into four subgroups (N = 40 animals per group) in order to test the efficacy and tolerability of two dosages (D1 and D2, defined with preliminary in vitro tests) of carbon sorbent for the intrauterine administration and control group. Another group of N = 40 will be used as a negative control without any treatment. To monitor the therapy, at times 0, 2, 3, 14 and 28 (days after treatment), blood and uterine contents will be collected for subsequent microbiological analyzes (bacterial identification and count) and for the determination of proinflammatory cytokines (tumor necrosis factor, TNF-α), interleukins (IL-1, IL-6, IL-10), redox balance and endotoxins of

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

bacterial origin (lipopolysaccharide, LPS). Follicular fluid and granulosa cells will also be collected by ultrasound guided follicular aspiration (OPU) to determine the follicular endocrine and metabolic environment in combination with gene expression analysis focusing on steroid biosynthesis genes and proinflammatory genes (via qPCR). In addition, the selected samples will undergo transcriptome analysis. The animals will continue their career on the farm and during the follow-up period (maximum 300 days of lactation) the following information will be extracted from the farm management software: calving-conception interval (CCI; days), number of inseminations necessary to achieve pregnancy (n AI), onset of abortion / embryonic losses, rate of replacement of animals, onset of other diseases. These data will then be compared between treated and control animals. The net yield (fertility, milk production, drug administration, human workload) of the experimental and control cows will be compared to ensure that the innovative therapeutic approach is able to improve the overall economic sustainability of the farm. The activities will take place over a period of 3 years, during which the planning of the experiment, the collection of samples, the implementation of the planned analyzes and the analysis of the collected data will be carried out. It is expected to obtain an improvement in the sanitary and reproductive performance of the animals, measurable in terms of a decrease in costs for drugs and an improvement in the reproductive data of the treated animals compared to the control and in line with those of healthy animals. Considering the aim of the study, that is to limit the use of antibiotics in breeding, the results to be pursued will concern the achievement of a reduction in microbial contamination, local pro-inflammatory activity and endocrine disruption of the uterine and ovarian environment thanks to the use of a charcoal absorbent matrix as an alternative treatment. The main ambition will therefore be to obtain and make marketable a new and innovative therapeutic tool designed to improve animal welfare, environmental and social sustainability. Besides, reaching the operators in the sector, such as veterinarians and breeders, the project also aims to restore a positive perception of the final consumer towards the methods of farm management.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: Research Institute for Farm Animal Biology - Forschungsinstitut für Nutztierbiologie (FBN), Wilhelm-Stahl-Allee 2, 18196 Dummerstorf, Germany

Period by the company: 6 months (mandatory)

Data of the company: TECNOZOO S.P.A

Research activity to be carried out by the company: The activities will be focused on the industrial implementation of the suspension of absorbent carbon aimed to explore the possible production of a ready to market product; knowledge relating to the possibility of applying other alternative products of natural origin will also be implemented with a view to sustainable investment. In addition, from a strictly practical point of view, knowledge relating to the use of software for feed formulation and industrial techniques that allow the creation of a feed will be acquired. A focal part will also be destined to the diffusion of the product in farms, presenting it as an innovative and alternative treatment to the use of antibiotics for uterine infections in cattle.

PhD Programme congruence with the PNRR principles and specific obligations: Health, considered from the perspective of a One Health approach, or as a transversal element that embraces the animal, environmental and social dimension, underlies the motivations of this project, and represents a key to understanding also the objectives defined by the National Recovery and Resilience Plan (PNRR). Furthermore, also considering the delicate issue of environmental pollution caused by the presence of antibiotic residues, this research intends to invest in areas such as "transversal health and" sustainable development ".

- Cross priorities: Health, and economic, social and institutional resilience - Health care for both humans and animals. The use of a new therapeutic approach capable of replacing antimicrobials in the treatment of uterine infections in livestock will have positive effects on animal welfare, on the healthiness of the foods they originate (and therefore indirectly on human health) and on the environment (thanks to a reduction in residues and the spread of bacteria resistant to antimicrobials).
- Twin transitions (green and digital): Sustainability, for an improvement in production and reproductive efficiency. From the reproductive point of view, thanks to the possibility of rapidly eliminating the cause of the inflammatory response from the uterine environment using an adsorbent material, a resolution of the inflammatory process and a consequent faster restoration of fertility will be achieved. From a production point of view, sustainability will also concern breeding; the losses due to the animals reformed due to infertility will in fact be reduced allowing to maintain, in this way, even a greater genetic variability. Not less important, considering the growing concern of consumers towards the use of antimicrobials and hormonal treatments for the synchronization of estrus and ovulation on the farm, the possibility of using an alternative therapy could give the final product an added value, with a consequent positive return also for the farm.
- do not significant harm - DNSH: considering the reasons underlying the development of this project, namely the need to reduce the use of antimicrobials on farm due to their negative impact on animals, humans and the environment; the project, promoting an alternative and sustainable therapy, can be defined as respectful of the transversal principles between the PNRR and the DNSH. This project, with its focus on sustainability, not only aims not to cause significant damage (Do No Significant Harm-DNSH) to any of the six environmental objectives of the Paris agreement, but to assist in the persecution of them.
- Open science and FAIR Data: the project aims to promote the exploitation of research results and guarantee the protection of intellectual property, ensuring open access to the public to research results and related data in the shortest time and with the least possible limitations, according to the "Open science "and" FAIR Data "

Contact Professor: Giuseppe Stradaioli

Research Topic 1.4: Feed efficiency and sustainability of Italian Simmental (PRI) dairy cows

TABLE 11 – PhD programme AGRICULTURAL SCIENCES AND BIOTECHNOLOGY

D.M. 352 of 9 April 2022 (NRRP "National Recovery and Resilience Plan" Mission 4 Component 2 Investment/Sub-investment 3.3)

Consistency of the proposed research with the PNRR areas of interest: the research is consistent with Mission 2 (green revolution and ecological transition) Component 1 (sustainable agriculture and circular economy) of the PNRR.

Expected aims and results, proposed research activities, methods and contents: the research aims to assess the feeding behaviour and methane emissions of Italian Simmental (PRI) dairy cows in order to improve feed efficiency and reduce environmental impact. The measurements will be carried out using innovative sensors capable of continuously recording the feeding and rumination times of each cow and monitoring the concentration of methane in the air. These data will be collected and analysed, together with data already available from the PRI National Association (ANAPRI), at the level of individual cows, allowing to obtain useful information for the calculation of genetic indexes within the framework of the selection activity carried out by ANAPRI. Dairy cow dry matter intake and ruminal fermentations are affected by marked individual variability due to factors related to the animal (age, size, genetics, production level) and the environment (chemical and physical composition of the diet, environmental temperature and humidity, interactions among animals and with the buildings). The research intends to study the contribution of the main sources of variability on the above-mentioned aspects, providing useful elements for the improvement of dairy farm management.

Period abroad: 6 months (mandatory)

Foreign Hosting Institution Data: to be identified later

Period by the company: 12 months

Data of the company: Tenuta Marianis srl, Via C. Kechler 1, S. Giorgio della Richinvelda (PN)

Research activity to be carried out by the company: the PhD student will be responsible for the handling of animals for experimental purposes (always in consultation with farm personnel), for setting up and checking the correct functioning of the sensors, and for collecting data and experimental samples.

PhD Programme congruence with the PNRR principles and specific obligations:

- Cross priorities: the doctoral programme is consistent with the transversal principles and obligations of the PNRR, and in particular with the transversal objectives for young people.
- Twin transitions (green and digital): the doctoral programme is consistent with the principle of encouraging and increasing the green transition of productions, and in particular of dairy cattle farms.
- do not significant harm - DNSH: the doctoral programme aims to investigate innovative management approaches to reduce the environmental impact of dairy cattle farms and is, therefore, fully in line with the DNSH principle.
- Open science and FAIR Data: the data obtained from the doctoral programme, after an agreement with the farm manager, will be made accessible in accordance with the principles of Open Science and FAIR.

Contact Professor: Mirco Corazzin