



IMT SCHOOL PHD PROGRAM IN "MANAGEMENT OF DIGITAL TRANSFORMATION",

**CALL FOR APPLICATIONS 2022/2023
EXECUTIVE SUMMARY**

PHD PROGRAM DESCRIPTION

The IMT School for Advanced Studies Lucca has launched the call for applications for the PhD Programs in "Management of Digital Transformation" (2022/2023 academic year):

<p>Course Description</p>	<p>The digital transition implies profound and highly complex technological, organizational, managerial, and economic changes in all sectors of society, with an important impact on green revolution and environmental sustainability. The ability to govern such changes is essential to take advantage of the opportunities made available by digital innovation by dominating the potential associated risks. The entrepreneurial system, in particular the small and medium-sized enterprises that constitute the beating heart of the Italian economic fabric, may not be ready to grasp the challenges posed by the digital transition as they do not have distinctive multi- and interdisciplinary skills capable of combining set strategic directions with the innovations deriving from the application of digital technologies. Digital transformation also necessarily addresses the psychological and cultural elements of change. Therefore, a correct socio-cultural, behavioral, and psychological approach is necessary to foster change.</p> <p>The objective of the PhD course in "Management of Digital Transformation" is to train a new executive class to respond to the management needs of digital transition processes, drawing inspiration from and responding to the needs outlined in the PNRR to bring businesses and institutions together with universities and research.</p> <p>The MDT doctoral program pursues this goal by combining a "horizontal" approach to academic activities with a "vertical" approach to research. The PhD Program offers a cross-disciplinary educational offer of a multidisciplinary nature dedicated to digital transition issues addressed from a cultural, economic, social, engineering, IT, legal, managerial, neuroscientific, and psychological perspective. Research activities envision a specific in-depth study on a highly-qualified scientific project aligned with the student's curricular profile and motivations.</p> <p>In this context, a distinguishing feature of the PhD Program is the presence of a company: in fact, a preponderant share of scholarships is expected to be co-financed by - and each scholarship linked to - a research project developed jointly by an academic advisor, to ensure scientific quality, and by a company representative, to ensure the relevance and industrial transferability, even in the long term, of the research object.</p>
<p>Output Profiles</p>	<p>In the study on "The Future of the Jobs" presented at the World Economic Forum 2016, it emerged that, in the coming years, technological and demographic factors would profoundly influence the evolution of the labor market. With the advent of enabling technologies for Enterprise 4.0, the skills and abilities sought will change. To date, companies and public institutions are encountering increasing difficulties in</p>



	<p>identifying, both at the level of graduates and graduates, the skills necessary for the digital transition. Universities cannot adequately train people and guarantee an effective and rapid placement into the job market around these innovative issues. Thus, this PhD Program aims to provide highly sought-after digital skills for the new tasks of the future, that is, that extensive set of technological skills that make it possible to identify, evaluate, use, share, and create content thanks to information technology and the Internet. The PhD Program will also provide in-depth transversal skills both in research and innovation on enabling technologies for Industry 4.0, with particular regard on their exploitation for the green revolution and the environmental sustainability, and for corporate lean and personnel management to be in line with the features of intelligent work, i.e., work that integrates manual interventions with solid technical skills of analysis, diagnosis, and scientific reasoning, and the application of complex knowledge.</p> <p>Career opportunities comprise the academic field in different scientific disciplinary sectors, including engineering, information technology, and economics, as well as technical-scientific and managerial roles in public and private companies. The partnership with leading companies in their respective sectors to develop research projects of high industrial interest will provide an additional advantage to students in terms of employment opportunities.</p>
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The IMT School adopts equal opportunity principles in its selection procedures and rejects any type of discrimination based on sex, gender identity, nationality, ethnicity, religious belief, sexual orientation, state of health, and any other status or quality that is not strictly relevant to the call outlined in this document.

Program official duration: 3 years.

Programs start on December 12th, 2022.

PhD Program Coordinator: Prof. Marco Paggi

Program official language: English.

Scholarships: 6 (distributed among research projects as follows)

Research Project	Description	Firm/Enterprise
Management of Digital Transformation in the Global Monitoring Decision Support System	See attachment 1.A	Leonardo S.p.A.
Paper mill sludge: new valorization opportunities	See attachment 1.B	Lucart S.p.A.
: Development of new technologies for the hydrogen supply chain: simulation methods aimed at the industrialization of devices for the production, storage and use of hydrogen	See attachment 1.C	Ne.me.sys. S.r.l.
Predictive modeling and digital innovation: implications on the business model and on the measurement of company performance	See attachment 1.D	Selene S.p.A.



Virtual prototyping methods for calculating the performance of sails and load-bearing hydrodynamic appendages of high-performance yachts	See attachment 1.E	ToolsPole OÜ
Digital libraries for cultural heritage: an interdisciplinary approach for project management	See attachment 1.F	Franco Cosimo Panini Editore
Meta-workplace and management: implications on company organization and business model	See attachment 1.G	Intesa Sanpaolo Innovation Center

The number of positions may be increased in the event that additional funding is made available after the publication of the Call.

Scholarship gross amount: 16,243.00 Euros/year (see the "Scholarships" paragraph).

Additional benefits:

- All PhD students admitted to the PhD Program are exempt from paying tuition fees, although they are still responsible for paying the yearly Regional Education Tax (currently 140.00 Euros/year);
- All PhD students are offered free meals (lunch and dinner) at the on-campus canteen;
- All PhD students are provided with free accommodation in shared double rooms within the campus residential facilities.

REQUIREMENTS

Applications are open to candidates who meet the following requirements:

1. Degree:

- "Laurea Magistrale" or "Specialistica" (according to DM no. 509, of November 3, 1999), or a four- or five-year degree (according to the previous rules of the Italian higher education system) obtained in Italy;
- Foreign degrees with a minimum duration equivalent to 4 years (full time). The 4-year duration should be considered a minimum but not sufficient requirement: the Selection Committees will assess the eligibility of degrees.

For the selection procedure, candidates are required to upload the documents indicated in Table 2 - Attachments to the application.

Applicants who obtain their degree by no later than **October 31st, 2022**, can also apply. These candidates will be admitted to the selection procedure "with reserve" and must provide their degree certificate by the date of enrollment, or they will be excluded from the program.

2. Knowledge of the English language: Applicants are required to indicate their level of English.

APPLICATION

The **application form** must be **mandatorily** filled out in **English** through the School's online procedure **by September 26th, 2022, at 12:00 pm (CEST)**.



Applicants must upload the **documents** in **PDF**. The **maximum size is 30MB** for each attachment.

The Selection Committee will accept **attachments** in **Italian or English only** (unless otherwise specified in the table below).

Table 1: Information		
Personal information	compulsory	In this section, applicants must enter their personal data (name, address, contact details, etc.).
English Language Level	compulsory	Applicants must indicate their level of English.
Additional information/Interview	compulsory	Applicants have to indicate the modality for the interview (IMT School campus, videoconference, or similar, or by telephone at an Italian embassy/consulate).
Additional information/Disability	optional	Applicants should indicate if they need assistance to participate in the selection procedure.
Additional information/How did you first find out about IMT?	compulsory	Applicants are required to indicate how they found out about the IMT School.
Education	compulsory	Applicants are required to indicate their university degrees (whose duration must be equivalent to at least 4 years of university studies), the average exam mark, and final grade (if any) for each degree obtained.
Additional qualifications	optional	In this section, applicants may list any other qualifications considered relevant in relation to their application.
Publications	optional	Applicants can list their own published articles, books, or any material that may be considered relevant for the PhD and research activity.
References	compulsory	<p>Applicants are required to provide the names and contact information of two referees.</p> <p>The referees who are invited to submit a reference letter in English through the IMT School's online application system, - by October 3rd, 2022, at 12:00 pm (CEST), will receive an automatic notification from the School's application system.</p> <p>Applicants will receive an automatic notification when a letter is submitted, but they may not access any reference provided.</p>



Table 2: Attachments

1	Copy of National Identity Card or Passport	compulsory	<p>Applicants have to upload a copy of a valid identity document:</p> <ul style="list-style-type: none"> • <u>For Italian and EU citizens</u>: Valid National Identity card or Passport • <u>Non-EU applicants</u>: National Identity card or Passport (the latter is highly recommended). <p><u>The copy has to be signed by the candidate, indicating the date and place of the signature</u>. In particular, the document has to contain the applicant's photograph, personal data, and document number, place and date of issue. If any of the above information is missing, the document will not be accepted.</p> <p>If the document is not in English or Italian, a translation into English or Italian should also be uploaded (an official/legal translation is <u>not</u> required).</p> <p>In the event that the copy of the document is unreadable, the Selection Committee may request a new submission.</p>
2	Curriculum vitae et studiorum/Resume	compulsory	<p>Applicants must upload their curriculum vitae et studiorum/resume in Italian or English (the latter is highly recommended), indicating their university degrees, work and research experience, and publications (if any).</p>
3	Education	compulsory	<p>Candidates are required to upload one of the following documents in Italian or English:</p> <ul style="list-style-type: none"> • for degrees obtained in Italy and/or in France, Ireland, Belgium, Denmark (Bruxelles Convention of May 25, 1987), and Germany (Italian-German Convention, ratified by the Law no. 176 of 1973): a self-declaration stating the possession of a degree, conferral date, issuing University, and final grade; • for degrees obtained in all other EU and non-EU countries: an official certificate indicating the possession of a degree, conferral date, issuing University, and final grade.
4	Academic transcript/Diploma supplement	compulsory	<p>For each degree, the applicant has to attach one of the documents listed below in Italian or English (English is highly recommended):</p> <ul style="list-style-type: none"> • Academic transcript: an official document detailing the course, classes attended or subjects studied and results, completion date, graduation date; <p><u>or alternatively,</u></p> <ul style="list-style-type: none"> • Diploma Supplement: document produced by the University accompanying the diploma, providing a



			standardized description of the nature, level, context, content, and status of the studies completed by the applicant (https://ec.europa.eu/education/diploma-supplement_en).
5	Research Project	compulsory	Candidates are required to express their preference for up to three (3) research projects as referred to in Article 1 of this call for applications. The preference expressed by candidates will not be binding when assigning the projects (see "Final Ranking").
6	Research Statement	compulsory	To best evaluate each candidate's aptitude for the PhD Program, all candidates must upload a document (maximum 10,000 characters, spaces included) mandatorily in English , describing: <ul style="list-style-type: none"> - the candidate's competencies and experiences within the scientific or academic field relevant to the project(s) chosen and how they would use them to address the project(s); - the candidate's motivation for pursuing study at the IMT School, with particular reference to the project(s) chosen; - future projects.

If the application lacks a piece of information or an attachment referred to as "compulsory", applicants can be conditionally admitted to the selection procedure. Their application will be considered valid only if they produce the required documents by the day scheduled for the interview.

The correct completion of the online application procedure is **confirmed by an automatic email** sent to the email address indicated by each applicant while registering for the procedure; the message only confirms the receipt of the application. The School will not verify the validity and completeness of applications before the call closes.

After the submission, no changes are allowed to the entered data.

SELECTION COMMITTEES

The Selection Committee is nominated by decree by the Rector of the IMT School in accordance with the School regulations and comprises experts from relevant fields.

EVALUATION CRITERIA AND SELECTION PROCEDURE

Evaluation criteria

The Selection Committees will evaluate candidates'

- academic background, knowledge, skills, and scientific potential;
- general aptitude for research and potential to collaborate in the specific research activities of the selected Track in the application form;
- interdisciplinarity, knowledge, and skills with reference to the multidisciplinary of the IMT School PhD Programs;
- pertinence to a track different than the one selected in the application form.

Assessment of qualifications

The first phase of the selection procedure is the assessment of qualifications. This assessment is carried out in relation to the specifics of the PhD Programs and specifically to determine who is admitted to the interview.

In the assessment of qualifications phase, the evaluation of the candidates is carried out by the Committees defined in the previous paragraph "Selection Committees" and based on the candidates' application form, uploaded documents, and reference letters provided by referees.

Based on the assessment of qualifications, the Selection Committees will draw up a shortlist of candidates admitted to the interview in alphabetical order.

The shortlist of applicants admitted to the interview will be published on the School's website and Online Notice Board ("*Albo Online*").

This is the only official communication of the preliminary results to all applicants.

Interview

Candidates admitted to the interview must confirm their participation by email to phdapplications@imtlucca.it within two (2) days of the publication of the shortlist, confirming their preference to have the interview conducted in one of the methods indicated in the "Application" paragraph of this call.

During the comprehensive interview, the Selection Committees will assess the candidates' knowledge and skills with reference to the specific characteristics of the PhD Program.

The Selection Committees will assess all interviews by assigning a score (up to 100 points): applicants scoring at least 70 out of 100 will be eligible for the Program and, therefore, listed in the final ranking.

Final ranking

At the end of the interviews, the Selection Committee will draft the final ranking of the eligible candidates for each research project according to the scores obtained in the interview. The preference expressed by candidates in the application form is not binding: the Committee can thus assign candidates to the ranking of projects deemed most corresponding to their profile.

If multiple candidates get the same score, preference will be given to the youngest candidate.

In the event of the withdrawal or exclusion of a candidate, they shall be replaced by the next suitable candidate according to the ranking.

If the ranking of a track does not list enough eligible candidates to allocate all available positions, the remaining scholarships will be assigned according to the ranking of other eligible candidates of the other PhD Program's track.

All rankings will be published on the School's website and Online Notice Board ("*Albo Online*").

ENROLLMENT

Once admitted to the PhD Program, candidates wishing to enroll must submit the complete enrollment form to the IMT School **no later than five (5) days from the publication of the results** on the School's Online Notice Board ("*Albo Online*") and website, using one of the following methods:

- in person or by post to:
IMT School for Advanced Studies Lucca



SCHOOL
FOR ADVANCED
STUDIES
LUCCA

PhD and Higher Education Office
Piazza S. Ponziano, 6
55100 Lucca – Italy

- by fax to +39 0583 4326565
- by certified email to imtlucca@postecert.it

Failure to submit the enrollment request by the deadline and through the above-mentioned methods will result in an automatic withdrawal of the candidate from the Program.

The enrollment request is valid only if all the requested documents have been enclosed.

If any of the documents submitted during the application procedure do not correspond to those submitted during enrollment due to an intentional false declaration, the applicant will automatically lose their right to enroll in the program.

Enrollment is effective on the first day of official classes. Unauthorized absences may nullify the enrollment procedure.

SCHOLARSHIPS

The scholarship amount is 16,243.00 Euros/year and shall be disbursed in monthly installments.

For any research or training activities at universities or research centers abroad, the scholarship amount is increased by 50% for the first nine (9) months.

Scholarships are subject to the payment of social security contributions (INPS) managed separately under Article 2, paragraph 26 of Law no. 335 of August 8, 1995, as amended, with two-thirds paid by the Administration and one-third by the scholarship recipient.

Admitted candidates who have already benefited from a PhD scholarship in Italy cannot be assigned another one.

The scholarship has a maximum duration of three (3) years and is subject to annual confirmation: according to articles 15 and 16 of the IMT School PhD Regulations, students must complete all the activities provided for each academic year.

If a student withdraws or is excluded within 45 days from the beginning of the Program, they are not entitled to the scholarship. The scholarship will be awarded to the next eligible candidate according to the final ranking. For this reason, the first scholarship payment will be made only after the successful completion of the first 45 days of the program.

If a student registers after 45 days from the beginning of the Program, he/she is entitled to the scholarship starting from the actual date of enrollment.

FACILITIES

Residential facilities: accommodation

All PhD students who are granted a scholarship have free accommodation in shared double rooms with private bathrooms, priority being given to on-campus residential facilities, or are assigned a housing grant for the entire official duration of the Program (3 years), except for periods spent off campus for study and/or research.

The School can revoke the right to accommodation if it is rarely or not used.

Residential facilities: canteen

All PhD students are offered free meals (lunch and dinner) at the School canteen located on campus for the entire official duration of the Program (3 years). Lunch and dinner are served each day, Monday through Sunday, for the entire academic year, except for the closing periods.

Other facilities

All PhD students have access to library facilities and can benefit from the IT support services for all technical requests related to study and research until the thesis defense.

The School subscribes to an insurance policy for all PhD students. It provides coverage against accidents and injuries incurred by students in Lucca or abroad while performing academic activities. The IMT School also provides students with health insurance policies for research trips outside Europe (students are automatically covered in European countries).

All international PhD students are offered the possibility to take an Italian language and culture course to receive an A2 language certificate (as defined by the Common European Framework of Reference for Languages), useful for obtaining credits in accordance with Italian Immigration law.

TREATMENT OF PERSONAL DATA

The IMT School will use the personal data provided by applicants solely for selection procedures and institutional aims in accordance with the provisions of the current European and Italian legislation (EU Regulation 2016/679 and Italian D. Lgs. 196/03 - *Italian Privacy Code*, as modified by the D. Lgs. 101/2018) and the relevant School Regulations.

Applicants are granted all the rights established by art. 15, sections 2, 3, and 4 of Chapter III, and art. 77 of the EU Regulation 2016/679.

For further information regarding the call and the selection procedure, please contact the PhD and Higher Education Office by email at phdapplications@imtlucca.it [mailto:](mailto:phdapplications@imtlucca.it) or by phone at +39 0583 4326530.

Further information regarding the PhD Programs and the IMT School is available at www.imtlucca.it.

FINAL PROVISIONS

Having adopted all the necessary measures to carry out the activities planned for the 2019/20, 2020/21 and 2021/22 academic years, during the health emergency related to COVID-19, if the aforementioned emergency continues, the IMT School will provide the activities and services planned for the 2022/23 academic year in ways that allow new PhD students to enroll, attend education activities, and undertake their doctoral studies.

Relevant laws and the IMT School PhD Regulations shall be applied to any issue or item not covered by the present call for applications.



Attachment 1.A

Project title: Management of Digital Transformation in the Global Monitoring Decision Support System

Company: Leonardo SpA, <https://www.leonardo.com/>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their effect on ecological transition and environmental impact. Where necessary, this training activity can be enriched by additional external courses or by seasonal schools on specialistic topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and valorization of research and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

In the research project, the PhD candidate will focus on the study of innovative methodologies, processes and technologies for a new model of "command, control and decision support", in extremely complex and multi-domain areas such as critical infrastructures, territorial protection and city management.

The new methodologies and emerging technologies to support digital transformation allow a redefinition of the paradigms used up to now for the monitoring and governance of complex systems both from the point of strategic planning and the operational management of accidents, in particular during crisis situations.

The research activity will investigate the application of cognitive tools for the understanding of complex multi-domain and interdependent phenomena typical of global monitoring, and the generation of operational responses. Possible models of cognitive dynamic geo-visualization will also be studied for the representation of information in the context of an automatic system to support decisions.

During the study, the applicability and scalability of Digital Twins for the monitored context will also be analyzed as an alternative and/or in synergy with classical data-driven models.

The research product will concern publications also of an applied nature on the new X-2030 Global Monitoring platform developed by Leonardo S.p.A.

The successful candidate will have the opportunity to carry out their research directly at the premises of Leonardo S.p.A. for a period of 6 to 18 months.

Attachment 1.B

Project title: Paper mill sludge: new valorization opportunities

Company: Lucart S.R.L., <https://www.lucartgroup.com/>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their effect on ecological transition and environmental impact. Where necessary, this training activity can be enriched by additional external courses or by seasonal schools on specialistic topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and valorization of research and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

Regarding the research project, the PhD student will concentrate his/her activities on the theme of reuse and enhancement of dried sludge from paper production starting from waste paper. The objective of transforming waste from the paper production cycle into a by-product is of great interest to the industrial sector of the country, due to the considerable amount of material involved which is around 40,000 tons per year only for the Lucca area. Attempts have been made since 1990 to reuse this material in construction and agriculture. The doctoral thesis aims, starting from the background of studies and research conducted by the industrial partner Lucart S.p.A., to carry out a holistic study on the recycling of dried sludge in order to identify innovative solutions for their reuse and explore what has already been done in the international field to understand how technologies already developed and applied in other contexts can be adapted, modified and integrated into the production cycles of Lucart and potential partners. These solutions will be guided by research on materials, starting from the unique properties of dried sludge, to identify possible applications of potential impact on the market. In parallel, for each technological solution identified, a life cycle assessment will be conducted and, for the most promising solutions, market barriers, possible strategic partners for the marketing of new products, the presumable annual volumes that the various supply chains will be analyzed, as well as the reference regulatory framework. Solutions, proposals, technologies that envisage partnerships with Tuscan companies or companies linked to the territory will be privileged. The final objective of the doctorate is the development of general projects that include at least a brief description of the production processes identified, accompanying the study with estimates of the plant costs to be implemented and the related management costs.

The research product will concern publications on the methods proposed for the recycling of the material and its characterization from a circular economy perspective. These results can be achieved both with traditional methods of an experimental nature, and through innovative methods of numerical simulation conducted with virtual testing techniques. The latter represent one of the main enabling technologies for Industry 4.0 aimed at reducing the time associated with laboratory experimentation and the development of new products and materials.

Attachment 1.C

Project title: Development of new technologies for the hydrogen supply chain: simulation methods aimed at the industrialization of devices for the production, storage and use of hydrogen

Company: Ne.m.e.sys S.R.L., <https://nemesysenergy.com/>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their effect on ecological transition and environmental impact. Where necessary, this training activity can be enriched by additional external courses or by seasonal schools on specialistic topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and valorization of research and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

With regard to the research project, the PhD student will focus their activities on the mechanics of materials for the hydrogen supply chain, in cooperation with the company Ne.m.e.sys srl, a research company specialized in development of technologies for the hydrogen supply chain, 30% owned by Nuovo Pignone Holding spa of the international Baker Hughes group. Baker Hughes with Ne.m.e.sys is committed to fostering the energy transition and guaranteeing continuity for society's energy needs, targeting the world goals by 2050.

Manufacturing technologies are developing innovative fuel cells to produce low-cost hydrogen. For example, the United States Office of Energy Efficiency & Renewable Energy has set the goal of 2 \$/kg by 2025 and 1 \$/kg by 2030, through a path to net zero carbon emissions. In Italy, the cost of producing hydrogen at industrial sites is around 6 Euro/kg and the price of hydrogen in a pumping station is around 13 Euro/kg. New materials and technologies used for fuel cell membranes are expected to have a positive impact on reducing manufacturing costs. Likewise, their use in combination with intermittent sources can lead to more efficient distribution networks, significantly reducing delivery costs.

This PhD position aims to develop an interdisciplinary approach for an accurate assessment of the operational characteristics of hydrogen fuel cell technologies and storage systems, integrating materials research when considering realistic usage operations and accurate assessment of the life cycle (LCA). Research on computational mechanics will be exploited to develop models for the evaluation of the durability of components (membranes, porous materials, etc.) used in standard and innovative fuel cells, towards a more accurate evaluation of their duration and costs. Knowledge of electrical networks and intermittent renewable sources (eg wind and photovoltaic) will be used to evaluate the operational performance in the reduction of disturbances on the energy distribution network. The result of the technical information will be integrated with a refined LCA approach, in order to support informed decisions of policies and decision makers on key topics ranging from the operation to the end of life of fuel cells.

The research product will concern publications on the proposed methods for the mechanical characterization of materials and devices for the production of hydrogen. These results can be achieved both with traditional methods of an experimental nature, and through innovative methods of numerical simulation conducted with virtual testing techniques. The latter represent one of the main enabling technologies for Industry 4.0 aimed at reducing the time associated with laboratory experimentation and the development of new products and materials.

Attachment 1.D

Project title: Predictive modeling and digital innovation: implications on the business model and on the measurement of company performance

Company: Selene S.p.A., [Selene S.p.A.](#)

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their effect on ecological transition and environmental impact. Where necessary, this training activity can be enriched by additional external courses or by seasonal schools on specialistic topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and valorization of research and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

With regard to the research project, the PhD student will focus the activities on the study and exploration of business modeling or the creation of models by which to understand the processes themselves with a perspective focused on the digital dimension. The modeling is based on symbols and conventions through which business processes can be simulated to evaluate different scenarios and govern business trends also from a predictive point of view: the physical world and the digital world will be increasingly interpenetrated and the line of separation and demarcation will become tenuous until it completely disappears.

The research product will concern publications, also of an applied nature, on the methods proposed for the digitization of the business model. These results can be achieved both through the use of traditional methods of analyzing business models and performance, and through the use of innovative digital simulation methods that involve the use of virtual managerial testing, virtual test data management and other techniques. The latter are also configured as enabling technologies for Industry 4.0 aimed at improving the efficiency of the corporate decision system with regard to both the water and energy issues, and environmental sustainability and the innovation process.

Attachment 1.E

Project title: Virtual prototyping methods for calculating the performance of sails and load-bearing hydrodynamic appendages of high-performance yachts

Company: ToolsPole OÜ, <https://toolspole.com/>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their effect on ecological transition and environmental impact. Where necessary, this training activity can be enriched by additional external courses or by seasonal schools on specialistic topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and valorization of research and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

Regarding the research project, the PhD student will concentrate his/her activities on the development of virtual prototyping methods for the calculation of the performance of sails and load-bearing hydrodynamic appendices of high performance yachts. These appendices are able to generate sufficient lift to lift the hull, and with it completely out of the water, to obtain a drastic reduction in drag, with a considerable increase in the speed of the hull. Given the relative novelty of the introduction of this solution, there are currently no consolidated design techniques for yachts that sail in foiling conditions. A multidisciplinary approach will therefore be used that will allow to identify an adequate physical mathematical model of the problem under examination. The hydrodynamic performance of foils and sails depends on the trim of the boat and on the actual shape that the appendices and the sails assume in operating conditions and, the latter, in turn, depend on the loads and fluid dynamic forces that water and air exert on the structure. Therefore, suitable predictive models will have to include aspects related to rigid body dynamics in three dimensions, structural dynamics, and fluid dynamics, and their mutual interaction. Furthermore, in order to properly adjust the sails and the mobile appendices of the foils in order to obtain the desired performance, notions from the theory of optimal control will be necessary.

The research product will concern publications on the proposed methods for the simulation of the aero/hydrodynamic behavior of the hull and its sails and appendices, as well as on the numerical discretization methodologies of the resulting governing equations, and control problems.

The innovative methods of numerical simulation conducted with virtual testing techniques, object of this project, represent one of the main enabling technologies for Industry 4.0 aimed at reducing the time associated with the experimentation and development of new and more efficient forms, materials and products.

Attachment 1.F

Project title: Digital libraries for cultural heritage: an interdisciplinary approach for project management

Company: FRANCO COSIMO PANINI EDITORE S.p.A., <https://www.fcp.it/>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD programme of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Enterprise 4.0, the management of digital transition processes and their impact on business models and society. Where necessary, this training activity can be enriched by additional external courses or by participation in seasonal schools on specialist topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and research exploitation, and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

With regard to the research project, the PhD student will focus his/her activities on the theoretical and practical study of technologies and process methodologies for the creation of digital libraries in the field of cultural heritage, through the study of best practices and a series of concrete case studies.

The following different interdisciplinary thematic areas will have to be addressed and deepened:

- standards, methodologies and technologies for the digitization of cultural heritage;
- standards, methodologies and technologies for the description and meta-dating of digital objects;
- technologies, platforms and standards for the computerized management of digital assets;
- technologies, platforms and standards for online publication and enhancement of digitized cultural heritages;
- project management and management methodologies with particular attention to the relationship with the various stakeholders.

The research product will concern publications on the proposed study methods, the design and implementation of a digital library, from the digitization and description of cultural objects, to online publication for its use.

Attachment 1.G

Project title: Meta-workplace and management: implications on company organization and business model

Company: Intesa Sanpaolo Innovation Center, <https://www.intesasanpaoloinnovationcenter.com>

Project description

From a training point of view, the PhD student will attend specialized advanced courses provided by the PhD program of the IMT School for Advanced Studies Lucca on topics concerning enabling technologies for Industry 4.0, the management of digital transition processes and their impact on business models and society. Where necessary, this training activity can be enriched by additional external courses or by participation in seasonal schools on specialist topics aimed at developing the research thesis. In addition to the courses of a scientific-technological nature, the student will develop soft skills through seminars offered by the IMT School for Advanced Studies Lucca on the foundations of academic entrepreneurship, on the management of intellectual property, on communication techniques for dissemination and research exploitation, and on critical thinking. The skills acquired will be aimed at developing the research project and training a researcher for his/her future job placement both in academia and in technical-scientific and managerial roles in public and private companies.

With regard to the research project, the PhD student will focus his/her activities on the macro-theme relating to "The development of meta-workplace". Specifically, the development of applications in Metaverse is rapidly growing and research on the subject is still in its infancy. The Metaverse, by changing the mode of functional and social interaction between individuals, could contribute to drastically redesign the environments and ways of working in a corporate context (e.g., enhancement of communication and virtual collaboration thanks to avatars and virtual environments). Therefore, one of the most immediate challenges of the Metaverse is the development of a meta-workplace.

So far, the scientific state-of-the-art -mainly related to the macro-theme of Virtual Reality and Augmented Reality- has investigated the nature of virtual interactions, in particular by exploring the characteristics of immersion or sensor-motor integration, but no work has characterized systematic and direct impact of the Metaverse in organizational and business contexts, which we could define as a Meta-workplace. In a first phase, the doctoral student will carry out a careful analysis of the literature on the Metaverse and a comparison between the solutions so far devised for the introduction and application of the Metaverse in a business context. Subsequently, the PhD student will face the task of characterizing -from a behavioral, organizational and neuroscientific point of view- the possible configurations and applications of the meta-workplace and the application of the Metaverse in relation to the various domains in terms of marketing, human resources, organizational and business applications, such as manager-customer interaction and customer engagement, business processes and business performance, interaction with corporate, improvement of the emotional dimension from the interaction between team members.

The research products will concern publications and applications on the methods proposed for the characterization and application of the Metaverse in organizational and business contexts, the preparation of reports, papers that can be used as: elements of knowledge dissemination within the ISP group; updates on the latest technological and market developments; preparatory activity for the development of a commercial proposition for the Metaverses. The project will allow to test the ergonomics of the meta-workplace, as it will allow us to understand how different configurations of the Metaverse manage to impact the functional, social and corporate interaction of team members and to correlate interactions with performance.

In summary, the project makes it possible to design -on the basis of neuro-cognitive and behavioral evidence- the workplaces of the future. The different configurations of the Metaverse are elements that can be defined

by the management and therefore represent levers for managing the team, but also for possible areas of collaboration with external Corporate for business issues.