



PhD in DESIGN - 38th cycle

Number of scholarship offered	9
Department	DIPARTIMENTO DI DESIGN

Description of the PhD Programme

General descriptionDescription of the PhD Programme

Detailed information on research proposals to be developed for Ph.D application is available at: <http://phd.design.polimi.it/>

The PhD Program in Design prepares designer-researchers who, addressing the problems and opportunities of contemporary society, are able to apply research methods to produce original design knowledge. The curriculum lasts three years, during which both training and research activities are provided. The Program develops analytical and design abilities and promotes a collaborative disposition.

The complete list of research proposals is available at <http://phd.design.polimi.it/>.

Once enrolled, each candidate becomes an effective member of a research group, within which she/he develops an original research project. This research activity is the fundamental core of the learning process. Parallel to this, each candidate is involved in other educational activities.

Proposing department: Department of Design.

Other involved departments: Department of Mechanical Engineering; Department of Chemistry, Materials and Chemical Engineering.

Scholarships: More details on the scholarships offered by the PhD Program in Design are available on page 2 of this document. The specific research subject will be assigned to each candidate within the first months of the PhD activity, with the agreement of both the candidate and the Board of Professors of the PhD Program. The number of available scholarships may be increased up to completion of the evaluation process.



PhD in DESIGN - 38th cycle

THEMATIC Research Field: FRAMING SUSTAINABLE MATERIALS IDENTITY FOR PRODUCT DESIGN

Monthly net income of PhDscholarship (max 36 months)

€ 1195.0

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

Society is going through a moment of rapid and profound transformation due to the necessity to switch towards more circular paradigms. The need for a direction change is evident also from the arising of significative international initiatives like the Sustainable Development Goals (SDGs). This context, confirmed by the specificity of SDG 12: responsible consumption and production, pushes the research to find alternatives that can better respond to the new economy of reuse, recycling, and consumption optimization of materials in product design. Thus, it can be noticed an increasing number and variety of emerging materials, not only from established companies but also from innovative start-ups. However, new materials' surround us, generating a multitude of sustainable materials reasons why, compositions and aesthetic-sensorial identities. This prolific environment drove to a mismatch between the effective sustainability level of innovative materials and the consumers' perception of them. The confusion not only arises in the consumer but generates disorientation in the manufacturers and designers themselves, as they are not yet completely aware of how these can be applied in product design and consequently accepted by market realities. Many concepts of sustainable materials such as biodegradability, compostability and recyclability are not yet part of the culture of the average consumer and, because of the absence of a clear identity, are difficult to distinguish from one another. In addition, the media attention on sustainability issues does not always provide truthful and scientifically reliable information. The research will frame



	the current sustainable materials' context with a multidisciplinary perspective. The study must explore and define sustainable materials for Design, paying attention to the aesthetic-sensorial aspect in order to develop a shared language to follow when designing and selecting sustainable materials.
Methods and techniques that will be developed and used to carry out the research	Operating in the circular economy sector, the research will be based on design-oriented methods. The field study will take place through qualitative methods and tools for the definition of the context. The research will use the proper methods and tools for the framing of the multiple stakeholders and principles of sensorial metrology in the definition of materials properties.
Educational objectives	The student will acquire knowledge on sustainable materials. This is an emerging theme due to the rapid development of new materials. By taking advantage of this, the candidate will become a reference point in the framing of sustainable materials aesthetics, acquiring knowledge on material properties, skills in framing the sustainable Design's actual context and in evaluating aesthetic-sensorial materials' properties.
Job opportunities	The candidate will contribute to the definition and advancement of sustainable materials. The sustainable materials' sector is hungry for new multidisciplinary and multifaceted experts. The candidate might be involved in R&D departments to develop sustainable innovation projects. Collaboration and networking with different technical Departments will take place.
Composition of the research group	1 Full Professors 0 Associated Professors 0 Assistant Professors 2 PhD Students
Name of the research directors	Barbara Del Curto

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):</p> <p>financial aid per PhD student</p> <p>max 4.872,90 euros per student</p> <p>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student there are various forms of financial aid both for research and teaching activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p>Computer availability: 1st year, 2nd year and 3rd year: Each research group will supply PhD student with a computer, if necessary.</p> <p>Desk availability: 1st year, 2nd year and 3rd year: Each research group will supply phd student with a desk.</p>



PhD in DESIGN - 38th cycle

THEMATIC Research Field: INNOVATIVE LIGHTING DESIGN AND INTEGRATION IN THE NEW DIGITAL DESIGN METHODS

Monthly net income of PhDscholarship (max 36 months)

€ 1195.0

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The evolution of IT has equipped designers with numerous tools for supporting digital design; however, the heterogeneity resulting from each sector's different specifications and requests has made the digital field very complex. To contain this complexity and standardize the project procedures, in recent years, the Building Information Modelling approach is increasingly becoming adopted worldwide, to the point of making it mandatory for public projects. Unfortunately, companies and developers have not yet been able to integrate their procedures optimally to this impending scenario. The lighting field is now suffering a significant slowdown because the classic lighting design tools are not duly integrated into the Building Information Modeling methodology. In this context, the need emerges to put together transversal skills to identify the actions necessary for developing advanced design tools that can support in the fundamental steps of lighting design without losing sight of the need for standardization dictated by this new digital design approach. The research will aim to conceptualize and subsequently develop methods and procedures to facilitate the development and integration of the lighting component in the context described, helping software developers and luminaire manufacturers create tools at the service of lighting and product designers in this delicate transition phase to advanced manufacturing. Hand in hand with the integration levels of Building Information Modeling, there are numerous areas of interest and potential research, such as, for example, virtual and augmented reality (VR/AR) that can guarantee



	<p>interactivity to designers in virtual environments. This interaction may also be possible by pushing computation methods to their maximum without sacrificing photometric accuracy. Still, in virtual prototyping of lighting, another aspect that should be addressed is the simulation of the light-matter interaction. In order to obtain satisfactory results in this area, it is necessary to describe optimal procedures to acquire and characterize real project colors and materials for digital design. The development of the tools described above may also lead to the development of innovative virtual didactic tools for teaching a transversal and complex subject such as lighting design and technology, where seeing the experience itself is infinitely more effective than describing it theoretically.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>A possible path of activity within the doctorate may include:</p> <ul style="list-style-type: none"> • Extensive investigation on the current state of research and technologies related to the world of lighting. The analysis will be carried out on solid-state light sources and new development trends, such as the miniaturization of LEDs, quantum dot design as a function of substituting phosphors for white conversion, and new technologies for IoT and building automation connected lighting. • Other innovations on which the research will focus are related to the virtual prototyping of these advanced features together with the most common aspects of the project to contribute to the development of design tools that can give maximum flexibility to the lighting designers. • Evaluation case studies through collaborations and interviews with professionals and companies in the lighting design sector. Analyzing different approaches by professional realities will help to better understand the strengths of the developed tools and identify situations that have the potential for improvement or the implementation of new features. • Development of innovative tools and methods to support



	<p>lighting design. These systems can be of various types (applications, toolset, procedures, and recommendations) and will be tested in collaboration with professional realities.</p> <ul style="list-style-type: none"> • Professionals will be involved in testing the tools developed to evaluate the various releases on real design issues. Then, with the feedback returned by the professionals, a refinement of the tools will be carried out where there is room for further improvements.
Educational objectives	<p>To successfully create tools to support the professional activity, it will be necessary to go through training in various fields.</p> <ul style="list-style-type: none"> • Main characteristics of new lighting design methods that could be part of the tool development process. Areas of this training are the physical aspects of light, application with new technologies, environments lit by artificial light and interaction with human physiology and psychology, and factors related to lighting design in the context of advanced manufacturing. • Training on the aspects related to virtual prototyping for digital design. Specifically, all the skills that can allow the implementation of the critical design elements within the lighting design methodology. In addition, it will be necessary to acquire skills that enable the evaluation of the practicality and reliability of the software calculation methods implemented in the lighting design tools. • The skills acquired and applying their principles will lead to the formulation of tools and hypotheses that will need to be tested and subsequently disseminated in accredited journals, preferably ANVUR class A and/or WoS/Scopus. The candidate must therefore learn to adopt the principles necessary to publish in these journals.
Job opportunities	The spread of procedures related to Building Information



	<p>Molding is constantly growing due to the EU regulatory framework that will make the use of these concepts mandatory for all public projects under one million euros by 2025. Consequently, the difficulty of translating procedures that have been consolidated for decades of project practice in a new paradigm that incorporates this collaborative method will require the presence of specialized figures able to facilitate this transition. For this reason, the completion of the research path of this doctorate will provide the candidate with professional skills in numerous fields.</p> <ul style="list-style-type: none"> • The academic field in universities or research at public or private facilities where support tools can be further developed. Especially those related to the measurement and acquiring of real projects materials and their interaction with light in the context of virtual prototyping and those associated with the production of innovative methods for teaching lighting design. • In the professional field, the search for specialized lighting professionals in the Building Information Modeling process will become urgent in the next few years, providing numerous spaces for field experts. In addition to this, the Covid-19 pandemic has caused numerous institutions to rely on digital tools and the cloud to make their activities remotely accessible. The lighting design sector could greatly benefit from the possibilities offered by VR/AR environments, which will form part of the research.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Maurizio Rossi, Andrea Siniscalco

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):

financial aid per PhD student

max 4.872,90 euros per student

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student there are various forms of financial aid both for research and teaching activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

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Desk availability: 1st year, 2nd year and 3rd year: Each research group will supply phd student with a desk.



PhD in DESIGN - 38th cycle

THEMATIC Research Field: REFRAMING META-DESIGN IN THE ERA OF UX

Monthly net income of PhDscholarship (max 36 months)
<p align="center">€ 1195.0</p> <p>In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.</p>

Context of the research activity
<p>Motivation and objectives of the research in this field</p> <p>The discipline of design has evolved, and the role of design has changed dramatically over the last decades, leading to the creation of new paradigms that explore how design can address the evolving challenges we are facing as a society. In this perspective, the Meta-Design process is compelling because it can find the meaning behind the idea. In fact, Meta-Design aims to understand what to design, but more importantly, what makes sense to design to meet users' needs. Meta-Design is a tool that trains the thinking process that leads to the definition of a concept. Finding the reason why of the product is the baseline of every design process, even User Experience (UX) always starts with the motivation behind the concept to create products that users can perform meaningful experiences with. For this reason, Meta-Design also finds a role in UX methodology and overall design path. With a critical perspective on the process under consideration, the research aims to analyse Meta-Design and its possible connection with other different design methodologies. In a future where challenges and user interactions with objects/systems will be more complex, the proposed PhD topic will investigate how and why the Meta-Design process can be integrated with methodologies and tools. The latter will be considered both in emerging research areas (Transition Design, Future Thinking, Design Justice, Circular Design etc.) and in established areas (such as Design Thinking). However, above all, it will be investigated how Meta-Design can coexist or enrich the UX process. Thus, this research aims to build a solid analysis of the connection between Meta-Design and the Diversity and Inclusion management in the design</p>



	<p>process, constructing a framework that explores how design culture can, while always keeping user research as a central point, foster sustainable development in the broadest sense of the term. Some of the questions that the research plans to investigate are: How does this approach relate to the changing society and the complexity designers must interface with? How can the Meta-Design process drive towards more sustainable design? Meta-Design takes much strength from a multi-disciplinary approach, but it is necessary to investigate what skills are needed to deal with this complexity. What areas can meta-design draw on to bring value to its approach? Meta-Design can address the specificities of design actions ranging from identity and communication systems to product-service systems, but how can the method be extended and lead to social innovation? Sometimes, design runs towards a solution, but a single solution is not possible for social innovation; everything is a "system" you cannot solve a small piece because everything is interconnected. How can this systemic thinking part of meta-design evolve from a user-centered to a humanity-centered approach?</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The intention is to define an action-research pathway that can effectively identify, test and validate specific design methodologies to develop a new approach from Meta-Design to validate its application in the strategies of companies, small businesses and other organisations. The research will be divided into several phases involving practical action and critical reflection;</p> <ul style="list-style-type: none"> • A first phase of theoretical investigation with a sensitive and critical analysis concerning the state of the art of design tools and methodologies, investigating their context of use, their results and their effectiveness. • Analysis and identification of best practices and methods and testing them. The aim is to collect data that will then be organised and analysed, possibly including different stakeholders actively in the research. This process should be repeated repeatedly to continually refine methods, data, and interpretation. • Development of guidelines and tools that will find



	<p>practical application in universities and companies.</p> <ul style="list-style-type: none"> • The methodology will be applied in different industrial sectors, validating its impact and consistency in concrete applications and projects.
Educational objectives	<p>The methodology of Meta-Design is widespread at the Politecnico di Milano and one of the pillars of the curriculum at the School of Design. However, it is necessary to redefine the discipline and consolidate it by creating an environment that takes advantage of the new learning patterns of the new generations and maximises their potential to define a common language and more reliable tools. This research could strengthen the Meta-Design methodology by making it more contemporary and integrating it into the current educational curriculum to prepare designers for new contemporary challenges. The research will find a robust application within the educational scenario with direct testing of the outputs in university courses and professional master courses.</p>
Job opportunities	<p>As the design process became more prevalent in business as an operational approach and Design Thinking as a mindset, companies were increasingly discussing using the designer's role as an implementer of new paradigms that can design our future. Design thinking allows even non-designers to use design processes and methods; however, following a structure does not guarantee good results. Design tools must be used critically and adapted to the context they operate; otherwise, they can be problematic and have inherent biases. Therefore, profiles that are competent and able to use the available tools critically are needed. It is necessary to give designers tools that consider the contamination of different disciplines and the presence of multidisciplinary hybrid professional profiles to create innovation in our evolving society. There is a growing demand for strategic design and people who can handle this complexity. The methodology of Meta-Design is a strategic starting point that combined with UX has a strong market potential.</p>



Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 1 PhD Students
Name of the research directors	Venanzio Arquilla

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):</p> <p>financial aid per PhD student max 4.872,90 euros per student</p> <p>Teaching assistanship: availability of funding in recognition of supporting teaching activities by the PhD student there are various forms of financial aid both for research and teaching activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p>Computer availability: 1st year, 2nd year and 3rd year: Each research group will supply PhD student with a computer, if necessary.</p> <p>Desk availability: 1st year, 2nd year and 3rd year: Each research group will supply phd student with a desk.</p>



PhD in DESIGN - 38th cycle

THEMATIC Research Field: TECHNOLOGIES 4.0 FOR THE TRANSITION TO CIRCULAR AND SUSTAINABLE MARINE DESIGN & PRODUCTION

Monthly net income of PhDscholarship (max 36 months)	
€ 1195.0	
In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.	
Context of the research activity	
Motivation and objectives of the research in this field	<p>The circular and clean economy, sustainability, digitalisation and servitisation are increasingly important issues for the productivity, stability and resilience of the industrial eco-system. In particular, in the nautical industry and in the luxury sector to which it belongs, a specific and careful research activity is necessary to formalise and systematise the existing widespread and fragmented knowledge and to systematise the definition of a methodological approach of reference for the practical application of these themes to the specific context of industrial design. The research represents a challenge for the nautical sector, in which Italy plays a leading role in the international market in the mega yacht segment, with 82% of yachts produced, 58% of design studios and 67% of shipyards active worldwide. On the other hand, recent joint research by the Departments of Design and Management Engineering on the digitalisation of the sector - Yacht Design 4.0 (Design PhD, 2017-2021), Nautical Observatory 4.0 (2019-2021), and LINCOLN (Horizon2020, 2016-2020) - have highlighted the lack of adequate tools for understanding and managing the digital transition underway to support the implementation of a sustainable model. The PhD will therefore explore and identify one or more circular design methodologies to support the transition towards a clean and efficient marine industry with the aim of answering the question: how can Industry 4.0 digital technologies applied to marine design and production be a tool to trigger a green transition?</p>
Methods and techniques that will be	



<p>developed and used to carry out the research</p>	<p>The research methodology envisages reference to design practices based on models of process circularity, design for disassembly, and end-of-life management contextualised in the search for new efficient production paradigms for the nautical sector (lean, continuous improvement, total quality management). The co-designing of the methodology with the stakeholders of the nautical system will be instrumental in achieving the long-term objectives of transition towards a clean and efficient boat product and shipbuilding industry. Analysis, comparison and evaluation activities, also with other industrial realities, are important elements of this research plan, as well as the involvement of relevant players on the international industrial scene (design studios, shipyards, subcontracting companies, industrial associations and 4.0 competence centres). The research activity will follow the following phases: (i) understanding of the state of the art and the state of practice, (ii) definition of an analysis model of nautical design for the circular, clean and efficient industry, (iii) comparison with other existing models/methods in the most advanced industrial realities, (iv) identification of one or more possible methodologies, (iv) validation of the model with design offices, companies in the sector, and subcontracting companies.</p>
<p>Educational objectives</p>	<p>The research proposal is in line with the strategies defined by the PNR and PNRR, and in continuity with recent activities on the role of Industry 4.0 digital technologies for the nautical and luxury sectors, which have demonstrated the complementary nature of the various disciplines in defining applied scenarios and industrial development roadmaps. The system of physical laboratory infrastructures (SmartLab, Industry 4.0 Lab @ SoM, MADE) and transversal skills becomes a multiplier of the capacity to satisfy the need for industrial growth through innovation. The innovative methodological approach promoted by 4.0 technologies is not only disruptive with respect to the practices of the nautical sector, which is still tied to traditional models of entrepreneurship, design and production, but is also an unexplored field for the transition towards a circular and clean product system. Goal of the research is exploring new approaches</p>



	<p>to the yacht design for a better interaction between new manufacturing models, digital technologies and smart, and green materials & production technologies. The research objectives are:</p> <ul style="list-style-type: none"> - mapping of a knowledge framework on the relationship between digital technologies, smart and green materials and emerging entrepreneurship models in the design practices that can drive the theoretical reflection in the yacht design approach; - construction of the project theoretical framework and literature review set-up; - definition of possible integrated scenarios in the field, through the exploration of co-design practices, open design and design thinking processes; - building guidelines for a design methodology; - participate in educational processes on digital and green technologies for yacht design; - participate in the construction and implementation of international research networks; - participate in research activities at national and international level.
Job opportunities	<p>The yachting industry and yacht design fields show today a strong professional vocation, with regard both to the skills necessary to the design of recreational boats, their components, and accessories, and to the management of the different stages of the production process facing new input coming from digital transition, and circular and green manufacturing. The advent of digital manufacturing is for example a challenge for the yachting sector and new professional skills are required. Job opportunities are expected from shipyards, design studios and research laboratories involved in the project activities.</p>
Composition of the research group	<p>0 Full Professors 2 Associated Professors 2 Assistant Professors 2 PhD Students</p>
Name of the research directors	<p>Andrea Ratti, Sergio Terzi</p>

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https://www4.ceda.polimi.it/manifesti/manifesti/controller/ricerche/RicercaPerDocentiPublic.do?evn_prodotti=EVENTO&k_doc=136858&aa=2019&lang=IT

sergio.terzi@polimi.it; tel. +39022399.2803;

Link to the Professors' webpage:

https://www4.ceda.polimi.it/manifesti/manifesti/controller/ricerche/RicercaPerDocentiPublic.do?evn_didattica=evento&k_doc=161307&aa=2014&lang=IT&jaf_currentWFID=main

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.50 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):

financial aid per PhD student

max 4.872,90euros per student

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