Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca
Direzione generale dell'internazionalizzazione e della comunicazione

Avviso pubblico per la presentazione di proposte progettuali per *"Rafforzamento e creazione di Infrastrutture di Ricerca"* da finanziare nell'ambito del PNRR

Missione 4, *"Istruzione e Ricerca"* - Componente 2, *"Dalla ricerca all'impresa"* -
Linea di investimento 3.1, *"Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione",*
finanziato dall'Unione europea - NextGenerationEU

REFORMS AND INVESTMENTS UNDER THE RECOVERY AND RESILIENCE PLAN
NextGenerationEU

Call for proposals

Intervention field 6: Investment in digital capacities and deployment of advanced technologies
DESI dimension 4: Integration of digital technologies + ad hoc data collections
055 - Other types of ICT infrastructure (including large-scale computer resources/equipment, data centres, sensors and other wireless equipment)

Mission 4 – "Education and Research"
Component 2: from research to business
Investment 3.1: "Fund for the realisation of an integrated system of research and innovation infrastructures
Action 3.1.1 "Creation of new research infrastructures strengthening of existing ones and their networking for Scientific Excellence under Horizon Europe

Annex B

Full Proposal template for 2022CALL_PNRR:M4/C2/L3.1.1 (technical annex), pursuant to Article 9 paragraph 10 of the call for proposals

(To be provided in English only)

Annex B

All information that are requested in this part of this document must be provided ONLY online (https://www.gea.mur.gov.it/Bandi/IR)

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

1 Legal name; Tax code; VAT number, Legal address

Legal Name	*CONSIGLIO NAZIONALE DELLE RICERCHE*	Tax code	*80054330586*
VAT number	*02118311006*	Legal address	*Piazzale Aldo Moro 7, 00185 ROMA RM*

2 Legal representative: personal data and contacts

First Name	*Maria Chiara*	Last Name	*Carrozza*
Gender	*Female*	TAX Code	*CRRMCH65P56G702V*
Birth date	*16/09/1965*	Birth place	*PISA*
Phone number	*0649933200*	e-mail	*presidenza@cnr.it*

3 Management and reasearch structure

The National Research Council (CNR) is the largest public research institution in Italy, with multidisciplinary competences, acting under the Ministry of University and Research and having legal public-law status as well as scientific, financial, organizational, patrimonial and accounting autonomy. CNR mission is to carry out, promote, transfer, encourage and enhance research in order to apply the results for the scientific, cultural, technological, economic and social development of Italy. It is the first research institution for number of researchers: the staff counts more than 8.000 researchers, technologists, technicians and administrators. CNR structure includes a central administration, 7 scientific Departments and 88 Institutes with specific leading expertise in science/technology sectors, with more than 220 secondary sites and laboratories in Italy and abroad. The Departments are structured in macro-thematic areas, whose task is to be the interface between the CNR' offer and the research demand within the whole Italian economic system and to coordinate the Institutes in the process of expanding their research activities. In some cities Institutes are aggregated within research areas, offering support services and representing a scientific and cultural attraction pole. CNR operates on the basis of its own 3-year activity plan, that sets general guidelines and establishes objectives, priorities, and resources for the entire period, consistent with the National Research Program and with EU research programs. Over the last years and under the coordination of one or more Departments, CNR has consolidated its position, as the main public research organization participating, at national level, in the largest number of Research Infrastructures of national and European interest, included in the ESFRI Roadmap or in the National Research Infrastructure Program, both as lead organization and as participant.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

4 Financial Management System

From an accounting-administrative point of view, CNR is equipped with a computerized recording and storage system of accounting data through which it is possible to obtain both prints and data extractions: SIGLA is an Integrated System for the Accounting Management that allows the management control (including the flow) of financial resources and aligns the internal accounting management with the reporting criteria of research projects to which CNR participates.
Moreover, in line with the European system and in order to improve the connection within the Public Administration's accounts, CNR adopts in its financial statement the integrated chart of accounts consistent with the provisions of the D.P.R. 4/10/13 n.132. General directives and provisions of Law 6 November 2012 n. 190 are published within the institutional website section "Amministrazione Trasparente", currently being updated to incorporate the changes introduced by Legislative Decree 25 May 2016 n. 97 (GU General Series N. 132 of 08/06/2016). In the specific sub-section "Bandi di gara e contratti", in compliance with the provisions of the law, there are published tender notices and summary tables - made freely available in an open standard digital format - relating to tender award procedures. With regard to the compliance with obligations set out in the Data Protection Regulation 679/2016, CNR has prepared a compliance plan to the law through the appointment of the Data Protection Officer - as well as the creation of register of the Data Controller of data processing activities.

5 Specific skills of the applicant with respect to this proposal

The applicant coordinates the NFFA European research infrastructure since 2008, and the Italian branch of NFFA since 2011, under the leadership of Prof. Giorgio Rossi, former director of the TASC-INFM National Laboratory and, as CNR-IOM associate, current coordinator of NFFA-Europe, a consortium of over 30 European Research Institutions offering unique integrated access to nanoscience facilities, mostly co-located with the large-scale Analytical facilities. The specific skills for the upgrade project NFFA-Digital Infrastructure have been strengthened during 10 years of investment and operation of the NFFA facilities, with a robust track record of users, scientific outcome of their access to the RI, and constant update of services and development of novel instrumentation. The research skills of all the participating nodes are at the top level internationally and their specialisations are fully complementary, with partial overlap of competences that allow a unique synergy at national level for bringing, through NFFA-DI, the Italian research in nanoscience at the highest international competitiveness levels. Managing a complex IR and its full digital transition, implying FAIR-by-design data acquisition, archiving and exploitation in full compliance with the EOSC, as well as advanced remotization of access, when appropriate, and development of digital-twins of specific experimental setups is also in the competences of the NFFA-DI ensemble of Co-Proponents. The intention of establishing, as a goal of NFFA-DI, a suitable Consortium will be the instrument for ensuring long term sustainability of operation of the IR for the 10 years after PNRR and beyond, allowing also new members both public and private, to join in after its constitution, and contributing new resources and competences.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [1] - Name, location, and contact person

General Information

OU Short Name	*UO 1*	OU Name	*CNR-IOM - Istituto Officina dei Materiali*
OU Type	*Institute*		

Address

Region	*Friuli Venezia Giulia*	Province	*TRIESTE*
Municipality	*TRIESTE*	ZIP Code	*34149*
Address	*strada statale 14*	Street Number	*km 163,5*

Contact Person

First Name	*Giancarlo*	Last Name	*Panaccione*
Phone number	*390403758409*	e-mail	*panaccione@iom.cnr.it*

6.2 OU CNR-IOM - Istituto Officina dei Materiali - Scientific-technological expertise and experience

CNR-IOM has been active in physics of matter and nanoscience since 1990. CNR-IOM acted as coordinator of EU FP7 NFFA Design Study, of the H2020 NFFA-Europe and presently of the NFFA-Europe Pilot (NEP) projects and of the national NFFA-FOE funding, aiming at expanding and consolidating the service offer by becoming a fully Interoperable Distributed Research Infrastructure for Nanoscience (IDRIN), supporting research on nanomaterials and functional systems, integrating growth, synthesis, advanced characterization, theory and fine analysis at Large Scale Facilities. The NFFA-EU distributed facility already gave support and access to more than 1000 European users, corresponding to more than 500 proposals submitted and more that 1700 lab sessions (NFFA-Europe) and 50 proposals and 543 days allocated (NFFA Trieste) in the last 5 years. Staff of CNR-IOM coordinated in the last two decades the in-house research activity and the user access of synchrotron beamlines (6 at Elettra) and at ESRF, and instruments at neutron beamline at ILL in Grenoble. CNR-IOM develops specific computer and simulation codes for supporting experimental activities. and is involved in advanced theoretical developments including ground state as well as excited and out-of-equilibrium properties.
The co-location of advanced analytical tool for the study of structural, electronic and magnetic properties of nanosystems (STM/STS, SEM, TEM, XPS, Spin-ARPES, XMCD, XAS, XRD, ultrafast optical and electron spectroscopies) and facilities for the growth and synthesis of complex materials (HMMBE of III-V, II-VI materials,

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

spectroscopies) and facilities for the growth and synthesis of complex materials (HMMBE of III-V, II-VI materials, dual PLD, oxide-MBE, CVD) is an added value to the present project with no equivalent in Italy.

Based on fundamental research, CNR-IOM targets the design and control of a large variety of materials. In particular, main axes of research and competences are:
-applications for photovoltaics and solar energy harvesting, solar to chemical energy conversion, catalytic and photocatalytic conversion, thermonuclear fusion, heat transport control. Phenomena driven by chemical interactions and physical mechanisms are investigated at the atomic scale by addressing model systems in ideal conditions up to complex systems in realistic environments.
- the study and the modification of the electronic states in anomalous metals and correlated oxides, in systems with reduced dimensionality and/or strong spin-orbit interaction (i.e., graphene, topological insulators, transition metal dichalcogenides)
- the reduced dimensionality in quantum materials, from quantum mono-dimensional nanowires to tailored 2D heterostructures, where the surfaces/interface properties are modified (for instance through strain and or doping), to display novel magnetic and electronic functionalities emerging from collective quantum phenomena.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [2] - Name, location, and contact person

General Information

OU Short Name	*UO 2*	OU Name	*CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano*
OU Type	*Institute*		

Address

Region	*Lombardia*	Province	*MILANO*
Municipality	*MILANO*	ZIP Code	*20133*
Address	*Piazza Leonardo da Vinci*	Street Number	*32*

Contact Person

First Name	*Caterina*	Last Name	*Vozzi*

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

Phone number *0223996085* e-mail *caterina.vozzi@cnr.it*

6.2 OU CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano - Scientific-technological expertise and experience

CNR-IFN is worldwide recognized for developing ultrafast laser sources, XUV and soft-X instrumentation, and advanced spectroscopic approaches for the study of light-matter interaction. The multidisciplinary team contributing to the infrastructure includes physicists, electronic engineers, and material scientists. CNR-IFN already collaborates with a large number of universities, research institutions, infrastructures, and high-tech companies at the national and international levels, including DESY and ELETTRA. CNR-IFN will make available their expertise on the advanced characterization of ultrafast dynamics in materials by XUV and soft-X spectroscopy, high-order harmonics in solids, and ultrafast THz spectroscopy:

Ultrafast THz spectroscopy. Many basic excitations in correlated and topological systems and nanoscale materials occur in the THz spectral range. Ultrafast THz time-domain spectroscopy represents a powerful tool in the family of time-resolved optical techniques for the study of these phenomena, providing a direct measurement of both the amplitude and phase of the THz electric field by exploiting the Pockels effect in an electro-optical crystal. This measurement allows the retrieval of the real and imaginary parts of the dielectric response directly. By varying the delay between the pump and the THz probe, it is possible to capture the transient dielectric response of the material that describes its fundamental physical and chemical properties.

Ultrafast XUV and soft-X spectroscopy allow the study of light-matter interaction with an unprecedented temporal and spatial resolution with the further advantages of being element-selective and oxidation- and spin-state specific. X-ray measurements at atom-specific absorption edges allow investigation of both the electronic and structural environment of the probed atom, providing a local probe of the dynamics under study. Indeed in this spectral region, the absorption of photons may take place in the core of atoms and thus it can be site-specific. X-ray measurements at atom-specific absorption edges allow the study of both the electronic and the structural environment of the probed atom. In transient absorption experiments, a pump pulse perturbs the electronic states in the solid target and the resulting electronic dynamics can be measured by looking at the change in the absorbance of an attosecond pulse or pulse train.

High-order harmonic (HHG) spectroscopy in solids. Beyond its relevance as a tool in attosecond science, the HHG spectrum encodes a direct fingerprint on the atomic size scale of the system electronic structure and its changes triggered by the laser on the attosecond timescale. HHG spectroscopy allows observing the real-time electronic and atomic dynamics following the excitation induced by a strong and ultrashort laser pulse. These dynamics are connected to the relaxation of a highly excited state through several decay channels like multi-electron-hole excitations, collective modes, phonon excitations, charge transfer, and even formation or breaking of chemical bonds and molecular rearrangements. HHG spectroscopy in the condensed matter enables access to the physical properties of the system in an all-optical way, allowing the reconstruction of the band structure and its out-of-equilibrium evolution.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

equilibrium evolution.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [3] - Name, location, and contact person

General Information

OU Short Name	*UO 3*	OU Name	*CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento*
OU Type	*Institute*		

Address

Region	*Trentino Alto Adige*	Province	*TRENTO*
Municipality	*TRENTO*	ZIP Code	*38123*
Address	*via alla Cascata*	Street Number	*56/C*

Contact Person

First Name	*Andrea*	Last Name	*Chiappini*
Phone number	*0461314920*	e-mail	*andrea.chiappini@ifn.cnr.it*

6.2 OU CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento - Scientific-technological expertise and experience

The "Photonics: Materials, Structures and Diagnostic" Trento IFN UOS (IFN-TN) of the Institute for Photonics and Nanotechnologies (IFN) belongs to the Department of Physics Sciences and Matter Technologies (DSFTM) of the National Research Council (CNR). The scientific and technological expertise, as well as the diagnostic techniques, which constitute an important patrimony of Trento IFN UOS, cover the full range from the study of physical mechanisms crucial for synthesis, development and characterization of innovative photonic materials to design and fabrication of devices suitable for application in strategic interest areas such as sensing, information technology, and light sources. The IFN area of expertise includes investigation of local structure, crystallization, energy transfer, optical and spectroscopic properties of rare-earth activated glasses and planar waveguides prepared by several techniques including sol-gel route, RF-sputtering, and co-evaporation. Several original diagnostic techniques have been developed in order to assess the physical-chemical properties of synthesized materials.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

techniques have been developed in order to assess the physical-chemical properties of synthesized materials.
IFN-TN is located within the premises of Fondazione Bruno Kessler as established through a formal collaboration agreement between FBK and CNR-IFN that is in place since 2009. A letter of intent to extend such collaboration agreement until 2035 has already been signed. The strong and longstanding scientific collaboration is the basis for the sharing of infrastructure, equipment and human resources in specific fields of photonics, namely: development and optical characterization of photonics materials and structures; development and realization of optical devices for sensing and applications in the energy and circular economy fields; high sensitivity detectors at the thermal noise limit. Indeed, through their collaboration CNR-IFN and FBK can already offer different Si-based integrated photonic platforms and precisely silicon-on-insulator, silicon nitride and silicon-oxy-nitride. Moreover, there is an established competence and international recognition in the development of electromagnetic radiation sensors. The technological platforms include Si-photodiods and phototransistors, planar technology fully depleted Si PIN devices (single diodes but also pixel matrix and strip array detectors), silicon drift detectors (SDDs), Single photon avalanche detectors (SPADs) Silicon Photomultipliers (SiPMs), Low Gain Avalanche Detectors (LGADs).
The integrated photonics and the single photon detection competences are currently the subject of in-house research for the establishment of a new micro-fabrication platform combining these two capabilities.
These activities are carried out in a CMOS-like clean-room where currently the critical dimension is given by the lithographic step: 350 nm with a stepper, and a few micrometers with a mask aligner. The concept-design-realization cycle takes a minimum of a few weeks due to mask/reticle realization by an external provider. The cleanroom offers all the other facilities for the complete process: ion implanter, furnaces for annealing, doping, deposition, dry and wet etching, metal deposition (Al, Ti).
The facility is also already equipped with a state of the art nanofabrication oriented dual beam tool (focussed Ion beam, electron beam) equipped with a liquid metal alloy ion source (currently composed of Si, Ge, Au). Such instrument allows the further extension of the Cleanroom micro-fabrication activities with localised ion implantation for the creation of optically/magnetically active defects (colour-centres) and/or localised nano-crystal formation (eg. Si or Ge in SiO2). A further state of the art dual beam instrument with a high current plasma based (Xenon) focussed ion beam and a high resolution scanning electron microscope is dedicated to the characterization of the micro-nano structures.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [4] - Name, location, and contact person

General Information

OU Short Name	*UO 4*	OU Name	*CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna*

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

Microsistemi Sede di Bologna

OU Type	*Institute*		
Address			
Region	*Emilia Romagna*	Province	*BOLOGNA*
Municipality	*BOLOGNA*	ZIP Code	*40129*
Address	*Via P. Gobetti*	Street Number	*101*
Contact Person			
First Name	*Vittorio*	Last Name	*Morandi*
Phone number	*0516399141*	e-mail	*morandi@bo.imm.cnr.it*

6.2 OU CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna - Scientific-technological expertise and experience

CNR-IMM Bologna has a solid background on nanomaterials synthesis and structural characterization as well as on MEMS technology, including synergic interactions between these two research fields: recent activities include development MEMS devices for in-situ and in-operando nanomaterial characterization and for quantum sorting in transmission electron microscopy.
CNR-IMM Bologna's specific expertise ranges from nanomaterial synthesis (catalytic CVD of CNT, graphene, 2D materials, oxide materials) to integration of graphene technology into microelectronics processes, while new structural characterization techniques for nanomaterials were developed using TEM, in-situ TEM and holography, SEM, STEM and X-Ray diffraction.

The multidisciplinary expertise (including physicists, electronic engineers and chemists) and the availability of a clean room comprising a MEMS pilot line enables research and process development for the prototyping of innovative MEMS devices based on silicon/glass stacks as well as on emerging nanomaterials. A complete set of electric and functional characterization systems and the related know-how incudes probe stations, hall effect and network analyzers. Packaging facilities, capabilities on custom PCB and firmware development as well as a 3D printing lab enable also mid- to high-TRL demonstrators and industrial research.

Further research lines which would foster external collaborations by the scale-up of the NFFA-DI infrastructure include materials and MEMS technology for chemical and physical sensors, as well nanomaterials for energy generation, storage and harvesting. Furthermore, expertise and research projects on optical-fiber based sensors and

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

silicon photonics will also benefit from the NFFA-DI upgrade.

A partial list of recent and ongoing international and national projects includes H2020 Graphene Core3, H2020 MINEON, H2020 RESIST, H2020 SiC Nano for PicoGeo, H2020 CHALLENNGES, H2020 5D Nanoprinting, H2020-NanoFabNet, H2020 SLAM-DAST, Horizon Europe – FAIR IMPACT, PRIN HY-TEC, PRIN AsBeST, POR-FESR 5G-CAR, as well as 7 active research contracts with international SMEs.
The actual number of researchers at CNR-IMM BO is 30, while the technical staff is composed by 10 units. The number of researchers and technicians to be involved in NFFA-DI will correspond to 8-10 Full Time Equivalent (FTE). The number of publications in the last 5 years is approximately 60 / year, and the number of patents is around 3-5 / year.

The involvement of external users inside CNR-IMM Bologna facilities is already significant, with an average of 30 users per year over the last 5 years, together with an average of 10 external user projects every year. This figure must be further detailed by the high fraction of industrial access of 30% (calculated on the basis of funding coming from industries over operational costs), indicating a well-balanced distribution between external access from academics and industry.
Previous expertise in technology transfer, fostered by Tecnopolo CNR composed by the PPPs Proambiente and MISTER Smart Innovation, will also be enhanced, building a tool for a rapid uptake and high impact of the new technologies developed by the NFFA-DI infrastructure and its users.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [5] - Name, location, and contact person

General Information

OU Short Name	*UO 5*	OU Name	*CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania*
OU Type	*Institute*		

Address

Region	*Sicilia*	Province	*CATANIA*
Municipality	*CATANIA*	ZIP Code	*95121*
Address	*Zona Industriale VIII Strada*	Street Number	*5*

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

Address	*Zona Industriale VIII Strada*	Street Number	*5*

Contact Person

First Name	*Antonino*	Last Name	*La Magna*
Phone number	*0955968220*	e-mail	*antonino.lamagna@imm.cnr.it*

6.2 OU CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania - Scientific-technological expertise and experience

The Institute for the Microelectronics and Microsystems (IMM) of the CNR with the Headquarter and University sites in Catania focuses its activity on innovative solutions for micro and nanoelectronics, optoelectronics and photonics, sensors and multifunctional micro/nanosystems. IMM in the Catania sites has a permanent staff of 74 people (42 of them Researchers) and a temporary staff of 29 young researchers (19 post-docs and 10 PhD students). The main research areas are: Low-D materials, Nanomaterials for water purification, Quantum technologies, MOEMS, Sensors, Functional nanomaterials, Power and HF Devices, Devices for information storage and processing, Optoelectronics devices and PV devices.

These application areas are supported by state-of-the-art activities in synthesis and micro- nano-manufacturing, characterization and modelling (i.e. the core of the UO@IMM-CT services). The upgrade will strengthen specific components in these three sectors whose competencies, as the demonstration of the international recognition of the UO in the fields, have been developed so far within the fremework of competivive european projects.

The team dedicated to the synthesis of advanced materials has in fact obtained, in the past few years, a huge funding from EU, through the FP7 project WATER (Winning Applications of nanoTEchnology for Resolutive hydropurification), that allowed the acquisition of new state of the art deposition equipments.

Advanced characterization is the backbone of many applicative activities and the team in the UO@IMM-CT, partitipating to the ESTEEM3 project https://www.esteem3.eu, is recognized as one leading Europen node of the atomic scale characterization.

The Theory, Numerical Simulation and Modelling team involved in the UO@IMM-CT is developing, whitin the framework of european projects Madein4 https://madein4.eu and MUNDFAB https://www.mundfab.eu, multiscale advanced physical models and simulation software dedicated to unconventional nanoscaled devices.

Synthesis and manufacturing. PicosunTM R-200 Advanced thermal and plasma enhanced atomic layer deposition (ALD) for the growth of TiO2, ZnO, Al2O3, Ag, Ru, Pt, Pd, transparent conductive oxides, on wafers up to 8; Aixtron Black Magic thermal and plasma enhanced chemical vapor deposition, for the deposition on wafers up to 6" of C-based low-D materials; AJA UHV confocal magnetron sputtering with 3 different targets to deposit, on wafers up to 8", high purity single element or alloys thin films and multilayers; DCA Molecular beam epitaxy system, with 3 electron guns (Si, Ge, Ga2O3) and 4 effusion cells for doping (B, P, As, MoO3), equipped with in situ RHEED, for the growth, on wafers up to 6", of Si, Ge, SiGe, MoO3, Ga2O3.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

the growth, on wafers up to 6", of Si, Ge, SiGe, MoO3, Ga2O3.
Characterizations. 1D/2D carrier profiling by spreading resistance probe (SRP); scanning capacitance microscopy (SCM) and scanning spreading resistance microscopy; TEM-based techniques on focused samples (HREM, STEM-EELS) to provide advanced structural and chemical characterisation of nanostructured materials; X-Ray based techniques (XRD, XRR); Optical characterizations of devices' materials by means of spectroscopic ellipsometry. IMM is a well known European center in the field of electrical and structural characterization of electronic materials.
Modelling. Currently state-of-the-art simulation tools are available at the CNR for their use in the development of advanced Si and SiC based semiconductor technology. A peculiar characteristic of these tools is the possibility of obtaining device scale simulation with extreme space accuracy (atomic level with the ab-initio schema) and using as input the machine parameters. Some recent achievements obtained within the past and present E.U. project: CHALLENGE, Madein4 and MUNDFAB have demonstrate that proper acceleration techniques within the atomistic approach allow for simulation of defect generation, evolution and impact in 3D micrometric systems.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [6] - Name, location, and contact person

General Information

OU Short Name	*UO 6*	OU Name	*CNR-ISM - Istituto di Struttura della Materia*
OU Type	*Institute*		

Address

Region	*Lazio*	Province	*ROMA*
Municipality	*ROMA*	ZIP Code	*00133*
Address	*via del Fosso del Cavaliere*	Street Number	*100*

Contact Person

First Name	*Stefano*	Last Name	*Turchini*
Phone number	*3931473878*	e-mail	*stefano.turchini@ism.cnr.it*

6.2 OU CNR-ISM - Istituto di Struttura della Materia - Scientific-technological expertise and experience

The CNR-ISM EFSL (EuroFEL Support Laboratory) is a laser facility operating since 2015 and participates in the

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

The CNR-ISM EFSL (EuroFEL Support Laboratory) is a laser facility operating since 2015 and participates in the new NFFA-Europe Pilot project (2021) in the Electronic & Chemical & Magnetic Characterization section. The central aim of the facility is to offer to the Italian scientific community access to IR-Vis-VUV ultrafast spectroscopies in order to characterize materials and to build effective proposals to the VUV-X Ray FEL facilities. Nowadays the laboratory is managed by six scientists whose expertise is rooted in physics, chemistry and material science, with experience in synchrotron radiation beamline management. Moreover, the research group has extensive experience in optical and VUV- X-Ray spectroscopies and, along with the time-resolved optical spectroscopy of the EFSL facility, has a current activity in synchrotron radiation and FEL facilities.
The scientific activity of the EFSL research group encompasses the ultrafast dynamics study of photovoltaic materials, plasmonic nanoparticles (NPs), semiconductors nanosystems and hybrid nanostructures. The activity on photovoltaic materials has been focused on the ultrafast carrier dynamics in nanostructured perovskites and heterojunction systems with the aim of improving device efficiency and at present is continuing that activity in the CitySolar-HORIZON 2020 project on transparent photovoltaic materials. The group is also interested in the conversion of absorbed visible light into heat on a nano-localized scale in metallic plasmonic nanosystems and how these nanosystems interact with semiconductors. In general the aim is to study the modification of the morphology of both the plasmonic and semiconductor components at the nanoscale, as well as tailoring interface states, which can be exploited to induce charge and/or energy transfer for applications in catalytic and optoelectronic applications. The carrier dynamics was also studied in semiconductor nanowires such as ZnSe and Si, and in their nanostructured semiconductor-metal NP hybrids, in particular the charge carrier and the energy transfer.
The techniques employed in the facility are:
1) Transient spectroscopy in transmission and reflection from near the UV to the infrared (260-1600 nm) with temporal resolution of 50 fs, with RT and LN temperatures;
2) Up-conversion luminescence with a temporal resolution of 50 fs;
3) Luminescence in single photon counting with temporal resolution of 40 ps, luminescence interval 400 - 1000 nm with temporal window around 4 ns and variable temperature 10-400 K;
4) Luminescence in single photon counting with temporal resolution of 200-500 ps, luminescence interval 300 - 800 nm with temporal window around microseconds and available temperature RT and LN;
5) Custom pump-probe experiments on an optical table to perform time-resolved measurements with pumps at 400 nm and probes in the range 250 - 20000 nm with a temporal resolution of 50 fs.
The specificity of EFSL in NFFA-DI is to offer a complete ultrafast characterization in absorption and luminescence in the UV-Vis-IR with a wide range of wavelengths of both pump and probe photons to encompass a very large choice and combinations of excitations and probing band energies in materials.
The CNR-ISM OU is currently involved in research projects in collaboration with FERMI@Elettra and the NFFA-Trieste SPRINT facility. In these collaborations the complementarity between time resolved spectroscopies based on VUV/Soft-X-rays and optical spectroscopy is exploited to probe localised versus delocalised states, bound versus continuum states. The CNR-ISM UO provides a complementary wavelength range to that present in the CNR-IFN

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

continuum states. The CNR-ISM UO provides a complementary wavelength range to that present in the CNR-IFN unit (THz and VUV-soft X-rays). In this configuration NFFA-DI could offer to the users state of the art ultra-fast laser sources with wavelength ranging from THz all the way to the soft-X-rays.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [7] - Name, location, and contact person

General Information

OU Short Name	*UO 7*	OU Name	*CNR-Nanotec - Istituto di Nanotecnologia*
OU Type	*Institute*		

Address

Region	*Puglia*	Province	*LECCE*
Municipality	*LECCE*	ZIP Code	*73100*
Address	*c/o Campus Ecotekne Via Monteroni*	Street Number	*N/A*

Contact Person

First Name	*Massimo*	Last Name	*Cuscunà*
Phone number	*3477063665*	e-mail	*massimo.cuscuna@cnr.it*

6.2 OU CNR-Nanotec - Istituto di Nanotecnologia - Scientific-technological expertise and experience

The Institute of Nanotechnology (CNR-NANOTEC) develops fundamental and applied research in the fields of nanosciences and nanotechnology. It gathers scientists and students from the disciplines of physics, chemistry, engineering, materials science, as well as biology and medicine. To promote knowledge and innovation in science and technology, CNR-NANOTEC develops cutting-edge experimental techniques and modeling tools in close collaboration with academic, institutional and industrial partners. The Institute was founded in 2015 and now hosts about 200 people and can embrace a wide area of knowledge, spanning from material characterization to the study of technological processes and from the design and fabrication of advanced devices to their integration in high TRL systems. CNR-NANOTEC has the largest publicly funded clean room facility in Italy (800 m2 ISO 5-8), capable of producing advanced nanosystems.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

producing advanced nanosystems.
In the framework of the present project, CNR-NANOTEC has extensive expertise and experience in the growth and patterning of functional materials along with their characterization by means of light- and electron-based correlative microscopy platform. Research activities are focused on the growth of materials via vapor- and/or solution-phase methodologies (ALD, CVD, MOCVD, MBE, PVD, PECVD, self-assembling, sol-gel). Based on fundamental research, CNR-NANOTEC elucidates principles underpinning processing-structure-property relationships in functional materials. Topics include III-V, metal-oxide and organic semiconductors, dielectrics, 2D-materials, halide perovskites, colloidal nanocrystals. The applications range from energy to electronics, optoelectronics, nanophotonics and biotechnologies. The main research lines are:
-Inorganic semiconductors of the GaAs and GaN families, realized by means of epitaxial techniques, such as molecular beam epitaxy and metal organic chemical vapor deposition.
-Metal-oxide semiconductors, realized by means of plasma enhanced-atomic layer deposition representing the ideal candidate for depositing strategic thin films with precise control of the thickness, very low contamination content along with conformal coverage on structured surfaces with complex shapes.
CNR-NANOTEC is also engaged in the field of light- and electron-based correlative microscopy aimed at developing novel functional materials. The correlative microscopy facility of CNR-NANOTEC is intended to facilitate the pursuit of research in emerging, interdisciplinary, and rapidly growing fields such as thin-film solar cells, batteries, photocatalyst for solar fuel production and electronic/optoelectronic/nanophotonic systems. The correlative microscopy facility aims to deliver outcomes that will have real impact for users. CNR-NANOTEC aims to increase the TRL of its correlative microscopy platform (TRL is ~2) by including novel state-of-the-art instruments and by promoting strong collaboration and cooperation with the technological nodes of the present infrastructure in order to extend the technology to a large plethora of materials and device optimization areas. After 3 years, technology development is expected with an increased TRL up to 4-5.
It is worth noting that the permanent staff dedicated to the present initiative is equivalent to about 10 full time equivalent employee.

6 Operating Unit(s) (OU(s)) directly involved in the project

6.1 OU [8] - Name, location, and contact person

General Information

OU Short Name	*UO 8*	OU Name	*CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli*

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

OU Type	*Institute*		
	Address		
Region	*Campania*	Province	*NAPOLI*
Municipality	*NAPOLI*	ZIP Code	*80126*
Address	*Via Cinthia*	Street Number	*21*
	Contact Person		
First Name	*Fabio*	Last Name	*Miletto Granozio*
Phone number	*081676833*	e-mail	*fabio.miletto@spin.cnr.it*

6.2 OU CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli - Scientific-technological expertise and experience

The Naples unit of CNR-SPIN has a long-standing expertise in the growth and characterization of functional materials in the form of thin films and heterostructures, as well as suspended membranes and nanoparticles. Employed growth techniques range from pulsed laser deposition, to sputtering and thermal/e-beam evaporation. The materials that have been addressed in the last decade include high-Tc superconductors, several different transition metal oxides, organic materials, hybrids, metals and alloys. The characterization of the produced samples routinely includes variable temperature transport (typically in cryogenic conditions), x-ray diffraction, magnetometry, photemission and scanning-probe microscopy. Standard lithographic process (including e-beam litography) are applied for device fabrication.

CNR-SPIN will contribute to the project with the expertise of all it's units, that, beside Naples, are located in Genoa (Institute headquarters), Rome, l'Aquila, Chieti and Salerno. In all SPIN Units, a long-standing expertise in the access to large scale facilities (synchrotrons, neutron sources, muons) is available. Furthermore, a strong theoretical component, mainly present in Aquila/Chieti and in Salerno, is going to support the NFFA-DI activities in Naples. The activity of CNR-SPIN theorists aims at understanding the fundamental microscopic mechanisms and the emergent physical phenomena of complex materials, which are characterized by a strong entanglement of spin-orbital-charge-lattice (SOCL) degrees of freedom, mainly driven by electron-electron correlations and spin-orbit interaction, and include the combination with quantum topology. Targeted material platforms, in bulk, thin-film and superlattice form, are based on transition metal oxides (TMO) at large, but also other transition-metal based systems where electron correlations and spin-orbit coupling can play a relevant role.

As a starting point of the upgrade process, CNR-SPIN will employ the so-called "MODA" facility (Modular facility for Oxide Deposition and Analysis). MODA is a multicluster system allowing for RHEED-assisted PLD with real-time plume analysis, XPS/UPS, SPA-LEED and AFM/STM. The already available hardware and the expertise

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

time plume analysis, XPS/UPS, SPA-LEED and AFM/STM. The already available hardware and the expertise gained in the management of such facility will allow creating a large UHV-interconneted platform for growth of epitaxial films and heterostructures and their in-situ characterization, which represent the major part of the requested investment.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

7 National and international collaboration

NFFA was born as a European Research Infrastructure through a FP7 Design Study, involving 5 National Research Organizations of Austria, Italy, Spain, Switzerland and the United Kingdom. NFFA-Europe operates since 2015 under H2020 with a Consortium of 20 national organizations of EU Countries and CH, and since 2021 with a PILOT (NEP) Consortium of 23 national organization and industries, and 10 more research organizations with the role of Third Parties against payment. The NFFA-Europe collaboration includes Joint Activities (research, development of new methods/tools for users, training/webinars/schools for young scientists, dissemination and communication), as well as Transnational Access (physical and remote) and Virtual Access services. Users come from a total of 58 Countries all over the world. International collaborations among the Beneficiaries and all nodes of NFFA is intense and highly productive. The Italian nodes that join under NFFA-DI are all leading institutes/organizations in their own speciality with a rich track record of scientific productivity, or with an established expertise in technology transfer and coaching of start-up enterprises based on the result of frontier research. NFFA-Europe is leading the digitalization of scientific services for the nanosciences in Europe, with a major contribution coming from the Italian nodes that therefore are internationally qualified to push it further by making NFFA-DI fully digital.

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

8 Scientific coordinator of project

8.1 Personal data and contacts

First Name	*Cristina*	Last name	*Africh*
Gender	*Female*	TAX Code	*FRCCST73A59L424Q*
Birth date	*19/01/1973*	Birth place	*TRIESTE*
Phone number	*0403756443*	e-mail	*cristina.africh@cnr.it*

8.2 Digitally signed CV

(See documents attached)

8.3 Appointment letter as scientific coordinator of the project

(See documents attached)

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

9 Financial Officer in charge of the project

9.1 Personal data and contacts

First Name	*Francesca*	Last name	*Fortunati*
Gender	*Female*	TAX Code	*FRTFNC71P51D969S*
Birth date	*11/09/1971*	Birth place	*GENOVA*
Phone number	*0106598733*	e-mail	*francesca.fortunati@cnr.it*

9.2 Digitally signed CV

(See documents attached)

9.3 Appointment letter as scientific coordinator of the project

(See documents attached)

a) APPLICANT

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

10 Manager of the infrastructure as per Article 1 of the call for proposals, provide

10.1 Duties, expected profile and specific requirements

The Infrastructure Manager (IM) plays a key role in the Management structure of NFFA-DI: a) the role of IM shall be that of performing optimal management of overall resources and administrative effort at all UOs to accomplish the upgrade; ensures proper communication among all nodes and prepares the agenda of decisions based also on inputs from the SC; b) the IM refers to the Coordination Committee (CC) and can be invited, with no voting rights, to its meetings as well as to those of the Executive Board of Directors and Strategy Committee. Strong leadership skills will be essential since the IM is expected to interact with the staff, the scientists, and the funders. The IM duties are:

- *Execute the infrastructure's strategies*
- *Monitor expenditures, coherent application of the project timing,*
- *Monitor and pursues of intermediate objectives (milestones), t*
- *Oversee the submission of the expected deliverables.*
- *Prepare and implement comprehensive business plans*
- *Communicate and maintain trust relationships with stakeholders, science professionals, business partners, and funders*
- *Oversee the organisation's financial performance*
- *Support the development of new service opportunities and funding*
- *Coordinate with science professionals in implementing research service provision and priorities*

The specific requirements are:

- *Proven experience as manager in science-based organisations; previous experience in managing research infrastructures and core facilities will be preferred*
- *Thorough knowledge of the research infrastructure ecosystem*
- *Strong understanding of financials and performance measures*
- *Excellent organisational and leadership skills*
- *Excellent communication, interpersonal and presentation skills, proficiency in English and Italian*
- *Outstanding analytical and problem-solving abilities*
- *MSc/MA in business administration or relevant field; MA in the field of research infrastructure/science management will be preferr*

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

11 Legal name; Tax code; VAT number, Legal address

Legal Name	*Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park*	Tax code	*00531590321*
VAT number	*00531590321*		

Legal address

Region	*Friuli Venezia Giulia*	Province	*TRIESTE*
Municipality	*TRIESTE*	ZIP Code	*34149*
Address	*Padriciano*	Street number	*99*

12 Legal representative: personal data and contacts

First name	*Caterina*	Last name	*Petrillo*
Gender	*Female*	TAX Code	*PTRCRN60M46L739B*
Birth date	*06/08/1960*	Birth place	*VENTICANO*
Phone number	*0403755202*	e-mail	*presidente.petrillo@areasciencepark.it*

13 Management and research structure

Area Science Park is a public national research organization under the Italian Ministry for Universities and Research and absolute majority shareholder of Elettra Sincrotrone Trieste, the Italian Representing Entity in the European Research Infrastructure Consortium CERIC-ERIC, an "Analytical Research Infrastructure" in the ESFRI Roadmap. Area manages the largest and longest established science park in Italy which hosts a number of national and international research organisations. Area provides open access to its research infrastructures to promote both excellent research and industrial applications and actively collaborates on research projects with other public and private sector partners. Area is at the centre of an ecosystem which favours technological research and innovation and serves as a link between the world of research and industry, transferring research findings to the market, and supporting the creation of new innovative companies providing numerous technical services including: researcher mobility, technology transfer, patent research and advanced training. Cutting-edge equipment and facilities for scientific and industrial research include a laboratory for Genomics and Epigenomics and a state-of-the-art HPC facility devoted to bio-informatics and data science.

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

Epigenomics and a state-of-the-art HPC facility devoted to bio-informatics and data science.
Area's President and legal representative, currently Prof. Caterina Petrillo, develops the long-term vision and the strategy to achieve it through identified objectives that are shared with the Scientific and Technical Advisory Board and the Executive Board which approves all initiatives. The General Director, currently Dr. Anna Sirica, oversees all technical, administrative, and financial management and ensures the implementation of the decisions and plans approved by the Board. Area has a UNI EN ISO 9001: 2015 certification and is committed to rationalizing procedures and improving information management tools, while ensuring transparency and equal opportunities and preventing corruption.

14 Financial Management System

Cost accounting: Area has an analytical accounting system structured at single project level; by appropriate coding all revenues and expenses are assigned to projects, thus enabling financial tracing of the project both in the budget and in the final balance. Furthermore, all transactions (contracts, invoices, payments etc) are marked with codes mandatory for projects (CUP) and tenders (CIG), tracking all financials related to the operation
State Aid
Area has adopted an evaluation procedure of potential State aid within new initiatives that makes possible to classify correctly economic and non-economic activities. All projects are classified as institutional / commercial. In this way economic and non-economic activities are separated allowing separate accounting between activities. This tracking system will be developed also for the new infrastructure, enabling monitoring of costs and revenues referred to economic and non-economic activities.
Document management
Area has digitalised all administrative procedures by setting up information systems for document filing, conservation and sharing. We will develop a specific site for the project where documents and financial data will be collected and stored, with adequate access permissions.
Monitoring and control
The project management site developed as explained above will be shared with the partners and will collect data relevant to monitor procedural, physical and financial progress of the project. On the basis of specific check-lists controls will be carried out on procurement procedures and costs to be reported.
Fraud prevention
Area has adopted a Code of conduct regarding the prevention, detection and correction of fraud, corruption and conflicts of interests which applies to all parties operating within or for Area. Furthermore, there is a triennial Plan regarding prevention of corruption and transparency; specific roles and responsibilities are identified for planning and implementing prevention of corruption.

15 Specific skills of the applicant with respect to this proposal

AREA is a unique example of multidisciplinary environment for science and innovation services with a rich diversity of expertise, from biotechnology and omic sciences to material science for energy applications. AREA has a long standing cooperation with ELETTRA

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

and the FERMI, framed under the OpenLab project to support research and industrial innovation activities. AREA coordinates the PON project Bio Open Lab, contributing to the development of the international RI CERIC-ERIC. AREA collaborates with the RI NFFA-Europe in the field of Data Science.

Area developed a robust plan to set up and manage Technological and Research Platforms, offering access and services to industrial and academic researchers and acting as hubs to link with and to support SMEs and larger companies' innovation programmes. Building upon the successful example of the Genomics & Data Center Platform, AREA decided to set up the new Material Platform which comprises the installation of a state of the art TEM. The TEM lab is in the AREA site in Basovizza, where the active interface with the whole scientific surrounding (Elettra, Fermi, CNR) is facilitated. The TEM facility together with the proposed upgrade will be integrated in the NFFA-DI offer for user access.

The investment in DATA Center ORFEO was accompanied by a parallel investment in human resources: data scientist, data engineers, HPC experts and data curators.

These competences are offered to develop novel advanced services for NFFA-DI and to enable driving such a complex RI towards its full digital transition. Area has the competences to lead the installation, develop the strategies to produce and collect FAIR-by-design data, and share them consistently with the EOSC approach.

The proven skills of AREA in supporting the innovation chain, also through procedures and tools, will help designing a suitable and robust structure to ensure long term sustainability of NFFA-DI over a 10 years period.

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

16.1 OU [1] - Name, location, and contact person

General Information

OU Short Name	*UO 9*	OU Name	*AREA - Area Science Park - Basovizza Campus*
OU Type	*Centre*		

Address

Region	*Friuli Venezia Giulia*	Province	*TRIESTE*
Municipality	*TRIESTE*	Address	*Strada Statale 14*
ZIP Code	*34149*	Street Number	*km 163,5*

Contact Person

First name	*Stefano*	Last name	*Cozzini*
Phone number	*3669393969*	e-mail	*stefano.cozzini@areasciencepark.it*

16.2 OU AREA - Area Science Park - Basovizza Campus - Scientific-technological expertise and experience

The equipment acquired with the upgrade will be installed at the AREA UNIT in Basovizza and the Area Data Center ORFEO.
The offer of scientific and data services to NFFA-DI users will increase. Protocols for technology transfer in nanoscience over a wide TRL range will be developed.
Electron Microscopy Platform
AREA is installing a technology platform for innovative services in material science based on TEM as a well-established method for advanced material characterization. Current TEM technology provides highly specialized solutions for structural and chemical analysis in materials science and nano-engineering. However, the needs of multidisciplinary research demand for complementary facilities and services covering the relevant aspects of sample synthesis, characterization, advanced optical or X-ray methods and nanofabrication. The TEM investment is solidly rooted in the scientific and technological environment of Basovizza campus, where integration with world class facilities (Elettra, Fermi) enables a truly multi-technique, combined approach to material science. The co-location facilitates the offer of integrated services to NFFA-DI users. This impacts both research and economy sectors, with a wide range of applications, from nanotechnologies and development of nano-structured materials, to failure

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

analysis and process control in industrial activities.

Scientific data and HPC infrastructure

The RET Institute in Area promotes Open Science through advanced research. It includes experts in data science & management, HPC and data infrastructure management. It collaborates with national and international institutes also supporting PhD programs and AI-related courses. Research activities focus on scientific data handling and optimization of scientific instruments in a FAIR-by-design approach. Several data services are maintained and contribute to develop competence on FAIR principles. The expertise level of a highly motivated team fits perfectly with the ambitious goal of taking care of the activities related to the data infrastructure setup and digital implementation of innovative FAIR-by-design approaches in data collection and storage, to address the challenges posed by NFFA-DI.

Ad-hoc protocols for technology transfer

Area developed and applied technology transfer and open innovation processes to many projects and initiatives, which led to a stage-gate approach for opening RI services to industry. It has a long-standing experience in managing intellectual property, with its Patent Information Center (PatLib) recognized by the Patent and Trademark Office of the Ministry of Economic Development since 1999.

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

17 National and International collaboration

Open Lab Support Structure (Innovative Materials Open Lab) and Open Lab – A system of Open Research facilities (Biomaterials Open Lab) are two MIUR funded initiatives led by Area in collaboration with CNR, to integrate the technological offer available at Area's major laboratories (Elettra, FEL FERMI, CNR-IOM nanoscience and nanotechnology laboratories, CNR-IC structural biology laboratory) to provide companies with expertise and facilities dedicated to the application of imaging techniques, structural analysis and chemical characterization and with a dedicated channel to submit technical issues or innovation needs.

InCIMa4 is an Italy-Austria Interreg European funded project aimed at strengthening a cross-border research infrastructure for synthesis and characterization of functional materials of natural origin. Three Research Institutions (Elettra Sincrotrone Trieste, Salzburg University of Applied Science and Paris–Lodron University) are granting access to the SMEs through a transparent peer-reviewed procedure, designed by Area, to conduct feasibility test to verify the compliance of the InCIMa4 technologies to solve their innovation needs.

Area coordinates BIO Open Lab, a MIUR funded project (Action II.1 - National Operative Programme – Research and Innovation 2014-2020) aimed at extending CERIC-ERIC research infrastructure with facilities dedicated to investigations in the field of biological and biomedical research plus a powerful Data Center offering the necessary support for storage, processing and integration of data. The facilities are located by Area (Data Center), University of Salerno (Mass Spectrometry Facility and Data Center) and University of Salento (Holographic Electronic Microscopy – Holo-TEM). The facilities are intended to be managed balancing the issues of CERIC-ERIC open access policies, institutional research, training activities, participation to competitive financed project and a quota of industrial demand of services and contract research

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

18 Principal investigator for the co-applicant

18.1 Personal data and contacts

First Name	*Stefano*	Last name	*Cozzini*
Gender	*Male*	TAX Code	*CZZSFN66D24L378Y*
Birth date	*24/04/1966*	Birth place	*TRENTO*
Phone number	*3669393969*	e-mail	*stefano.cozzini@areasciencepark.it*

18.2 Digitally signed CV

(See documents uploaded)

18.3 Appointment letter as principal investigator

(See documents uploaded)

b) CO-APPLICANT - Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

19 Administrative contact for the co-applicant

19.1 Personal data and contacts

First Name	*Eva*	Last name	*Vessel*
Gender	*Female*	TAX Code	*VSSVEA63R47L424S*
Birth date	*07/10/1963*	Birth place	*TRIESTE*
Phone number	*0403755274*	e-mail	*eva.vessel@areasciencepark.it*

19.2 Digitally signed CV

(See documents uploaded)

19.3 Appointment letter as principal investigator

(See documents uploaded)

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

11 Legal name; Tax code; VAT number, Legal address

Legal Name	*Politecnico di Milano*	Tax code	*80057930150*
VAT number	*04376620151*		

Legal address

Region	*Lombardia*	Province	*MILANO*
Municipality	*MILANO*	ZIP Code	*20133*
Address	*Piazza Leonardo da Vinci*	Street number	*32*

12 Legal representative: personal data and contacts

First name	*Ferruccio*	Last name	*Resta*
Gender	*Male*	TAX Code	*RSTFRC68M29A794Y*
Birth date	*29/08/1968*	Birth place	*BERGAMO*
Phone number	*0223992250*	e-mail	*rettore@polimi.it*

13 Management and research structure

Politecnico di Milano is organised in Departments, Schools and regional Campuses. To ensure the democracy, transparency and representativeness of the governing procedures, the responsibility for the guidance of the University, the Departments and the Schools is entrusted to elected members. The Department is the University structure in which human resources for research and teaching activities are developed and coordinated. The Department is responsible for research activities in sectors which are consistent with each other in terms of content and methods or objectives, as well as the development of skills for the corresponding teaching activities

PoliFAB, the micro and nanotechnology facility of Politecnico di Milano, is one of the Large Research Infrastructures of Politecnico di Milano. It is centrally managed and does not refer to a specific Department, as it is part of the Research, Innovation And Corporate Relations Area. Currently it is located in the main Campus of Milano Leonardo. PoliFAB provides high technological equipments and processes for a wide range of applications, including the five Key Enabling Technologies identified by the European Commission: photonics, micro and nanoelectronics, biotechnologies, advanced materials and nanotechnology. The facility is open to internal and external users on the basis of transparent access policies, upon payment of access fees according to a pricing list and an accounting system which allows to expose these costs in national and european projects.

Some research groups and laboratories working in the fields of nanoelectronics, photonics, nanomagnetism and spintronics, are co-localized

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

Some research groups and laboratories working in the fields of nanoelectronics, photonics, nanomagnetism and spintronics, are co-localized in the PoliFAB infrastructure, providing additional expertise and device characterization tools in their disciplines.
The management bodies of Polifab are: (i) the Scientific Committee; (ii) the Scientific Director; (iii) the Cleanroom Manager.

14 Financial Management System

The administration activities of the Politecnico di Milano are aimed at ensuring the pursuit of institutional aims, guaranteeing economic, financial and asset-related balance in compliance with the accounting principles for financial statements included in the current laws. The administrative-accounting processes are inspired by the principles of lawfulness, transparency, efficiency, effectiveness and affordability.
The internal regulation define the accounting and the administrative systems, their structure and purposes, the accounting processes and the control system.
The accounting system is organised in Management Centres, Departments and Campuses. POLIMI implements the accounting system in addition to the analytical accounting procedures and systems.
The analytical accounting: a) defines the assignment of resources to the Management Centres; b) is used to check the actual residual availability of resources; c) permits the economic analysis aimed at improving management efficiency and effectiveness.
The analytical units for assignment in the accounting system are the Management Centres, the Cost Centres and the Projects.
The Projects can refer directly to Management Centres. In the present case the NFFA-DI project will refer to the Research, Innovation and Corporate Relations Area, which will be in charge of administrative aspects.
General resources are assigned to the Management Areas by the General Director when the economic budget and the annual investments are approved.
POLIMI financial management system is compliant with the relevant European legislation and guarantees to maintain a separate accounting system for all transactions relating to the project, making all documents available for inspection or monitoring activities.
POLIMI management system is coherent with the provisions of EU Regulations 2018/1046 and 2021/241. It guarantees the correct allocation of data relevant to the monitoring the procedural, physical and financial progress of the project.

15 Specific skills of the applicant with respect to this proposal

Polifab (www.polifab.polimi.it) is one of the four large infrastructures of POLIMI, namely the open-access (pay-per-use) reference micro and nanofabrication facility. It has been created to provide the highest technological standards for a wide range of applications, including micro and nanoelectronics, photonics, biotechnologies, advanced materials and nanotechnology. The mission of Polifab is to support and boost the activities of the research groups of Politecnico as well as of external research institutions and industries. Since its foundation, in 2015, a lot of effort has been put in setting clear access policies, both in terms of users training on safety and technical issues concerning the equipment, and of access costs. Well-established access rules for distinct classes of users (internal/external researchers, start-up, companies) and a transparent pricing list, with hourly access costs to each equipment, allow to handle all kinds of access requests (direct access, service, development contract, etc.). The accountability of access costs for research groups is guaranteed thanks to a cost calculation algorithm

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

(average hourly access cost) accepted by the European Commission in the Horizon 2020 and Horizon Europe program.

The relevant KPIs of Polifab for 2020 are summarized below:
-Registered (Active) users: 245 (87)
-Research groups using Polifab: 18
-Startup using Polifab: 4
-Companies using Polifab: 2
-Research projects based on Polifab: 30
-ERC projects based at Polifab: 3
-Contracts for service: 6
-Papers mentioning Polifab in the acknowledgments: 34
-Patents on activities carried out at Polifab: 4
-Students (education and training): 60

Nowadays Polifab is established as reference facility for micro-nanofabrication in Milano area, with a users community in expansion and increasing interest by high-tech industries mainly based in Lombardy Region: Technoprobe, Huawei, STMicroelectronics, etc.

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

16.1 OU [1] - Name, location, and contact person

General Information

OU Short Name	*UO 10*	OU Name	*Polifab, the micro and nanofabrication facility of Politecnico di Milano*
OU Type	*Centre*		

Address

Region	*Lombardia*	Province	*MILANO*
Municipality	*MILANO*	Address	*via G. Colombo*
ZIP Code	*20133*	Street Number	*81*

Contact Person

First name	*Andrea*	Last name	*Melloni*
Phone number	*0223998928*	e-mail	*andrea.melloni@polimi.it*

16.2 OU Polifab, the micro and nanofabrication facility of Politecnico di Milano - Scientific-technological expertise and experience

Polifab is based on a cleanroom of 630 m2 (400 m2 ISO06 and 230 m2 ISO08) plus annexed laboratories for materials and device characterization. The original core of Polifab is a pilot line on 6" (unless specified) for micro-nanofabrication, not specifically dedicated to CMOS and thus allowing the processing of a wide range of materials. It includes facilities for thin films deposition (e-beam and thermal evaporation, PECVD, sputtering (3-4"), electroplating (4"), MBE and PLD on 10x10 mm2), direct printing (ink-aerosol jet printer), optical lithography (mask aligner, laser writer), e-beam lithography (Raith Elphy Plus), thermal scanning probe lithography (Nanofrazor), Etching (wet, RIE, IBE), metrology (stylus and optical profilometer, SEM+EDX+EBSD, AFM (conductive, MFM, PFM), ESCA, probe station (I-V, C-V), spectroscopic ellipsometry), back-end (dicing saw, scriber, ball bonder). Advanced characterization techniques available are: micro-MOKE, Vibrating Sample Magnetometer, in-vacuum/variable temperature probe station for MEMS characterization and magneto-transport measurements, P-E loops for ferroelectrics

In December 2021 we inaugurated a new portion of the cleanroom, additional 250 m2 in ISO06 class, to host new machines and projects devoted to the wafer-scale integration of functional materials in MEMS devices in the framework of a strategic alliance with the AMS division of STMicroelectronics.This is the first step towards the

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

creation of a physical Joint Research Center on "Sensor sysTEms with Advanced Materials" (STEAM) including a further expansion of Polifab for the realization of a pilot line for MEMS prototyping on 8" wafers.
A new cleanroom (1200 m2 of classified area plus 2000 m2 of annexed laboratories) is currently under realization in the Bovisa campus of Polimi, in the framework of a large project for the creation of the "Milano Smart City Innovation Hub". The new cleanroom (move-in of the equipment in 2024) will be in the basement of a building hosting not only academic researchers, but also startups incubated by PoliHub (https://www.polihub.it) and companies units.
The new cleanroom will host all the equipment currently available to the users and installed close to the main campus, plus the new machines foreseen in the framework of the JRC "STEAM". This represents a quite unique example of public-private engagement for the joint realization of a Research and Innovation infrastructure. Despite the investment in new equipment comes mainly from private capital, a portion of the machine time will be available to Polifab users for curiosity driven, Italian and EU projects.
Thanks to this program of Polifab expansion, the facility will make available to users, by 2025, advanced wafer-scale tools for micro- nanofabrication, namely:
-Maskless optical lithography on 8", 300 nm resolution, grey scale, high speed direct writing
-Dual beam SEM+FIB, with TOF SIMS for nanofabrication, TEM preparation, tomography and reverse engineering
-Dedicated wafer scale EBL system
-Automatized photolitho line on 8" for coating, baking, etc.
-Nanoimprinting apparatus on 8"
-3D nanoprinter
-Microscope vibrometer for MEMS characterization
-Station for quantitative measurement of piezoelectric coefficients
-ESCA(SIMS) station for chemical depth profiling
-Cluster tools for confocal magnetron sputtering of metals and oxides on 8-12"
-ALD system
-Pilot line for MEMS prototyping on 8" (PECVD, DRIE, systems for dry HF release, Electroplating, wafer bonder, laser dicing, CMP, back-end and packaging)
This represents the solid background of techniques and know-how the NFFA-DI initiative can be built around, with the creation of a node of a national Research Infrastructure co-localized with an existing Research and Innovation Infrastructure.

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(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

17 National and International collaboration

Polifab is co-founder, of It-FAB, the Italian Network for Micro and Nano Fabrication aiming at aiming at:
-establishing harmonized rules for clean room management, access policies, IP management, accountability and reporting;
-defining joint best practices for reciprocal support and backup,
-promoting interoperability thanks to common data exchange formats;
-promoting access to research infrastructure based on the principles set up by the European Charter for Polifab is co-founder, of It-FAB, the Italian Network for Micro and Nano Fabrication aiming at aiming at:
-establishing harmonized rules for clean room management, access policies, IP management, accountability and reporting;
-defining joint best practices for reciprocal support and backup,
-promoting interoperability thanks to common data exchange formats;
-promoting access to research infrastructure based on the principles set up by the European Charter for Access to Research Infrastructures.
-supporting the establishment of the pan-European distributed research infrastructure EuroNanoLab.
In five years of activity Polifab has established a good connection to other members of It-Fab, in particular CNR-IMM, CNR-Nanotech and FBK nodes which already participate in NFFA-NEP.
According to It-Fab mission, Polifab participates in the Euronanolab initiative (http://euronanolab.eu) , a new distributed research infrastructure consisting of over 40 state-of-the-art academic nanofabrication centers across Europe.
Furthermore, Polifab acts as third party in NFFA-NEP, with in-kind contribution against payment for providing the following services to the NEP action tasks related to clean room processes.
Finally, many groups of POLIMI have a well-established scientific connection to Eettra and FERMI beamlines, for fine-analysis of films and heterostructures deposited in-house.

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

18 Principal investigator for the co-applicant

18.1 Personal data and contacts

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18.2 Digitally signed CV

(See documents uploaded)

18.3 Appointment letter as principal investigator

(See documents uploaded)

b) CO-APPLICANT - Politecnico di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

19 Administrative contact for the co-applicant

19.1 Personal data and contacts

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19.2 Digitally signed CV

(See documents uploaded)

19.3 Appointment letter as principal investigator

(See documents uploaded)

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

11 Legal name; Tax code; VAT number, Legal address

Legal Name	*Università degli Studi di Milano*	Tax code	*80012650158*
VAT number	*03064870151*		

Legal address

Region	*Lombardia*	Province	*MILANO*
Municipality	*MILANO*	ZIP Code	*20122*
Address	*Via Festa del Perdono*	Street number	*7*

12 Legal representative: personal data and contacts

First name	*Elio*	Last name	*Franzini*
Gender	*Male*	TAX Code	*FRNLEI56E19F205V*
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Phone number	*0250312000*	e-mail	*ricerca@unimi.it*

13 Management and research structure

The governance at the University of Milan (UNIMI) is composed by 17 committees, headed by the Rector. The most important are:
Administration Council: strategy definition and management
Academic senate: supervision and verification in the field of teaching & research
Patent Committee: Reviews patent applications
Research Observatory: collects and analyzes information on University research findings.
With a teaching staff of about 2.200 tenured professors and with almost 60.000 students, is the largest university in Italy. Research activities are conducted in 33 Dep and 53 Research centers, with around 8500 scientific publications in the last year, more than 300 patents and 12 active spin-off. UNIMI's researchers occupy leading positions in numerous research programmes at national and international level. 4 technological platforms equipped with next-gen instrumentation are available for implementing research activities: COSPECT (spectroscopic, spectrometric and diffractometric analysis- spectroscopy), INDACO (computing power and data storage), NOLIMITS (imaging – light, confocal and electron microscopy) e OMICs (proteomic and metabolomics). The protection and exploitation of the scientific productivity is a strategic focus of UNIMI. Several patent applications, in co-ownership with partners, have

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

exploitation of the scientific productivity is a strategic focus of UNIMI. Several patent applications, in co-ownership with partners, have been filed to protect such results. This is achieved through a close collaboration among the Research Services Division (deals with all types of grants at national and international level) and the Innovation and Knowledge Valorization Division (oversees all Intellectual Property issues and exploitation of results).

14 Financial Management System

The economic accounting at Università degli Studi di Milano is organized in two integrated systems:

• Analytical accounting

• General accounting

The analytical accounting is based on responsibility centres and on linked cost centres, profit centres, investment and project management and it is fed by results of the annual forecast budget. Thus, we maintain a separate accounting system for all transactions relating to each project.

Financial statements on accrual basis of accounting include information not only on past transactions, but also on obligations to pay and money to be received in the future. Also risks and losses of the accounting year have to be noted in the balance sheet, or eventually in the accounts or provisions, even if they occur after the end of the accounting year. The definition of the annual result implies a procedure of identification, measurement and correlation of revenues and costs for each accounting year.

In general, revenues have to be acknowledged when the following conditions occur:

1. The good and services production process has been completed;

2.The substantial (not formal) transfer of title has already been completed. This phase is represented by the shipment or when the services have been delivered and can be invoiced.

Costs have to be correlated to accounting year revenues:

1. With a causal association between costs and revenues;

2. With transactional profit split on a systematic and rational basis (for example the depreciation)

3. With the direct allocation of costs to the profit and loss account when: a) the costs incurred in the financial year terminate their economic benefit in the same financial year; b) their economic benefit cannot be evaluated in the future; the causal association and the systematic transactional profit split are not useful.

The economic accounting is an integrated process of quantitative registration, allowing to systematically monitor and control all the economic and financial transactions.

15 Specific skills of the applicant with respect to this proposal

The Physics Department of Università degli Studi di Milano (Unimi) contributes to research infrastructure design, coordination and services in the domain of analytical physics of matter since FP7. Unimi was one of the nodes of the European Theoretical Spctroscopy Facility, active under FP6 and FP7 to provide theory and simulation in connection with advanced spectroscopy experiments typically at

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

synchrotron radiation facilities. This activity has been largely included in the Theory Facility of NFFA-Europe since 2015 (currently under NFFA-Europe PILOT -NEP). On the experiemtnal side Unimi provides access to cluster-beam sources for nanostructured functional materials as a facility of NFFA-Europe and NEP, and surface-science characterization methods. The Physics Department of Unimi has been involved since 2014 in the StR-ESFRI support project to ESFRI and has been editor of the Roadmaps 2016, 2018 and 2021. Giorgio Rossi of Unimi has been chair of ESFRI until 2018 and coordinator of NFFA since the first design study in 2008. During that time 3 ESFRi-Scripta books on long term sustainability, industrial usage of RIs and on the neutron landscape of Europe were edited by Unimi. Giorgio Rossi was the chair of the High Level EC Group on long term sustainability in 2019-2020. The proposant's skill range from service provision of advanced theory methods to users, in combination with experiments, or to cluster-growth projects through the combined NFFA-Europe proposals. Novel laboratories for magnetic surface microscopy based on Spin-Polarimetry and scanning probes do enhance the offer by Unimi to NFFA-DI with unique methods at international level.
Training in connection with research infrastructures is one of the skills of Unimi as it participates as work-package leader to the RITRAIN-Plus EC action for advanced training of Research Infrastructure Managers. Several PhD students of Unimi actually perform their research at NFFA in Trieste.

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(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

16.1 OU [1] - Name, location, and contact person

General Information

OU Short Name	*UO 11*	OU Name	*UNIMI - Dipartimento di Fisica*
OU Type	*Laboratory*		

Address

Region	*Lombardia*	Province	*MILANO*
Municipality	*MILANO*	Address	*via Celoria*
ZIP Code	*20133*	Street Number	*16*

Contact Person

First name	*Giovanni*	Last name	*Onida*
Phone number	*0250317402*	e-mail	*giovanni.onida@unimi.it*

16.2 OU UNIMI - Dipartimento di Fisica - Scientific-technological expertise and experience

The UO "department of physics" is developing, among others, specific research themes: i) the synthesis of nanostructured materials with advanced functionality by evaporation techniques, molecular beams, and deposition of nanoparticles; ii) the physico-chemical and structural characterization of nanoparticles by mass spectrometry, electron-ion coincidences, and deep electron level spectroscopy with synchrotron light; iii) the design of materials and nanostructures, with theoretical-computational methods based on first principles. The department hosts since 2001 the Milan node of the European Theoretical Spectroscopy Facility (ETSF), a distributed reasearch infrastructure stemming from the European Network of Excellence "Nanoquanta" and the e-i3 ETSF EU-funded projet (Grant Agreement n.211956). Moreover, since 2015 it hosts the Milan node of the Theory and Growth Installations within the NFFA-Europe infrastructure. The UO participates in the NFFA-Europe distributed infrastructure as an access provider to instrumentation and skills in the areas: Theory and simulation, Synthesis and fabrication, Lithography and patterning, Measurement and characterization. The department director is Prof. Giovanni Onida, who has been the local PI for UNIMI within to the NFFA-Europe initiative (H2020 programme, G.A. n.654360) and coordinates the participation of UNIMI to the EU-funded NFFA-Europe-Pilot (NEP) project (G.A. n. 101007417, from 1/03/2021 to 28/02/2026). G.O.'s scientific production (ORCID: 0000-0001-9532-5083) includes More than 140 papers, of which about 120 are published in international journals with referee (11 in Physical Review Letters), 1 invited review paper on Reviews of Modern Physics, selected in 2004 and 2008 as one of

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

the "most cited papers in physics" by the ISI Essential Science Indicators (http://archive.sciencewatch.com/dr/erf/2008/08octerf/08octerfOnidET). On January 2022, G.O's h-index is 35 (Scopus) with a total number of citations above 10300.

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

17 National and International collaboration

UNIMI is constantly developing projects in cooperation with some of the most relevant international research groups. It is the only Italian member among the prestigious Universities of the League of European Research Universities (LERU).
EU programmes represent a major source of funding for UNIMI, which has signed 182 grants under the Horizon 2020 Programme. During the period 2014-2021 it has also signed additional 60 grants under other funding programmes and initiatives. Up to now, UNIMI is participating in around 45 COST Actions.
UNIMI is part of the 4EU+ Alliance with the Sorbonne in Paris, the Charles University in Prague, and the Universities of Copenhagen, Heidelberg and Warsaw.
It is actively promoting its internationality with English being the official language in the 31 PhD programmes, and the only language in one Bachelor programme and 10 Master. Other courses are partially held in English. Exchanges of students, scientists and professors are also encouraged and promoted through exchange programmes (e.g. Erasmus+, Lifelong Learning, Socrates, Business Exchange and Student Training, Fulbright, Galileo, Vinci, Vigoni), and several specific international agreements.

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

18 Principal investigator for the co-applicant

18.1 Personal data and contacts

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18.2 Digitally signed CV

(See documents uploaded)

18.3 Appointment letter as principal investigator

(See documents uploaded)

b) CO-APPLICANT - Università degli Studi di Milano

(The information provided in this section will be evaluated with reference to criteria A.3 and A.5)

19 Administrative contact for the co-applicant

19.1 Personal data and contacts

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19.2 Digitally signed CV

(See documents uploaded)

19.3 Appointment letter as principal investigator

(See documents uploaded)

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

20 Project title and acronym

Project title	*Nano Foundries and Fine Analysis Digital Infrastructure*	Project acronym	*NFFA-DI*

21 Duration of the project (in month)

Project duration	*30*

22 Project type

(i) Strengthening of an existing RI among those listed in NPRI with high priority

23 Research Infrastructure(s) targeted by the project

RI : NFFA - Nano Foundries and Fine Analysis

ESFRI domain	*PSE*	Capofila	*CNR*
RI Type	*Phisical Sciences and Engineering*	RI priority	*IR a priorità alta*

24 Proposal ESFRI domain

PSE

26 Free Keyword(s)

Nanoscience, Fine-Analysis, FAIR-by-design Data, Integrated RI services, material synthesis/growth, digital infrastructure

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

27 Publishable project abstract

NFFA-DI is the NFFA upgrade proposal for realizing a Full-Spectrum Research Infrastructure for nanoscience and nanotechnology, capable of enhancing the Italian research competitiveness on the fundamental interactions of multi-atomic matter to explore the origins of materials behaviour at all relevant dimensional and temporal scales, to describe, understand and design material solutions for engineering innovation. The rationale of NFFA-DI is to integrate nanofoundry laboratories, i.e. facilities for atomically controlled growth, structural characterization of nano-objects and nano-structured materials, including upscaling the most promising systems to the level of intermediate TRL developments, and the experimental facilities for the fine analysis of matter using synchrotron and FEL radiation (at Elettra and FERMI), therefore raising the quality, reproducibility and overall competitiveness of Italian research in nanoscience, and full integration within the European RI ESFRI landscape. NFFA-DI creates a unique environment for basic nanoscience and advanced technologies, bridging the gap between fundamental research on quantum matter and functional micro-systems for the digital transformation. The upgrade will enable frontier research projects by users, enhancing the scientific competences and productivity of all nodes, along with the continuous upgrade of the RI. Mission oriented research at EC level and NRRP Centres and Partnerships will also exploit access to NFFA-DI. The combined digital access to a wide portfolio of services through a Single-Entry Point and Catalogue of state-of-the-art experimental and computational resources and FAIR-data services covers the whole value chain from material discovery to industrial technology transfer. It will become a reference RI in Europe, with huge potential for the acceleration of the digital transformation of research and society. Co-location with synergic NPRR initiatives will enhance the overall impact.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

28 Extended abstract

Disruptive results for the green and sustainable nanotechnology transformation, require extremely high control of materials and sensitive experimental probes of energy, space and time, and advanced numerical simulation. NFFA operates since 2011 as a user facility of CNR-IOM and Elettra in the AREA-Science Park Campus Basovizza-Trieste, integrating competences, facilities and data services. Since 2015 NFFA-Europe has implemented the concept of integrated access facility for carrying out full-spectrum research projects on nanoscience and nanotechnology: science services to users integrate material synthesis and design, nanofabrication, characterization with atomic resolution and fine analysis with radiation sources and theory as provided by over 30 national research organizations, universities, synchrotron facilities and industry. NFFA-DI is the upgrade of NFFA to become an interoperable distributed research infrastructure for nanoscience and nanotechnology, introducing FAIR-by-design technology in all upgraded laboratories, therefore contributing to the Italian and European research competitiveness. The nodes of NFFA-DI are distributed on the Italian territory and provide complementary competences and facilities; collectively the nodes have served about one thousand users over the last 5 years. NFFA-DI will realize the Digital goals of NRRP by creating an overarching FAIR data management system which builds on the implementation of the FAIR-by-design technology on all experimental and computational resources. The FAIR data/metadata system will enable the interoperability of protocols, access procedures, training modules and RI monitoring. A single-entry point (SEP) for access to information and project submission will display a unique digital catalogue of methods, facilities and competences. A centralized technical authority, involving all nodes, called Technical Liaison Network (TLNet), will establish the feasibility and the best work-flow for the peer-review prioritized research. NFFA-DI shall become interoperable: sample exchange under proper conditions will enable subsequent analysis steps at different nodes, regulated online access to FAIR data/metadata, online data analysis and numerical simulation of the results. Further digitalization will include artificial intelligence (AI) instruments and pilot digital twins. All NFFA-DI upgrade of instrumentation will implement FAIR-by-design technology solutions, which require specific extra investment, but guarantees highly automatized FAIR data production. Joint exploratory research will focus on the continuous innovation of RI services. NFFA-DI will feature advanced material growth methods, clean-room writing/nanofabrication processes, high throughput imaging facilities, fine analysis methods based on highly focused EUV few-fs pulses, advanced electron microscopy, numerical simulation for basic research as well as for material architecture and device design. Upscaling facilities will transfer results on quantum materials (e.g. 2D) onto 6-inch wafers to explore interfaces and architectures integration with CMOS industry standards. The integrated offer will enable all combinations of materials fabrication and fine analysis to meet the needs of users as well as those of the NRRP Centers (e.g the Center for HPC regarding AI and Digital-Twin of selected experimental setups), Partnerships and EU-Missions, as will support in-house frontier research. NFFA-DI adopts an innovative access programme identifying different user classes: a) academic research proposals aimed at publication of novel scientific results, involving young researchers; b) academic long-term research proposals backed by support contracts (EC, Missions, ERC, PRIN, PON, etc.); c) proprietary research by private organizations (industry, services). Access of a-type will be free of charges, with limited contribution against the cost of consumables. Access of b-type will be based on a negotiated contribution by the user. Access of c-type will be based on a per-day cost model. Access will be performed in the standard hands-on mode (national and transnational) and/or exploiting effective remote usage options.
The digital infrastructure will define and implement FAIR-by-design standards for all data-generating instrumentation, enabling users and staff to be suppliers of interoperable data and protocols (EOSC readiness) with minimal effort, and overcoming the critical

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

and staff to be suppliers of interoperable data and protocols (EOSC readiness) with minimal effort, and overcoming the critical reproducibility of frontier research results. Common metrology and FAIR protocols will be beneficial to national and international research as reliable references for researchers and companies addressing high TRLs. Valorisation of research results and IP generation, with ad-hoc protection rules, and technology transfer activities will be the outcome of FAIR digitalization. Opportunities for supporting spin-off activities linked to the RI, or start-up entrepreneurship exploiting research results, will be created also in connection with specific regional or industrial actions.

The in-house research of NFFA-DI nodes, upon the upgrade, will reach a higher level of competitiveness at the frontiers of nanoscience. Exploratory methodological research will generate a continuous upgrade of the open-access facility in the 10-year perspective beyond NRRP.

The NFFA-DI training programme will include dedicated schools and workshops, webinars and personalized stages and exchange/rotation of research and management staff. Master and Ph.D. projects will be established at the participating universities. This will provide unique opportunities for young scientists to add NFFA-DI to their research tool-kit, to become acquainted with the full range of methods, techniques and digital services. The risk analysis of the upgrade concerns timing of procurement and hiring. The future operation of NFFA-DI will be resilient against interruptions of service due to temporary unavailability of resources (programmed maintenance or unexpected breakdown of instruments) as an optimised level of redundancy of the basic science services present in different nodes will allow real-time adaptation of the work-flow.

In view of the NFFA-DI 10-year operation after the completion of NRRP, the Agreement among co-proponents engages them to adopt a suitable organization ensuring smooth operation and potential inclusion of new actors, public and private, contributing with new resources, enhancing competitiveness in EU calls, in the research and data market, and internationalization for the long-term sustainability of the RI. The impact of NFFA-DI on research will be highly positive, as well as the socio-economic impact on all territories hosting the nodes. The governance structure of NFFA-DI will ensure the upgrade under NRRP and the 10-year operation: a Coordination Committee, a Strategy Committee, an Executive Board of Directors and the Infrastructure Manager will support the Coordinator; advise will be provided by a fully external Scientific and Technical Committee (STC).

The NFFA-DI upgrade is organized in 8 work-packages (WPs) dedicated to the key objectives, each coordinated by a leader and articulated in several activities, each one attributed to single operational unit and detailed in other parts of the document (UO). WP1 sets up the Management of NFFA-DI suitable for the upgrade phase under NPPR and for the 10-year operation phase to follow. Main objectives are the effective Project management and the Strategy for Long Term Sustainability. The Activities involve CNR-IOM, AREA and CNR-IMM@CT and will build the governance, monitor the procurement/tender decisions, the timely progress according to GANTT, the Data Management Plan, and the future model for the RI during operation.

IOs include: Start-up of all activities at BIM4; Data Management Plan adoption at BIM5; Analysis of the activities of the project at BIM7/10/13; Draft of bylaws of future consortium at BIM8; Identification of the most suited methodologies for the FAIRness/definition of the baseline/analysis of the post-upgrade situation of the scientific outcomes at BIM9/12/15; Identification of a model for the integration in the Eu landscape at BIM14. The deliverables correspond to the achievements of the above IOs. WP2 sets up the new scheme for a Digital Operational Workflow of the RI for user-dedicated services. Main objectives are the development and test of a fully digital operational workflow as a single integrated distributed RI with a single database, and of a harmonized access

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

plan integrating multiple types (free of charge/proprietary/...) and new solutions. The Activities involve CNR-IOM, AREA, UNIMI and CNR-IFN@CT and will setup the access scheme and interoperability protocols, the real-time monitoring of integrated access provision, the setup of the Single Entry Point (SEP) and Digital Catalogue, of the Technical Liaison Network (TLNet), and of the scientific access review panel (ARP). IOs are: Procedures for real-time monitoring at BIM4; Design/ publication of SEP and Digital catalogue at BIM5/8; Digital workflow for access at BIM6; Start of central TLNet coordination at BIM7; Interoperability protocols at BIM9; Scientific evaluation protocols at BIM10. The deliverables correspond to the achievements of the above IOs.

The WP3 sets up the Digital Structure of NFFA-DI and Overarching FAIR Ecosystem for Data System (OFED). Main objectives are the development and test of the digital setup, of the fair data services, of metadata, data sharing and repository, integration with EOSC, and ICDI, alignment with PNSA (Open Science). The Activities A.3.1-A3.2 are under responsibility of AREA to develop FAIR-by-design technology and FAIR data services. A3.3 until A3.13 involve all UOs for implementation of FAIR-by-design technology in their own facilities. facilities. IOs are: Survey of current FAIRness and plan for action at BIM5; Upgrade of ORFEO at BIM9; Releases of OFED at BIM9 and 13; Metadata system for OU upgrade at BIM10; FAIR-by-design modules at BIM10 and 14; FAIR-by-design research data at BIM15. The deliverables correspond to the achievements of the above IOs.

The WP4 coordinates the Upgrade of NFFA instrumentation of all nodes to the international state of the art. Main objectives are the absorption of the largest fraction of budget for a major upgrade of all UOs to perform competitive services with state-of-the-art FAIR-ready instruments in all INSTALLATIONS. The Activities A4.1-A4.2 are under responsibility of CNR-IMM@BO and UNIMI to identify the technical needs of all UOs for the new setups and the coordination of the strengthening of all nodes. A4.3 until A4.13 involve all UOs for upgrading their own facilities.

IOs are: Complete overview on tender/procurement status at BIM5; identification of tenders and advance payments at BIM6; Completion of the acquisition procedures for items under 139 keur (NET) at BIM7 and 12; Intermediate payments at BIM9/12/14; Installation and commissioning of instruments above 139 keur NET value at BIM10/13/15; Preparation of the premises for the new instrumentation at BIM11; Definition of the needs for a constant technical upgrade of the facilities at BIM15. The deliverables correspond to the achievements of the above IOs.

WP5 engages all nodes for the Commissioning of access to the upgrades and community building Main objectives are the dissemination and community building (A5.1 CNR-SPIN) and (A5.2-A5.12 all UOs) the commissioning of access according with the new digital model and through the two test calls at M21 and M26. IOs are: Complete TLNet structure at BIM7; Digital catalogue of pre-upgrade instrumentation at BIM9; Personalized laboratory DMPs at BIM9; First/second test call for access at BIM10/15; Digital catalogue of upgraded/new instruments at BIM12. The deliverables correspond to the achievements of the above IOs.

WP6 designs and delivers New Research Support Services: Access provision through advanced methods and technology; Intellectual Property management; Technology Transfer

Main objectives are the digital technology for user access, operative collaboration method with Centres and Partnerships, knowledge transfer and AI augmented platform for selected experiments. The Activities A6.1-A.5 include Interactive Remote Access, Virtual Access, IPR, Technology Transfer services, and prototyping an AI platform for augmented experiments. A.6.6 will develop the in-silico augmented experimental platform.

IOs are: IRA procedures and guideline at BIM6 and 12; Graphical interfaces and standardized workflows for simulation tools at

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

BIM8/14; Virtual Access Services at BIM9 and 15; Helpdesk and Digital portfolio at BIM9/14; AI-augmented research infrastructure facility at BIM15. The deliverables correspond to the achievements of the above IOs.
WP7 is devoted to Strengthening competence and leadership in research services through in-house research Main objectives are the development of full competence (upskill) in exploiting the new/upgraded instrumentation through in-house experiments, to be fully operational as RI providers, and to perform, in some cases, exploratory research of novel methods and instrumentation for continuous future upgrade of RI. The Activity A7.1 (POLIMI) explores synergies among nodes through upskill in-house research. The Activities A7.2-A713 describe post-commissioning upskill measurements by all UOs. The Activities A7.14-A7.20 describe exploratory developments for future upgrades by several UOs. IOs are: Organization and start of the purchase procedure for innovative equipment at BIM6; Deliveries of instrumentation for exploratory research, protocol design and innovative methods at BIM9 and 12; Start of research with the new instrumentation/developments at BIM14; Completion of innovative research test activities with the new instrumentation at BIM15.The deliverables correspond to the achievements of the above IOs.
The WP8 is devoted to Training of a new generation of RI operators and users of NFFA-DI and analytical RIs to address scientific and social challenges
Main objectives are the internal and open training on usage of the digital infrastructure, associating FAIR-Data Stewardship and scientific/technical skills on upgraded instrumentation, with focus on advanced infrastructure practices of general interest, webinars, MSc and Ph.D. bursaries, long term programme and outreach. WP8 will be built upon Actions involving all UOs: a) Establishing a training network among all nodes; b) Establishing a FAIR-data training programme; c) Support for specific training of RI managers; support for participating to dedicated webinars; managerial staff exchange among headquarters and nodes; d) Webinars and Schools; e) 5 PhD bursaries for research projects including residency at more than one node of NFFA-DI. Design of a new PhD Course. Each UO will carry its Activity contributing to one or more actions. IOs are: Financing PhD positions at BIM3; Start of training programme at BIM4; Acceptance to RITRAIN school at BIM7; Training of data stewards at BIM10 and 12; Laboratory/user support by data stewards at BIM13/15; Training of users and young researchers for the usage of the upgraded RI at BIM15.The deliverables correspond to the achievements of the above IOs.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

29 Objectives and ambition

The General Objective of NFFA-DI is to enhance Italian competitiveness in nanoscience and nanotechnology by creating a unique integrated research environment for user projects proposed by academic scientists and by application-oriented technology developers. Nanoscience is the frontier research on the fundamental interactions in multi-atomic matter and explores the origins of materials behaviour at all relevant spatial and temporal scales, in the effort to describe and understand materials and their potential use for disruptive nanotechnology applications in all domains. Raising the quality and reproducibility of research in nanoscience defines the rational for a Research Infrastructure integrating nanofoundry laboratories, i.e. facilities for atomically controlled growth and structural characterisation of nano-objects and nanostructured materials, including capabilities of upscale to meet the requirements of technology developers, with facilities for the fine analysis of matter based on radiation sources and advanced computational methods.

Research on nano-structured matter and its quantum behaviour requires a suite of advanced methods for producing material samples of highest quality and reproducibility in combination with high resolution fine analysis tools. In fact, quantum effects and order parameters, such as ferroic behaviour, magnetism and superconductivity, depend on fine details of the energy landscape, being highly sensitive to structure, defects, strain fields, compositional changes, vacancies or doping levels. Reliable interpretation of the results at the nanoscale depends on the integrated availability of the above research capabilities, which cannot be afforded by individual academic or industrial laboratories.

Gaps exist in the current organization of research, e.g. between the researchers specialized in growth and characterization of materials and the experts of high energy resolution spectroscopies based on synchrotron radiation or laser HHG-sources, or with developers and practitioners of ab-initio theoretical analysis and numerical simulations.

Even more serious is the gap between application-oriented developments (e.g. functional microsystems) and fine characterization and analysis methods. These gaps currently delay the overall achievements in nanoscience, and reduce the impact of the results. By integrating in a single-entry research infrastructure the coordinated access to the above capabilities, with advanced interoperable services and FAIR data management, will boost the Italian and international research in different domains that need nanoscale sensitivity and nanoscience competences.

The NFFA-DI Catalogue of methods and instrument facilities for access is organized in INSTALLATIONS that define distributed ensembles of complementary instruments and methods that are needed to carry out a given aspect of the research, like growth, lithography, microscopy or spectroscopy, theory. The Unit of Access (UoA) is the quantum of service of NFFA-DI: it represents one day (8-hour) of work using an INSTALLATION at a given node, or one 8-hour shift at continuous operation facilities, warranting the completion of a significant step of the research. Nanoscience projects, involving many work steps with different instruments and methods, will be granted the optimal number of UoAs at the different INSTALLATIONs. NFFA-DI enhances, through the integration of different INSTALLATIONs, the effectiveness of research projects that expand on the broad catalogue of research infrastructure services. The upgrade builds on the successful model of NFFA-Europe (EU-H2020 RIA 2015-2021 and PILOT

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

infrastructure services. The upgrade builds on the successful model of NFFA-Europe (EU-H2020 RIA 2015-2021 and PILOT 2021-2026):

•A set of Nanofoundry laboratories partly co-Located with Fine Analysis facilites (Elettra at Trieste) and/or with industrial research laboratories and innovation infrastructures (Catania, Milano, Trieste), as well as distributed clean-room nanofabrication and theory facilities. nanofabrication and theory facilities.
•A web-based Single-Entry Point (SEP) guiding the genesis and submission of the users' proposal
•An online digital Catalogue of INSTALLATIONS describing technical, scientific and data-science services and facilities:
•Lithography&patterning, Growth@synthesis, Advanced Characterisation, Theory&Simulation, Upscale-to-intermediate-TRL
•Combined access to two or more complementary INSTALLATIONs (at any combination of NFFA-DI nodes)
•A Technical Liaison Network (TLNet) with central coordination, that assures assessment of technical feasibility of the user's project,
•and optimizes the work plan and access sequence to the relevance nodes for executing the scientifically prioritized projects.
•An independent Access Review Panel (ARP) for the scientific merit assessment with 6-10 independent experts, covering all the science
•domains that can be supported by NFFA-DI.
•A scheme for operation as an Interoperable Distributed Research Infrastructure for Nanoscience and Nanotechnology (IDRIN)

The NFFA-DI project is structured in 8 work packages (WP) each addressing a specific objective (S.O.) and articulated in Actions engaging all the nodes. All WPs and Actions are strongly integrated to optimise the research potential and quality of services to users.

NFFA-DI STRUCTURE OF UPGRADE
WP1: Management - S.O: Project management and strategy for long-term sustainability
WP2: New scheme for a Digital Operational Workflow - S.O: A new model of operational workflow as a single integrated distributed RI, using a fully digital approach in all workflow steps with single data base
WP3: Digital Structure of NFFA-DI and FAIR Overarching Data System (OFDS) - S.O: Making RI research FAIR
WP4: Upgrade of NFFA instrumentation - S.O: Upgrading to the international state of the art the offer of all nodes (Operating Units)
WP5: Commissioning of access to the upgrades and community building- S.O: Strategy for opening access to the upgraded facilities, constant update and expansion of the Catalogue
WP6: New Research Support Services: Access provision through advanced methods and technology; Intellectual Property management; Technology Transfer - S.O: Use of interactive remote access, provision of virtual access, valorisation of research results

NFFA-DI JOINT RESEARCH AND ADVANCED TRAINING SERVICES
WP7: Strengthening competence and leadership in research services through in-house research - S.O: in-house exploitation of upgrades; exploratory research to develop novel methods and instruments.
WP8: Training of a new generation of researchers to the usage of NFFA-DI and European analytical RIs and dissemination

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

activities - S.O: A new generation of researchers trained to formulate their science objectives and research work-programmes by taking full advantage of the interoperable research infrastructures.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

30 Project framework and main expected impact

The NFFA upgrade will enhance the impact on the way nanoscience is done in Italy by implementing the Integrated/Interoperable Distributed Research Infrastructure for Nanoscience and Nanotechnology (IDRIN) that was designed in 2008 (NFFA-FP7) established in 2011 in Trieste and since 2015 in Europe, becoming in 2016 an element of the ESFRI landscape. NFFA-DI builds on the Italian nodes, already connected at different levels by NFFA-Europe. A new generation of researchers on the physics and chemistry of matter, and of engineers of nanodevices, will use NFFA-DI as a unique tool-kit to shape nanomaterials, to investigate quantum properties at the nanoscale, and to upscale those findings that may lead to disruptive technology solutions. Digitally supported access makes NFFA-DI services resilient in case of post-pandemics restrictions of mobility of researchers.

The upgrade of top laboratories performing nanoscience research in Italy, including instruments at the light sources in Trieste, will populate a digital catalogue of advanced services for nanoscience of high relevance for the European Research Area and international scientific cooperation. NFFA-DI creates a unique research environment, accessible through a single entry point and operating in eleven nodes (Operative Units) across Italy. The upgrade does meet the needs of state-of-the-art methods and staffed instrumentation for frontier research across disciplines and will introduce a novel dimension: the possibility of upscaling the results of low TRL research to meet the needs of intermediate TRL development projects. The upgrade of NFFA will impact the organization of research by offering Installations as coherent ensemble of methods for addressing a given aspect of nano-material research, including fabrication of samples for low TRL projects as well as upscaled objects for work at intermediate TRL. NFFA-DI is a translational platform connecting research on quantum effects to wafer-size material architectures and their interfaces with electronic industry standards for effective innovation. NFFA-DI will impact on the digital transformation by systematically adopting FAIR by-design acquisition prototype systems. This major effort, absorbing about 20% of the whole project, including an extra cost (>5%) for FAIR-readiness of new instrumentation, will impact the FAIR-data technology well beyond NFFA-DI. NFFA-DI will develop innovative FAIR data and metadata management practices and services for interdisciplinary research, also impacting the national contributions to the implementation of EOSC through the active participation in ICDI (Italian Computing and Data Infrastructure) and in the EOSC-Association and EOSC-Partnership.

The access to NFFA-DI will be tailored to the main typologies of users, from academic research proposals to long term project-funded academic research, to proprietary research by economic operators (industry, service providers), with special attention to the low and intermediate TRL research needs of SMEs or startup companies. NFFA-DI will contribute to overcome the bottleneck for science-based innovation. The value chain of research will be better connected by NFFA-DI: from basic research to prototype material systems, to technology transfer. The training of a new generation of researchers capable of exploiting NFFA-DI will also impact the development of their autonomy as well as the establishment of a "multiscale" approach in their research projects. The socio-economic impact of the upgrade of NFFA has several strategic components: a) the strategic recovery of competitiveness in research and development of "on chip solutions" for addressing and overcoming the "semiconductor crisis and dependence of Europe" needs integration of translational platforms with fundamental research infrastructures and competences; b) the digital transition must be practised at the most advanced technology level of research instrumentation and protocols that simultaneously can realise some of the key elements of Open-Science, representing a further element of competitiveness for Italy and the ERA; c) free of charge access to the full spectrum of facilities for successful proposals creates an effective right to research fostering the establishment of young independent

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

spectrum of facilities for successful proposals creates an effective right to research fostering the establishment of young independent research groups; d) upgrading Interactive Remote Access (IRA) modes of operation ranging from conventional to full AI-supported remote instrument control, impacts the post-COVID-19 scenario with partial or severe restrictions to conventional mobility of researchers, but also green advantages in terms of Co2-footprint of access to the RI.
Attractiveness of capital investments on the territorial nodes will be pursued also by a suitable organization of the post NRRP 10-year operation phase open to direct participation of the private sector already demonstrated by NFFA-Europe.
The upgrade of NFFA will impact the socio-economy: e) each node will become a reference at European level as far as quality of the new instrumentation; f) the integrated support to research projects will benefit all researchers who will be able to compete at international level overcoming the limitations of locally available resources; g) SMEs, Startups, Industry, Public or Private operators will access a translational platform suitable to support open-innovation, enterprise creation and proprietary projects; h) the training in an internationally well-established RI will create novel paths to reach high visibility and to "navigate" in the European Research Area; i) NFFA-DI will be a structural added value for attracting to Italy ERC-grantees and young researchers considering their overall options to work in research, and to establish their living.

Detailed impacts:
–NFFA-DI will support submission of comprehensive proposals combining all the catalogue options in order to carry out complex research projects on fundamental science and/or extending to intermediate TRL.
–NFFA-DI upgraded resources will represent a translational platform for research across the low to intermediate TRLs impacting on the recovery and resilience of European science and technology facing the semiconductor crisis and international strategic dependence on chip technologies.
–NFFA-DI upgraded nodes are synergistic and will perform services harmonized by the TLNet to reach interoperability, crossfertilization, and overall higher productivity of both users and co-proponents.
–NFFA-DI addresses the long-term sustainability of the Research Infrastructure services by designing and implementing a model strongly focussed on the interoperability of the different nodes and on synergistic upgrade investments.
–A new suitable model of formal agreement for long-term operation (beyond NRRP) will be elaborated, impacting on national RI organization and business model.
–A new generation of researchers will exploit NFFA-DI not only as a user facility, but also as an overarching reference infrastructure for designing and performing comprehensive research projects. Training will be provided in a tailored innovative way, by personalized training associated with access, on-demand webinars, workshops and schools in addition to dedicated PhD programmes.
–Cross-disciplinary and multi-disciplinary research work-plans will be enabled.

The successful implementation of the NFFA-DI model will have a societal impact on the way access to scientific infrastructures is practised by the research and innovation communities, and it is perceived by citizens.
An overarching data management platform will cover all activities of NFFA-DI, from production of FAIR research datasets to economic metadata associated with the access, allowing for new socio-economic analysis of the usage of RIs.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

31 Compliance/consistency with NRRP rules and constrains

31.1 Sustainability of the initiative

31.1.1 Awareness of project timing

The upgrade of NFFA-DI is capital intensive, largely concentrated in WP4 to be under central control, with strict time constraints. A careful scheduling of tender procedures is described below, based on the necessary assumption on the availability of funding authorization for publishing the tender procedures, which are all concentrated in the second, third and sixth bimesters, and of the hiring procedures, similarly to all PNNR projects. The scope of the fixed-term positions is linked with the NFFA-DI management and with the delivery and commissioning of instrumentation, and upskill activity through research which are activities concentrated in the last 8 bimesters, as well as to the FAIR-by-design and FAIR-data management implementation that concerns all nodes to upgrade their data system to the NFFA-DI goals. According to different activities the hiring is present in all WPs. The overall quota of hiring is about 12.62% as NFFA-DI builds on operational nodes and own competences. Criticalities in hiring are connected with the scarce demand, the respect of the gender criteria, and the timing.

The rules of Avviso 3264 requires a tight timing of actions, as delivery and commissioning times that are preliminary to invoice payment can be substantial and with a potential risk of delays at this time of shortage of i.e. semiconductor devices.

Most of the investment for the upgrade is in capital equipment that requires public tender procedures. We have adopted the following schedule:

-All technical descriptions (capitolato tecnico) of instruments/apparatuses for tender shall be ready at the beginning of the project, or within the first bimester;

-Time to publish and complete the tender procedure and assignment of tender: 4 months;

-Time for fabrication/factory-test/delivery 6-20 months according with complexity;

-Time for installation/commissioning/approval 2 months;

-Time to process the invoice and final payment 2 months;

Risk of overall delays of 3-4 months can be assumed.

With those assumptions we have scheduled:

All NFFA-DI tenders with 20-month delivery-time MUST be carried out by second bimester;

All NFFA-DI tenders with 12-month delivery-time MUST be carried out within third bimester;

All NFFA-DI tenders with 6-month delivery-time MUST be carried out within sixth bimester;

This is in compliance with the constraints to identify all the executors of NFFA-DI by end of 2023.

Furthermore all procurement for amounts between 40K€ and 139k€ shall be done without tender before July 2023 and therefore shall be made within third bimester;

We foresee two test-calls for users of the upgraded RI on month 21 and 26. The timing risk connected with the test-calls is that only a fraction of the instrumental upgrades will be ready for access (i.e. commissioned and described on the catalogue), but the mitigation is that users will anyhow access to the full digital infrastructure though the Single Entry Point and FAIR data procedures.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

31.1.2 List of critical risks

There are three classes of risks: risks connected with absorption of budget (1-8), risks connected with gender and FAIR data policy (9-12) risks connected with effectiveness of upgrade and long term sustainability (13-21). All risks are detailed here below.

[Risk number) Description of risk - WP number - Likelihood; Severity - Proposed risk-mitigation]

1) Tender delays - WP4 – medium likelihood; high severity - Full technical specifications at beginning and start tendering with CUP before start

2) Tender assignment failure - WP4 – low likelihood; high severity - Full market exploration before tendering

3) Delivery delays - WP4 – high likelihood; high severity - Explore realistic delivery timing and insert in tender explicit penalty for delayed delivery

4) Commissioning delays - WP4 – low likelihood; low severity - Contribute adequate staff manpower for commissioning

5) Administrative delays – All WPs – low likelihood; medium severity - Contribute adequate staff manpower for invoicing/payment

6) Difficulties in hiring Fixed-Term personnel - All WPs – medium likelihood; medium severity - Strong advertisement campaign on social networks and institutional channels, also national press/media

7) Difficulties in engaging PhDs - WP8 - low likelihood; medium severity - Strong advertisement campaign on social networks and institutional channels, also national press/media

8) Difficulties in engaging post-MSc student with training bursaries involving FAIR data management - WP8 – medium likelihood; low severity - Strong advertisement campaign on social networks and institutional channels, also national press/media

9) Difficulties in respecting gender proportions – All WPs – high likelihood – high severity - Pro-active advertisement for female engaging with NFFA-DI

10) Difficulties in implementing FAIR-by-design solutions in all nodes – All WPs – medium likelihood – medium severity - Strong training of staff and trainees by webinars; encouraged participation to international activities of EOSC-related projects

11) Delays in adoption of personalised DMPs – All WPs – low likelihood; low severity - Assistance by AREA or, if needed, tendering for external expert consulting

12) Delays of integrated tools for NFFA-DI management - WP2 and WP3 – low likelihood; medium severity - Temporary expansion of tools used in NFFA-Trieste and NFFA-EU

13) Underperformance of FAIR-by-design solutions - WP3 – low likelihood; medium severity - Higher level of collaborative effort among nodes and at international level (NFFA-EU)

14) Underperformance of upgraded instrumentation - WP4 and WP7 – low likelihood; high severity - Co-creation of technical solutions with suppliers

15) Difficulties in establishing a proper organizational status for 10-year operation - WP1 – low likelihood; low severity - Extensive benchmarking of suitable solutions at national and EU level

16) Difficulties in design of a robust sustainability plan - WP1 – low likelihood; medium severity - Stronger engagement of Strategy Board and International Experts to strengthen Long Term Sustainability strategy

17) Scarce subscription of test-calls - WP5 – low likelihood; low severity - Higher dissemination and community building effort and international linkage with NFFA-EU and other RIs

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

18) Excessive subscription of test-calls - WP5 – low likelihood; medium severity - Strict selection criteria that will combine excellent science with community building goals
19) Persistent restrictions of mobility hindering user access - WP5 – medium likelihood; medium severity - Enhancement staff effort for Remote Access availability in all modes (Interactive, Mail-in, remote control)
20) Ineffective synergy with Centers/Partnerships – All WPs – low likelihood; low severity - SWOT analysis of collaboration and synergy issues
21) Ineffective synergy with EU programmes (Pillar 1-3) – All WPs – low likelihood; lowseverity - SWOT analysis of barriers to full exploitation of synergies

31.1.3 Economic ad financial plan for the operation of the infrastructure(s) as resulting from the project, for at least ten years starting from the final payment

All UOs operate in existing premises (laboratories, office spaces, general services) and with existing scientific, technical, and administrative staff partially dedicated to the RI operation, including assistance to user prior, during and after the granted/purchased access. The added costs due to RI operation are currently covered by European projects that reimburse the transnational access provide to users according with a definition of unit of access (8h shift/1 day) and its pre-defined standard cost. Additional costs will incur in NFFA-DI connected with the upgrade: 1) consumable material and services for operation of upgraded laboratories; 2) maintenance contracts of equipment that cannot be self-serviced; 3) maintenance and extraordinary maintenance – continuous upgrade – of equipment offered for access; 4) hiring/renewing contracts of staff involved in the project for guaranteeing operativity and to enforce interoperability; 5) hiring/renewing contracts of technical/scientific staff for enforcing FAIR-data operation; 6) hiring/renewing contracts for managerial/administrative functions, including the infrastructure manager position at proper level for 10 years.

Overall, the yearly operational costs of a European RI is estimated <10% of initial investment. Our experience identifies in 7% of the upgrade investment the operational cost that must be added to the current actual cost of the quota of the UO's activity devoted to RI services. This means additional 2.5 M€/year which increases by 50% the current cost of operating the Italian nodes of NFFA (for their RI functions and services). An overall budget of the order of 7.5 M€/year must be sought for sustaining full operation and continuous upgrade.

The benefits concurring to the economic balance are both elements of direct income and elements of indirect income:
1. contributions against access costs by paying users (industry) estimated 5-10%
2. contributions against access costs by long-term proposals supported by grants estimated 1-3%
3. increased competitiveness in acquisition of EC and other international funding; 10-15%
4. increased competitiveness in acquisition of national research funding; 5%
5. Additional contributions from new partners, also from the private sector (after Consortium or equivalent status will be established)
6. Dowry from MUR or equivalent institutional support of RIs; 60%
7. Internationalization of services and cost/benefit analysis

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

The balance of benefits includes the national coverage of advanced digital services for nanoscience and access to state-of-the-art instrumentation and methods enabling young Italian researchers to be themselves competitive in ERC, PRIN and other international competitive funds. NFFA-DI will also strengthen, in a strategic sector, the Italian competitiveness in the nanosciences and Analytical Research Infrastructures and in the application of the EOSC paradigm. NFFA-DI may actually generate within the WP8-Training a relevant number of young researchers/engineers fully engaged in the FAIR data technologies for research, capable of exporting this knowledge in the follow-up of their careers. This is a specific socio-economic benefit that NFFA-DI will bring to reduce the national and European digital divide.

31.1.3.1 Managements Costs

(See documents uploaded)

31.1.3.2 Revenues

(See documents uploaded)

31.2 Brief analysis related to DNSH principle

The NFFA-DI upgrade increases the research capacity of the nodes (clean-rooms, analytical laboratories, growth laboratories, electron-acceleration sources, laser sources, computing/memory facilities) with new instruments of state-of-the-art energy efficiency. The footprint of NFFA-DI is determined by: a) increased heat load in the cleanrooms; b) decreased consumption of cryogenic fluids (LN and LHe); c) increased electricity consumption by sources, mitigated by increased efficiency of the new lasers and data related hardware (computing, storage); d) usage of uninterruptable power from efficient electricity/heat trigeneration of the Basovizza Campus (AREA, CNR-IOM), or geotermic heat pump solutions and photovoltaics (Most UOs in current premises and later in all new or refurbished buildings/campuses under construction); e) increased electricity consumption of data-center and HPC services, mitigated by higher efficiency of setup and workflows; f) decreased footprint due to travel due to increased efficiency in access by remote methods. In the upgrade stage the low footprint solutions must comply with the energy class of the current premises at all UOs, but new/refurbished buildings will be available after 2025 with state-of-the-art solutions for the >10-year operation phase of NFFA-DI. (AREA laboratories in Basovizza 2026, PoliFAB all-new Gasometer Cleanroom, UniMI MIND Campus 2027, NANOTEC building envelope).

In particular: the clean-room facilities will undergo a substantial improvement of energy class; growth laboratories, e.g. Molecular Beam Epitaxy plants, will be upgraded with highly efficient compact systems and 50-70% reduction of cryogenic fluid consumpion (LN2 and impact of delivery by trucks); local He close-circuit liquifiers for experimental stations that avoid He gas waste, expensive procurement of LHe and delivery by trucks; novel gas-line design will optimise the usage and waste of process gases for in-operando experiments. Furthermore, with the trigeneration plant at the Basovizza campus, more than 80% of the gas fuel is effectively converted in useful power, reducing the CO2 emission. Heat pumps and photovoltaics are employed at most UOs to power clean-room and datacenters, contributing about 50% of need, the NANOTEC building will be renovated with high performing envelope and LED lighting. Novel driving laser

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

about 50% of need, the NANOTEC building will be renovated with high performing envelope and LED lighting. Novel driving laser sources for the upgrade of ultrafast spectroscopy beamlines at CNR-IFN, CNR-ISM and CNR-IOM rely on new technology with higher power-to-light conversion efficiency. The datacenter/computing facility's cooling solutions will be optimised to reach PUE 1.2 relying partially on district heating and cooling and to photovoltaic renewable electricity generation; overall power absorption of 40kW and electricity yearly consumption of 30 MWh; and optimization of workloads to increase efficient usage.

The lifetime cycle of NFFA-DI will imply a first 10-year period of operation after the major PNRR upgrade, and an expected overall 20-year operation phase before major re-evaluation of scope and potential re-funding. The full operation cost analysis of the NFFA-DI infrastructure will require monitoring the fraction of the UOs operation for delivering research infrastructure services and the fraction of in-house institutional activities and the implications on the share of general costs, staff, consumables, utilities, maintenance. Nevertheless, it is possible to estimate the operational cost of the upgraded laboratories will be of the order of 7% of the upgrade investment, which will increase by 50% the current operational costs of NFFA nodes. Careful real-cost analysis will be performed, generating FAIR data for monitoring the RI in time and identifying possible improvements on evidence basis.

There is no plan for the decommissioning phase. NFFA-DI has an expected lifetime of 20 years before major reinvestment or reorientation. NFFA-DI is hosted inside institutional buildings that may undergo civil engineering renovation/refurbishment and upgrades in laboratory standards, or possible reorientation of usage, without permanent footprint or hazards created by operation of NFFA-DI services (no radioactive or toxic footprint in the hosting buildings). Low volumes of waste chemicals are lawfully treated and do not accumulate in air or ground or waste waters. Clean-room filters are lawfully recycled or disposed.

The adoption of FAIR-by-design technology is a major, disruptive, improvement of the RI model as data intensive producers do support high costs (manpower, energy) for acquisition of metadata and conversion of raw-data in combined FAIR datasets compatible with the EOSC. FAIR-by-design implies installing low power sensors to automatically digitize measures of key experimental parameters and conditions. The raw-data automatic conversion and combination with the metadata, as well as the data generated by intermediate and final data analysis steps, will minimize the researcher time effort to be compliant with the FAIR principles and ready to exploit EOSC services. At the same time the number of write/readout steps and memory space occupancy will be minimized with a substantial gain in sustainability and energy efficiency. The implementation of advanced remotization of usage with standard and innovative technologies may reduce the footprint of user travel, as well as render NFFA-DI resilient in providing scientific services at times of reduced human mobility.

After a careful assessment on the DNSH principle, in accordance with the Taxonomy Regulation (Regulation (EU) No 2020/852), NFFA-DI declares that in the whole life cycle of the infrastructure, all activities by all the Operational Units do not significantly harm:

- climate change mitigation as it does not lead to significant greenhouse gas (GHG) emissions;

- change adaptation as it does not increase adverse impact of the current climate and the expected future climate, on the activity itself or on people, nature or assets;

- the sustainable use and protection of water and marine resources as it is not detrimental to the good status or the good ecological potential of bodies of water, including surface water and groundwater, or to the good environmental status of marine waters;

- the circular economy, including waste prevention and recycling, as it does not lead to significant inefficiencies in the use of materials or in the direct or indirect use of natural resources, and does not significantly increase the generation, incineration, or disposal of waste, or if the long-term disposal of waste may cause significant and long-term environmental harm;

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

long-term disposal of waste may cause significant and long-term environmental harm;
- the pollution prevention and control as it does not lead to a significant increase in emissions of pollutants into air, water or land;
- the protection and restoration of biodiversity and ecosystems as it is not significantly detrimental to the good condition and resilience of ecosystems, or detrimental to the conservation status of habitats and species, including those of Union interest.

31.3 Brief analysis to FAIR principle

NFFA-DI is structured to perform as a EOSC-ready research infrastructure with two key innovations: a) developing and implementing FAIR-by-design data and automatic metadata acquisition technologies; b) adopting FAIR data principles and their implications not only on the research data, but also on economic data of the RI; c) developing FAIR data services for the interoperability of all nodes (operational units), analytic software, computational instruments; d) realizing a FAIR data archive for the nanosciences with research data, protocols, procedures, also optimizing the reporting activity.
WP2 is devoted to establishing the interoperable distributed infrastructure heavily interlinked with WP3 that develops the FAIR-by-design protocols and instrumentation, and pilots the implementation at all nodes on upgraded instrumentation (WP4) as well as support, along with WP8 the training of data stewards and data expert staff (WP7).
The FAIR data archive, possibly mutuated from the MetaStore of NFFA-Europe, will also connect with recognized open publication archives (Zenodo or similar).
The Single Entry Point will establish a unique identifier to the submitted user proposal that will enter the NFFA-DI database as well as all subsequent steps of proposal processing and access performance (in presence or remote) leading to data and metadata acquisition and storage, data analysis, publishable FAIR datasets, preprints and reprints of scientific papers. The database will also contain economic and administrative data related with the access and other costs related to the project, e.g. consumables, transfer of samples, travel of users, computational costs etc.
The FAIR database will enable, with appropriate authorizations, combinations of data and metadata (FAIR datasets) for research results, but also combination of data for accurate cost-analysis of research at the RI.
The user of NFFA-DI will be prompted with a DMP adapted to their proposal. The users will engage with FAIR data technologies and practices that might be exported to their home-laboratories as a service (possibly against a financial contribution against costs).

The remote access methodologies will also feed into the database, being simple information streams like sample tracking in and in-between facilities (nodes) or complex information connected with remote interaction by video, voice and textual exchanges between user and staff and remote interventions directly on instruments, when enabled.

AI instrumentation will be developed for browsing information through the database, as well as for supporting real-time analytics through digital-twins of selected experimental techniques and apparatuses. This exploratory activity will exploit synergies with specific activities supported by the National Center for HPC supported by PNRR. NFFA-DI will contribute to open science objectives in synergy with ICDI, the Italian Computing and Data Infrastructure, offering unique contents to the competence center an the OPEN-IT infrastructure of PNRR.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

31.4 Gender equality plan

NFFA-DI will fully enforce the European Strategy for Gender Equality 2020-2025 and the Horizon Europe guidance on gender equality plans. The Proponent and Co-Proponents have active policies in support of equal opportunities, non-discrimination, equality and integration of gender perspective. In 2021 CNR, UNIMI and PoliMI published updated Gender Budgeting with disaggregated data essential to define concrete actions to be included in the Gender Equality Plan (GEP), that was adopted in 2021 by PoliMI and UniMI and will be adopted in 2022 by CNR and Area Science Park. The GEP includes: Work-life balance and organisational culture; Gender balance in leadership and decision-making; Gender equality in recruitment and career progression; Integration of the gender dimension into research, teaching, and technology transfer; Measures against gender-based violence including sexual harassment. Specific objectives and actions address the GEP issues, identifying performance indicators, target groups, timeline, responsible entities and allocated resources. The NFFA-DI upgrade offers an opportunity to increase the number of women involved in Italian nanoscience and nanotechnology. GEP's actions will be strengthened by the chances that NFFA-DI will offer to young researchers in the STEM subjects, in terms of recruitment and of career progression and leadership in an open, merit-based research infrastructure environment with high international exposure. The institutional strategies for gender equal opportunities will guide the project starting from the NFFA-DI governance and composition of scientific and decision-making committees. NFFA-DI will perform communication events devoted to overcome stereotypes and cultural biases and attract female students and practitioners in the STEM area. Data and quantitative elements useful for monitoring the evolution of gender balance in all nodes of NFFA-DI will be periodically collected and analysed to seek for mitigation actions if needed.

31.5 Synergies with other proposals within the recovery and resilience plan

NFFA-DI provides unique services for the synthesis, fabrication, and analytics of matter at the nano and atomic scale that are synergical with other relevant research infrastructures of the PNRR-Next Generation EU Plan endeavour as well as with already operational research and infrastructure activities.
Co-location of NFFA-DI headquarters (CNR-IOM) with large scale analytical facilities is in the DNA of the NFFA model. NFFA-DI has headquarters co-located and highly synergical with the independent activities of IOM-CNR and Elettra. Furthermore co-location with AREA Science Park, its industry-oriented activities in scientific and technology-transfer jointly with the industrial-incubator, create a direct link with local as well as national enterprises. Also connections with the Pathogen Readiness Platform (Infrastructure Project PRP@CERIC,coordinated by Area) will create synergies in research on pathogen/surface interactions and potential biomedical devices while strengthening the link with the offer provided by CERIC-ERIC.
Co-Location of two large nodes: IMM-CT and PoliFAB with industrial R&D investments in the domain of microelectronics, and possible co-location in the same sites of Innovation Infrastructure nodes of NPPR as HPMI (High Preformance Microelectronics Infrastruture). The co-location of UniMI with the developing MIND campus ad its industrial research interfaces, as well as with Human Technopole.
Co-Location of PoliFAB with the Center for Sustainable Mobility.

The National Center for HPC, Big Data and Quantum computing has a direct scientific synergy for developing digital integration of

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

The National Center for HPC, Big Data and Quantum computing has a direct scientific synergy for developing digital integration of materials modelling and simulation with the experimental NFFA-DI installations. NFFA-DI will be synergic with the Spoke "Materials and Molecular Sciences" e.g. by integrating HPC real-time applications for supporting spectroscopies.
The perspective PARTNERSHIPS of the PNRR include certainly the broad activity on "Scienze e tecnologie quantistiche" that will benefit from the unique services offered by NFFA-DI on quantum-devices that in the domain of research of NFFA-DI, both by staff and international users. Similarly for "Scenari energetici del futuro" concerning energy materials, "Diagnostica e terapie innovative nella medicina di precisione" concerning bio-medical sensors/devices/drug vectors.
The headquarters support the "Innovation Ecosystem" project on "Materiali e dispositivi per la Sostenibilità degli ambienti di vita e benessere della persona".
Fine Analysis facilities developed by NFFA-DI are, and will be unique at international level for soft-X ray femtosecond science, extending the activities of other initiatives on ultrafast photonics based on laser sources.
At European level the full synergy with NFFA-Europe/NEP (recently extended to 2026 and projected by a MoU among 9 leading European partners towards long term engagements). NFFA-DI will interface all the Large Scale Facilities (LSF) of the ESFRI Landscape (ESRF, ELI, ILL, ESS, ...) and the new configurations of national LSFs (AIRE, LEAPS, LENS, E-DREAMS, LASERLAB) in the novel configuration of ERA. One node (UniMI) is a leading partner of StR-ESFRI (responsible for organizing and editing the ESFRI Roadmaps since 2016) as well as of RITRAIN-Plus the EC project for a permanent School for RI Managers: NFFA-DI will network with managers from all European RIs.
NFFA-DI is synergic with EOSC (European Open Science Cloud) as a champion of FAIR-by-design technology. The extensive implementation of the Digital Infrastructure paradigm will create an EOSC-ready RI. NFFA-DI contributes to ICDI and EOSC Association through AREA and CNR. The PI of UniMI represents Italy in the EOSC-Steering Board. NFFA-DI is highly synergetic with the OPEN-IT upgrade project (CNR) for the Italian open data infrastructure. The ICDI Competence Center is a synergic activity favouring FAIR data culture and implementation.

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32 Total budget for the proposal

32.1 Entire project costs

COSTS (€) ENTIRE PROJECT			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	1.455.400,00	2.836.306,00	4.291.706,00
b. Scientific instrumentation and technological equipment, software licenses and patent	10.652.430,00	15.893.991,60	26.546.421,60
c. Open Access, Trans National Access, FAIR principle implementation	68.799,46	7.320,00	76.119,46
d. Civil infrastructures and related systems	130.511,94	122.000,00	252.511,94
e. Indirect costs, including running costs	870.475,89	1.353.823,15	2.224.299,04
f. Training activities	128.228,40	480.713,52	608.941,92
Total	13.305.845,69	20.694.154,27	33.999.999,96

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) WORK PACKAGE [WP1 - Management]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	75.240,00	390.793,00	466.033,00
b. Scientific instrumentation and technological equipment, software licenses and patent	0,00	0,00	0,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	5.266,80	27.355,48	32.622,28
f. Training activities	0,00	0,00	0,00
Total	80.506,80	418.148,48	498.655,28

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) WORK PACKAGE [WP2 - New scheme for a Digital Operational Workflow]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	0,00	99.297,00	99.297,00
b. Scientific instrumentation and technological equipment, software licenses and patent	0,00	134.200,00	134.200,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	0,00	16.344,79	16.344,79
f. Training activities	0,00	0,00	0,00
Total	0,00	249.841,79	249.841,79

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) **WORK PACKAGE [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	99.306,67	193.326,00	292.632,67
b. Scientific instrumentation and technological equipment, software licenses and patent	15.860,00	2.557.120,00	2.572.980,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	8.061,67	192.531,22	200.592,89
f. Training activities	0,00	0,00	0,00
Total	123.228,34	2.942.977,22	3.066.205,56

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) WORK PACKAGE [WP4 - Upgrade of NFFA instrumentation]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	346.940,00	874.814,00	1.221.754,00
b. Scientific instrumentation and technological equipment, software licenses and patent	10.461.500,00	13.076.401,60	23.537.901,60
c. Open Access, Trans National Access, FAI principal implementation	68.799,46	0,00	68.799,46
d. Civil infrastructures and related systems	130.511,94	122.000,00	252.511,94
e. Indirect costs, including running costs	770.542,60	985.125,09	1.755.667,69
f. Training activities	0,00	0,00	0,00
Total	11.778.294,00	15.058.340,69	26.836.634,69

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) WORK PACKAGE [WP5 - Commissioning of access to the upgrades and community building]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	83.093,33	163.328,00	246.421,33
b. Scientific instrumentation and technological equipment, software licenses and patent	4.270,00	0,00	4.270,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	6.115,43	11.432,96	17.548,39
f. Training activities	0,00	0,00	0,00
Total	93.478,76	174.760,96	268.239,72

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) WORK PACKAGE [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	0,00	253.572,00	253.572,00
b. Scientific instrumentation and technological equipment, software licenses and patent	0,00	0,00	0,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	0,00	17.750,04	17.750,04
f. Training activities	0,00	0,00	0,00
Total	0,00	271.322,04	271.322,04

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) **WORK PACKAGE [WP7 - Strengthening competence and leadership in research services through in-house research]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	817.380,00	822.686,00	1.640.066,00
b. Scientific instrumentation and technological equipment, software licenses and patent	170.800,00	126.270,00	297.070,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	7.320,00	7.320,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	69.172,60	66.939,32	136.111,92
f. Training activities	0,00	0,00	0,00
Total	1.057.352,60	1.023.215,32	2.080.567,92

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.2 For each Work Package (Specific Objective), as per the following table

COSTS (€) **WORK PACKAGE [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	33.440,00	38.490,00	71.930,00
b. Scientific instrumentation and technological equipment, software licenses and patent	0,00	0,00	0,00
c. Open Access, Trans National Access, FAI principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	11.316,79	36.344,25	47.661,04
f. Training activities	128.228,40	480.713,52	608.941,92
Total	172.985,19	555.547,77	728.532,96

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.3 For each project participant (Applicant and co-Applicants), as per the following table repeat the table for each Applicant and co-Applicant.

COSTS (€) PARTICIPANT [CONSIGLIO NAZIONALE DELLE RICERCHE]			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	1.455.400,00	1.690.840,00	3.146.240,00
b. Scientific instrumentation and technological equipment	10.652.430,00	6.850.190,60	17.502.620,60
c. Open Access, Trans National Access, FAIR principal implementation	68.799,46	0,00	68.799,46
d. Civil infrastructures and related systems	130.511,94	0,00	130.511,94
e. Indirect costs, including running costs	870.475,89	604.886,11	1.475.362,00
f. Training activities	128.228,40	100.200,00	228.428,40
Total	13.305.845,69	9.246.116,71	22.551.962,40

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.3 For each project participant (Applicant and co-Co-Applicants), as per the following table repeat the table for each Applicant and co-Co-Applicant.

COSTS (€) **PARTICIPANT [Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	0,00	587.466,00	587.466,00
b. Scientific instrumentation and technological equipment	0,00	4.263.351,00	4.263.351,00
c. Open Access, Trans National Access, FAIR principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	0,00	346.557,19	346.557,19
f. Training activities	0,00	100.000,00	100.000,00
Total	0,00	5.297.374,19	5.297.374,19

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.3 For each project participant (Applicant and co-Co-Applicants), as per the following table repeat the table for each Applicant and co-Co-Applicant.

COSTS (€) **PARTICIPANT [Politecnico di Milano]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	0,00	279.000,00	279.000,00
b. Scientific instrumentation and technological equipment	0,00	4.077.850,00	4.077.850,00
c. Open Access, Trans National Access, FAIR principal implementation	0,00	7.320,00	7.320,00
d. Civil infrastructures and related systems	0,00	0,00	0,00
e. Indirect costs, including running costs	0,00	317.149,25	317.149,25
f. Training activities	0,00	166.533,52	166.533,52
Total	0,00	4.847.852,77	4.847.852,77

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

32.3 For each project participant (Applicant and co-Co-Applicants), as per the following table repeat the table for each Applicant and co-Co-Applicant.

COSTS (€) **PARTICIPANT [Università degli Studi di Milano]**			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	**Total requested grant**
a. Fixed term personnel specifically hired for the project	0,00	279.000,00	279.000,00
b. Scientific instrumentation and technological equipment	0,00	702.600,00	702.600,00
c. Open Access, Trans National Access, FAIR principal implementation	0,00	0,00	0,00
d. Civil infrastructures and related systems	0,00	122.000,00	122.000,00
e. Indirect costs, including running costs	0,00	85.230,60	85.230,60
f. Training activities	0,00	113.980,00	113.980,00
Total	0,00	1.302.810,60	1.302.810,60

c) PROJECT DESCRIPTION

(The information provided in this section will be evaluated with reference to criteria A.1, A.2, A.4, B.1-B.4)

PROPOSED PAYMENT PLAN

Bimester	Payment Amount	Cumulative Payment Amount
3	**268.049,47 €**	**268.049,47 €**
4	**84.816,37 €**	**352.865,84 €**
5	**277.122,51 €**	**629.988,35 €**
6	**10.157.290,26 €**	**10.787.278,61 €**
7	**1.093.064,92 €**	**11.880.343,53 €**
8	**152.798,14 €**	**12.033.141,67 €**
9	**5.474.443,99 €**	**17.507.585,66 €**
10	**1.961.267,17 €**	**19.468.852,83 €**
11	**583.825,60 €**	**20.052.678,43 €**
12	**1.406.239,73 €**	**21.458.918,16 €**
13	**344.253,99 €**	**21.803.172,15 €**
14	**7.673.133,90 €**	**29.476.306,05 €**
15	**4.523.693,91 €**	**33.999.999,96 €**

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
4	Start-up of all activities	62.858,90	62.858,90
5	NFFA-DI Data Management Plan adoption	13.664,97	76.523,87
7	Analysis of the activities of the first part of the project	94.288,40	170.812,27
8	Draft of bylaws of future consortium	27.329,94	198.142,21
9	Identification of the most suited methodologies for the FAIRness of the scientific outcomes	26.835,60	224.977,81
10	Analysis of the activities of the central months of the project	94.288,40	319.266,21
12	Definition of the baseline of the scientific outcomes of the RI before upgrade	26.835,60	346.101,81
13	Analysis of activities carried out in the user access start-up phase	94.288,40	440.390,21
14	Identification of a model for the integration of the NFFA-DI RI in the European context	31.429,47	471.819,68
15	First analysis of the scientific outcomes of the post-upgrade NFFA-DI RI	26.835,60	498.655,28

36 WP title

Management

37 WP number

WP1

38 Start month(relative to kick-off of the project) and **duration** (in month)

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	OU Name	Applicant
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE

40 WP Leader

Cristina Africh (CNR-IOM)

41 Summary of the activities envisaged in the WP

This Specific Objective of WP1 is establishing an effective project management of the upgrade phase under PNRR and strategic governance for ensuring long-term sustainability.
Managing the upgrade of NFFA-DI requires specific instruments as the challenge of absorbing the PNRR budget with the time constraints established by the Avviso n. 3264 imposes a swift management organization, under tight control by the Coordinator and Coordination Committee, and highly efficient monitoring of progress in action, and communication with external authorities. The minimum planned operation of NFFA-DI will extend for 10 years after the end of PNRR and the management setup must be suitable also for running the operation phase with the high flux of users, and the continuous update.
NFFA-DI upgrades the Italian nodes of NFFA-Europe that has a well established role in the ESFRI landscape of RIs with coordination by CNR-IOM. NFFA-Europe is pursuing its long term perspective with an international (EU Countries + CH) MoU projecting its actions beyond the current EC Grant (ending 2026). NFFA has established liaisons with nanoscience organizations worldwide. These assets are reflected in the strategy governance of NFFA-DI that will be established from the beginning with the goal of identifying the best options for long term sustainability.
The evolving landscape of the Italian and European landscape of research infrastructures, through PNRR and other Next-Generation-EU measures, needs to be monitored and participated by NFFA-DI, under guidance of a robust strategy governance.
The governance of NFFA-DI includes: the Coordinator, the "Coordination Committee" as stated in Art. 6 of the "Agreement between Parties", the "Strategy Committee", and the "Executive Board of Directors", the independent Scientific and Technical Committee (STC) as well as, at managerial level, the "Infrastructure Manager" to be appointed with a specific job position.
The Coordinator (CO) is responsible of the project quality and scientific content, and of the consistency of executed activities with the foreseen objectives of the project. The Coordinator may identify a Deputy agreed by the Coordination Committee.
The Coordination Committee (CC) is defined by Art. 6 of the Agreement among parties, it is chaired by the CO and is composed by two members for each co-proponent and by the Financial Officer in charge of the project. It supervises the activity of the Infrastructure

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

members for each co-proponent and by the Financial Officer in charge of the project. It supervises the activity of the Infrastructure Manager and it monitors:
-the expenditures,
-the coherent application of the project timing,
-the fulfilment of intermediate objectives (milestones),
-the submission of the expected deliverables.
Decision-making by the CC will be inspired to consensus. In case of vote each delegation (Proponent, Co-Proponents) will cast one vote. In case of tie the CO will break the tie.
The Strategy Committee (SC) is defined as the strategic board composed of scientific leaders of NFFA-DI, identified by the Coordinator and appointed by the CC, with the responsibility of promoting the best positioning of the RI in the national and international landscape, focusing the leadership potential in the European scene, identify strategic alliance options, orient participation to competitive calls, identify new user communities, promote NFFA-DI in the FAIR data market and in the EOSC. The Strategy Committee may invite external national or international experts in specific discussions of strategic issues. The SC elects its own Chair for a fixed term mandate, renewable. The SC Chair (SCC) refers to the Coordinator and can be invited (even permanently) at the CC.
The Executive Board of Directors (EBD) is the assembly of Contact Persons of all Operational Units. Its role is to verify the alignment of each unit to the timing and quality standards set by the upgrade project, the correct execution of tenders and procurement, the timely hiring procedures of fixed-term personnel, the timely achievement of deliverables, the timely commissioning of new instrumentation and methods and their inclusion in the digital catalogue of accessible services, the active approach to gender balance goals of the project. The EBD refers directly to the CO and CC.
The fully independent Scientific and Technical Committee (STC), made of national and international experts, with advisory role. The STC will identify a Chair among it members and will report with presentations and in writing to the CC. In particular the STC will address:
-quality and performance of the user programme
-quality and performance of scientific production
-need for constant upgrade
-optimise synergies among nodes
The management of NFFA-DI will be largely assured by the Infrastructure Manager (IM) to be hired on a specific fixed term position within 6 months from the beginning of the upgrade project. The role of IM shall be that of performing optimal management of overall resources and administrative effort at all UOs to accomplish the upgrade; ensures proper communication among all nodes and prepares the agenda of decisions based also on inputs from the SC.
A Scientific Secretariat will be put in place to support the CO and the IM by collecting, analysing and producing documents, organizing general (video)meetings.
The management WP defines also the policy for open access to research data and monitors that the upgrades result in an improved scientific quality of the user access outcomes.
According to the upgrade and introduction of INSTALLATIONS supporting also intermediate TRL projects, an upgraded access methodology will be defined, tailored to the new ensemble of user classes enabled to access NFFA-DI.
The set of foreseen activities includes:
A1.1: Implementation of the Upgrade of NFFA-DI, procurement and tender decisions, overseeing the timely progress of the update process (CNR-IOM)
Description: Decisions are made at CC level, including mandate to the CO to act autonomously on issues involving limited economic engagements. The SC will provide all the background material and analytical evidences for decisions of strategic value, of both non-economic and economic character. The decisions may also be inspired by advise from STC.
A1.2: Monitoring, reporting, guidance to the OUs and WP leaders, interaction with MUR (CNR-IOM)
Description: The IM actively monitors the implementation of the project against the original planning: i.e. the accomplishment of WP activities, the bimonthly achievement of the Intermediated Objectives and the prompt request of reimbursement; the timely submission of deliverables, the financial progress. The IM prepares periodic and final reports, manages with the Financial Officer and the Coordinator the dialogue with MUR and ensures optimal management of overall resources and administrative effort to accomplish the upgrade, as well as proper internal communication and prepares the agenda of decisions to be submitted to the CC.
A1.3: Data management plan (AREA)
Description: This Activity formulates the DPM for the entire project and monitors its full adoption by all activities.
A1.4: Preparation of an Organizational Model of NFFA-DI suitable for ensuring sustainable long-term operation (AREA)
Description: A suitable Organizational Model will be designed and benchmarked against successful European RI consortia.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Description: A suitable Organizational Model will be designed and benchmarked against successful European RI consortia.
A1.5: NFFA-DI within the European and International landscape of RIs (CNR-IOM)
Description: This activity will pursue full integration in the evolving European RI scenario, from the participation to EU projects to possible alliances and/or international legal status.
A1.6: Monitoring of scientific outcome of user access (CNR-IMM@CT)
Description: The quality of the scientific outcome of the upgraded infrastructure is monitored. The continuous improvement of user services will be stimulated also by advise of the STC.

42 WP inter-relation with other WWPP

WP1 manages and orients the progress of the whole project.

43 Most relevant outcome:

The main relevant outcome of WP1 is the setup of an innovative management model for the NFFA-DI digital infrastructure well adapted for carrying out successfully the upgrade phase under NPPR, monitoring the timely absorption of the budget. At the same time the model must be fit and robust for the 10-year operation phase that will follow NPPR. Main outcome is the effective organizational model as full digital infrastructure and the sustainable long term strategy. The positioning of NFFA-DI in the evolving European landscape of analytical research infrastructures will be a strategic asset that may include international alliances, in particular within the roadmap of the NFFA-Europe consortium.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Start-up of all activities	4	D1.1 - Full set-up of the governance bodies and operational structure
NFFA-DI Data Management Plan adoption	5	D1.2 - Data Management Plan - First release
Analysis of the activities of the first part of the project	7	D1.3 - First progress report
Draft of bylaws of future consortium	8	D1.4 - Consortium agreement for long-term operation
Identification of the most suited methodologies for the FAIRness of the scientific outcomes	9	D1.5 - Specification report of the PPP related data integration in the NFFA-DI FAIR protocols
Analysis of the activities of the central months of the project	10	D1.6 - Second progress report

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

of the project		
Definition of the baseline of the scientific outcomes of the RI before upgrade	12	D1.7 - Pre-upgrade retrospective monitoring of the NFFA scientific outcomes
Analysis of activities carried out in the user access start-up phase	13	D1.8 - Third progress report
Identification of a model for the integration of the NFFA-DI RI in the European context	14	D1.9 - Report on possible opportunities for the NFFA-DI Ri in the European context
First analysis of the scientific outcomes of the post-upgrade NFFA-DI RI	15	D1.10 - First post-commissioning monitoring report of the NFFA scientific outcomes

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Start-up of all activities	4	KPI1.1 - # of periodic reports submitted
NFFA-DI Data Management Plan adoption	5	Number of sections included in the DMP [possible sections are: 1) type and format of research data generated/collected; 2) methodologies and standards followed; 3) organization and storage of data; 4) definition of responsible for the various aspects of the project's data management]
Analysis of the activities of the first part of the project	7	Number of periodic reports submitted
Draft of bylaws of future consortium	8	Number of benchmarked European organizations
Identification of the most suited methodologies for the FAIRness of the scientific	9	Number of in-house data-sets to test the methodology

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

of the scientific outcomes		
Analysis of the activities of the central months of the project	10	Number of periodic reports submitted
Definition of the baseline of the scientific outcomes of the RI before upgrade	12	Number of analysed pre-upgrade publications, presentations and patents
Analysis of activities carried out in the user access start-up phase	13	Number of periodic reports submitted
Identification of a model for the integration of the NFFA-DI RI in the European context	14	Number of strategic discussions at European level
First analysis of the scientific outcomes of the post-upgrade NFFA-DI RI	15	Number of monitored post-upgrade results and publications

46 WP Intermediate Objectives:

IO Title *Start-up of all activities*

IO Bimestre *4* IO Costs *62.858,90*

IO Desciption

Set-up of the governance bodies and operational structure. Preparation of foreseen periodic reports up to B4

IO Title *NFFA-DI Data Management Plan adoption*

IO Bimestre *5* IO Costs *13.664,97*

IO Desciption

Definition od the NFFA-DI Data Management Plan

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Title	*Analysis of the activities of the first part of the project*		
IO Bimestre	*7*	IO Costs	*94.288,40*

IO Desciption

Monitoring and analysis of activities carried out in the first part of the project. Preparation of foreseen periodic reports up to B7

IO Title	*Draft of bylaws of future consortium*		
IO Bimestre	*8*	IO Costs	*27.329,94*

IO Desciption

Proper legal and organizational structure of the consortium for long-term operation of NFFA-DI

IO Title	*Identification of the most suited methodologies for the FAIRness of the scientific outcomes*		
IO Bimestre	*9*	IO Costs	*26.835,60*

IO Desciption

Assessment of the methodology for implementing the FAIRness of the scientific outcomes generated by user access. Publications, conference presentations and patents (PPP monitoring) will be used for measuring the success of the awarded access packages.

IO Title	*Analysis of the activities of the central months of the project*		
IO Bimestre	*10*	IO Costs	*94.288,40*

IO Desciption

Monitoring and analysis of activities carried out in the first part of the project. Preparation of foreseen periodic reports up to B7

IO Title	*Definition of the baseline of the scientific outcomes of the RI before upgrade*		
IO Bimestre	*12*	IO Costs	*26.835,60*

IO Desciption

Evaluation of the pre-upgrade scientific outcomes to be used as a reference for the monitoring activity.

IO Title	*Analysis of activities carried out in the user access start-up phase*		
IO Bimestre	*13*	IO Costs	*94.288,40*

IO Desciption

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Monitoring and analysis of activities carried out in the user access start-up phase. Preparation of foreseen periodic reports up to B13

IO Title	*Identification of a model for the integration of the NFFA-DI RI in the European context*		
IO Bimestre	*14*	IO Costs	*31.429,47*

IO Desciption

Interaction with the EC, NFFA-Europe and other RIs at European level. Identification of possible opportunities in view of long-term operation within the European context

IO Title	*First analysis of the scientific outcomes of the post-upgrade NFFA-DI RI*		
IO Bimestre	*15*	IO Costs	*26.835,60*

IO Desciption

Application to a first set of post-upgrade results of the methodologies previously developed and tested

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

At OU CNR-IOM
-1 Infrastructure Manager (IM) - rank Dirigente Tecnologo I livello - 24 PM
-1 technologist to create the scientific secretariat supporting the Coordinator and the Infrastructure Manager - rank Tecnologo III livello - 24 PM
-1 personnel unit with Legal-Administrative background specifically dedicated to Activity 1.5 - rank Funzionario IV livello - 24 PM
At OU Area:
-1 technologist acting as NFFA-DI project manager for AREA - rank Tecnologo III livello - 9 PM

At UO CNR-IMM@CT:
- 1 technologist to support activity 1.5 - rank Tecnologo III livello - 18 PM

Scientific instrumentation and technological equipment, software licenses and patent

Cost description: N/A

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

Civil infrastructures and related systems

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Indirect costs

Cost description: Travel

Training activities

Cost description: N/A

48 Activity title

Implementation of the Upgrade, procurement and tender decisions, progress of the update process

49 Activity short name

A1.1

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The Coordinator (CO) convenes at least every four months the Coordination Committee (CC) for an update on the status of the upgrade in all nodes of NFFA-DI. The CC takes decisions on adoption of mitigation actions in case of materialization of risks, ensuring timely progress of all activities. The CC can mandate the CO to take autonomously decisions on issues involving limited economic engagements, for efficient coordination. The CO identifies potential members of the Strategy Committee (SC) among the scientific leaders of NFFA-DI, seeking gender balance, and proposes their appointment to the CC. The SC is convened at least bimonthly to oversee the progress of NFFA-DI, re-orienting the activities if needed, to ensure the best positioning in the National and International RI scenario (see also activity A1.5). Within this activity, the SC will define criteria and elements for an upgraded NFFA-DI user access programme, considering different classes of users: academic research proposals yielding scientific publications will be granted access free of charge with possible contributions by users against the cost of consumables directly used for their proposal; proprietary research against payment of a real-cost-based access price list will be available. Furthermore, an innovation in access will be introduced for long-term research proposals that are backed by research support grants/contracts (EC, Missions, ERC, PRIN, PON, …) that do require an extensive usage of NFFA-DI. This will include a negotiation between users and NFFA-DI nodes on a financial contribution by the users to cover costs directly linked to the access as well as a pre-assessment of the technical/scientific content of the proposal by the NFFA-DI staff.
The fully independent Scientific and Technical Committee (STC) can be contacted by the CO and the SC chair asking for advice on strategic matter.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

100.320,00 €

Cost description: 1 technologist to create the scientific secretariat supporting the Coordinator and the Infrastructure Manager - rank Tecnologo III livello - 24 PM (100.320,00 eur)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

7.022,37 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Day-by-day monitoring, reporting, guidance to the OUs and WP leaders, interaction with MUR

49 Activity short name

A1.2

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-IOM will promptly hire the Infrastructure Manager (IM) according to the prescriptions of Avviso MUR n. 3264. The IM will be in charge of the day-by-day monitoring of the progress of the work, soliciting the timely preparation of the deliverables and collecting all documents, overseeing the progress towards Intermediate Objectives, identifying in advance possible issues and devising proper solutions in liaison with the Executive Board of Directors (EBD). To this end, the EBD will be convened monthly to verify alignment of all UOs with the project timing (GANTT). Major issues will be brought to the attention of the CO and the SC. Timely payment of invoices after delivery and test of the purchased equipment will be monitored and solicited if needed. The IM will also prepare the bimonthly scientific reporting and assist the Financial Officer for the financial reporting and the interaction with the MUR. Proper communication of project decisions to all nodes will be ensured, as well as guidance for the correct implementation of funding and internal rules. Continuous interaction with the WP leaders will be essential to build a complete picture of the progress of the project that need to be always up-to-date as instrumental for the overall control of the effectiveness of the investment. The IM will be invited to SC meetings to present the status of the project and collect indications, preparing also the agenda of decisions to be submitted to the CC.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

164.000,00 €

Cost description: Infrastructure Manager (IM) - rank Dirigente Tecnologo I livello - 24 PM

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

11.480,00 €

Cost description: travel

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Data management plan

49 Activity short name

A1.3

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The DMP will be drafted and delivered by M6 The document is for for the entire project, and describes the measures envisaged to efficiently manage the data collected and generated during the project. It is intended to be a living document in which information can be made available on a finer level of granularity through updates as the implementation of the project progresses and when significant changes occur. The document is therefore versioned in order to keep track of changes and improvements.
Revision will be in any case done at month 18 and then at Month 30. The document will outline how Research Data and personal data collected or generated during and after project completion will be handled, providing guidance to project partners. It describes the standards and methodologies for the collection and generation of data that be applied throughout the duration of the project, as well as the conditions for sharing and publishing such data. This document aims to facilitate the creation of common understanding and, where possible, common practices It also gives indications on the correct management of the data produced, but it is the responsibility of each Operating Unit to implement the correct protocols and FAIR-by-design methodologies. The DMP will present also a quick overview of the forthcoming OFED data services developed at WP3 with the goal to discuss correct FAIR data approaches through their usage.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

12.771,00 €

Cost description: 3 PM of a project manager (TD technologist 3 livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

893,97 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Organizational Model of NFFA-DI suitable for ensuring sustainable long-term operation

49 Activity short name

A1.4

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

Operation of NFFA-DI for at least ten years after the end of the project calls for the identification of a proper organizational model that

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Operation of NFFA-DI for at least ten years after the end of the project calls for the identification of a proper organizational model that engages the participating Institutions and ensures long-term sustainability, both in terms of funding and in terms of operational impact on the institutional activity of the constituting OUs. Different models will be considered and analyzed, benchmarking against successful European RI consortia. The most appropriate options will be proposed for consideration to the SC and the CO, and ultimately to the CC that will be in charge of the involvement of the proper institutional offices. Detailed obligations and operational schemes will become part of the Model as implementation regulations. A business plan will be prepared to take into account the economic impact of a long-term operation and set the basis for a stable and sustainable upscale of the role of NFFA in the Italian RI scenario.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

25.542,00 €

Cost description: 6 PM of a project manager (TD technologist 3 livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.787,94 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

NFFA-DI within the European and International landscape of Ris

49 Activity short name

A1.5

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

A1.5

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

NFFA-DI builds on the well-established role played by the Italian nodes in the NFFA-Europe context, coordinated by CNR-IOM. The full integration of NFFA in the evolving European RI scenario requires first of all alignment of standards and procedures of the Italian RI NFFA-DI with its European counterpart NFFA-Europe. Liaison between the two projects (NFFA-DI and NFFA-Europe Pilot) will allow for identification of possible synergies between national facilities in the participation to EU projects, for example in view of providing continuity to capital investment in the ten years of operation. The integration of NFFA in the European context should consider the opportunity of establishing strategic alliances with leading players and/or an international legal status. To this aim, possible models will be evaluated, taking into account legal and administrative aspects, also in interaction with funding agencies and ministries. The most appropriate options will be proposed for consideration to the CO, the SC and ultimately to the CC.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

88.160,00 €

Cost description: 1 personnel unit with Legal-Administrative background specifically dedicated to Activity 1.5 - rank Funzionario IV livello - 24 PM

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.5 e. Indirect costs

6.171,20 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Monitoring of scientific outcomes of user access

49 Activity short name

A1.6

50 Activity Start month and duration

Activity Start month	13	Activity Duration	18

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The general objective of this activity is the development and testing of the scientific monitoring strategies for user access. The evaluation methods will be systematically applied in the long-term providing fundamental information for the IR management.
The initial stage of the activity will be dedicated to the assessment of the methodology for implementing the FAIRness of the scientific outcomes generated by users. Publications, conference presentations and patents (PPP monitoring) will be used for measuring the success of the awarded access. Two different protocols will be proposed in case of total or partial use of the NFFA-DI support for the generation of the single PPP item. The general rule is that any NFFA-DI data must be "FAIR" if present and discussed in a PPP, therefore it should necessarily contain at least a digital identifier pointing to the related (meta)data. The FAIR principles already implemented will facilitate this bridging also in the case of complex applications since NFFA-DI (meta)data will grow according the "I" ad "R" principles. Detailed description of the NFFA-DI metadata will include also PPP identifier: this requirement is crucial for the automatic monitoring. In strict connection among this activity and WP3, the above protocols will be hosted and made available on the last release of OFED data infrastructure.
An evaluation report of the pre-upgrade scientific outcomes will be prepared as a reference of the monitoring activity. Monitoring criteria will be decided in advance and tested for the pre-upgrade outcomes. Weighted and multidimensional grading rules will be appointed, depending on the typology and the application fields of the PPP products. Ambitious relative qualitative and quantitative indicators for the scientific impact of the upgrades are foreseen, whereas the advancements with respect to baseline NFFA scientific productivity will be

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP1 - Management]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

the scientific impact of the upgrades are foreseen, whereas the advancements with respect to baseline NFFA scientific productivity will be significant already by bimester 15.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

75.240,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, will be focused on the monitoring of the scientific outcomes of the NFFA-DI accesses. The activity requests funding for 18 person months of one technologist (CNR rank: level III), i.e. about half of duration of the project.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

5.266,80 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	Cumulative Costs
4	Procedures for real-time monitoring	13.664,97	13.664,97
5	Conceptual design of SEP and Digital catalogue	71.797,00	85.461,97
6	Definition of the digital workflow for access	26.835,60	112.297,57
7	Start of activity for the central coordination of the TLNet	32.202,72	144.500,29
8	Online publication of digital catalogue and SEP	71.797,00	216.297,29
9	Definition of interoperability protocols	26.835,60	243.132,89
10	Setup of scientific evaluation protocols for users' proposals	6.708,90	249.841,79

36 WP title

New scheme for a Digital Operational Workflow

37 WP number

WP2

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	OU Name	Applicant
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE

40 WP Leader

Roberto Gotter (CNR-IOM)

41 Summary of the activities envisaged in the WP

This work package aims at achieving as Specific Objective a new model of operational workflow for a unique integrated distributed RI, using a Fully digital approach in all workflow steps with common data base. The operational workflow will cover the user interface (different access options and user contribution against costs) and the internal coordination of activities and services.
Specific activities are: a) the development and test of a fully digital scheme of the operational workflow and of the monitoring of all the actions that concur to the access. This is the backbone of the RI to make interoperability effective and sustainable throughout the value chain from proposal to research data to publication and archiving of FAIR datasets.
The creation of the online digital catalogue of NFFA will innovate the presentation of the technical offer of the RI: it will be organized in five INSTALLATIONS describing the ensemble of available tools and methods concurring to the performance of a step in the research: lithography&patterning, growth&synthesis, advanced characterization, theory&simulation, upscale-to-intermediate-TRL. Each installation includes laboratories located at different nodes, all contributing with specialized, or unique, instruments as well as standard diagnostic tools with necessary redundancy. All items in the NFFA-DI catalogue will be presented in a multi-level uniform format (text and images) describing the methodologies, the technical features of the instruments, and the specialization of each node when more than one node is offering options of the same technique in the same INSTALLATION. The technical offer of the RI will be continuously updated by including the upgrades as they come "online" i.e. ready for access.
All the data will populate a unique data base that is the backbone of access provision as it describes the science services and represents the first interactive level with the perspective users. Redundancy of some techniques (e.g. Scanning Electron Microscopy, or X-ray diffractometry) at different nodes is at the same time an element of resilience of the RI in case of down-time of some instruments (failures, maintenance) and an element of interoperability of all methods present in the different nodes. All nodes will align to a common technology for UHV transfer of sample with UHV shuttles that can travel and identical docking stations, and likewise for GloveBox and inert gas protected transfer gears. The data and metadata of each sample will also be available to users and all NFFA-DI nodes.
Users will prepare and submit their proposals through an online Single Entry Point – within the NFFA-DI Website, building on the model developed by NFFA-Europe (www.nffa.eu).
The Single Entry Point, with Catalogue and flow-chart, guides the users to the preparation of proposals for comprehensive research projects, requesting access to more than one INSTALLATION as expected for low TRL research. Other proposals, e.g. with industrial or upscale objectives, may be exceptions to the multi-INSTALLATION rule.
All data of the users project are stored in a central data base and the relevant data are automatically distributed to the RI nodes for the technical feasibility check. Once verified as "feasible", the proposals are made available to an independent, international, Access Review Panel made of highly recognized experts who will evaluate the scientific and/or innovation merit and rank in a short list those projects that deserve granting the access.
Once the TLNet has optimized the access workflow (to one or mode nodes) and schedule of the access-granted projects, the user will be notified by the digital interface to conform the schedule.
Thanks to the digitalized workflow, all steps in the access procedure, from the presentation of the offer to the provision of access, will be constantly monitored in order to timely identify and solve any issue.
The set of WP2 activities includes:

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

The set of WP2 activities includes:
A2.1: Setup of the new integrated access scheme and interoperability protocols. (CNR-IOM)
Description: Procedures and detailed rules for access provision to the upgraded RI, including new nodes, will be established. The integration of all steps needed for user access (submission/TLNet assistance/evaluation/notifications to users/ …) in a new digital work-flow will be implemented. Practical guides for users and providers will be prepared and distributed in the access commissioning phase (see WP5). In particular, the Access Coordination Center (ACC) coordinates the development of the SEP, the implementation of all access procedures and the integration of all nodes in the digital work-flow. Different access models for different users classes will be developed and integrated in a single harmonised access programme. Interoperability protocols and a set of round-robins to be carried out in WP5 will be identified.
A2.2: Development of a new real-time monitoring scheme for integrated access provision (AREA)
Description: The upgraded RI will need a continuous and precise monitoring for optimization of the services to users. This activity will set and test a new model for continuous real-time monitoring, also making use of dedicated online tools. Any issue will be timely reported to the Director of the concerned node for a prompt solution. During the access commissioning phase, bimonthly reports will be transferred to the Strategy Committee and the Executive Board of Directors.
A2.3: Set-up and maintenance of the Single Entry Point (SEP) and Digital Catalogue with digital guiding tools for users to the facilities with interoperability data and status (UniMI)
Description: Development and maintenance of a single online interface for proposal submission, a single data base, a digital catalogue of the integrated offer and related services. The activity may be assigned to an external operator (fornitore di servizi) to be identified according to National and European regulations.
A2.4: Setup and coordination of a Technical Liaison Network (TLNet) (CNR-IOM)
Description: This activity concerns the setup and coordination of the Technical Liaison Network (TLNet) that is in charge of integration across the nodes, development of interoperability practices and their monitoring, and of the management of the technical offer. The TLNet is the technical backbone of the distributed infrastructure. It will ensure the uptake in the catalogue of the upgraded instrumentation, the monitoring of its effective online status, the organization of the access commissioning phase to be carried out within PNRR, and its full implementation for distributing the access to the nodes according to the best option/best schedule for a successful and timely access performance. The activity of TLNet local nodes is part of WP5.
A2.5: Setup of the scientific evaluation of users' proposals (CNR-IFN@MI)
Description: Proposals for access to the NFFA-DI facilities are evaluated by a panel of independent international experts, the Access Review Panel (ARP). Within this activity, a list of international experts potential candidate as Panel members will be identified and proposed to the Coordinator and the Strategy Committee , following the criteria identified in A2.1, and the liaise with the ARP Chair will be established. Access to the relevant technical feasibility data (read only) and communication of the ranking of projects will be integrated in the digital platform.

42 WP inter-relation with other WWPP

Closely linked to all other WPs

43 Most relevant outcome:

WP2 is the core of the Digital Infrastructure that will support the operation of NFFA-DI, from user interface to access work-flow, to technical liaison among all nodes and external scientific control of usage quality.
NFFA-DI draws upon the experience of NFFA-Europe and further develops digital technologies for optimal and transparent processing of access requests and scientific output.
The most relevant outcome is the operational Single Entry Point that represents the interface with users and contains a database structure that enables both internal and external services.
The SEP will guide the formulation of a Workflow for user's proposals through user identification and consultation of the online Digital Catalogue. The user will pick from the catalogue the desired services filling a wish-list that will guide to the preparation of the technical part of the proposal. The procedure leading to submission will have a permanent identifier and the database will be progressively enriched with data on the feasibility of all proposed research steps by the TLNet as well as the science evaluation data from ARP and the associated administrative/economic data, and finally publications, generating FAIR datasets that will be accessible with

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

administrative/economic data, and finally publications, generating FAIR datasets that will be accessible with selective credentials.
Establishing the TLNet is also a major outcome of WP2. The model adopted by NFFA-Europe will be further developed also as a key liaison for the upgrade phase where new instruments will add in a coherent and harmonized manner preparing the upgraded integrated NFFA-DI science services.
The internal services will refer to the database for the operation of the TLNet, though a dedicated dashboard allowing real-time evaluation of technical aspects, update of operation condition of all nodes, planning of round-robin alignment tests for scientific services and protocols, including nanosafety standard and sample exchange solutions. Real time monitoring of the research activity of users will also allow prompt changes of workflow, or mitigation actions in case of accidents (instrumental failure, maintenance downtime) that might delay or reduce effectiveness of the access.
Also the ARP's work will be facilitated by the digital editorial office services that will make the heavy refereeing work of the panel more flexible and with immediate full access to the relevant information. The sustainability of the ARP refereeing of large volumes of user's proposals requires reducing the protocol burden for the referees and for reaching the output ranking, and communicating back to TLNet and with management.
Interdisciplinary projects as well as projects by inexperienced young scientists or by industry or by civil-services will be assisted both by the SEM machine learning services and by the open dialogue with the TLNet. All governance and management organs of NFFA-DI will exploit new database services for developing and analyse useful statistical data and administrative and economic data providing evidence bases for analysing the NFFA-DI sustainability.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Procedures for real-time monitoring	4	D2.5 - Protocols for Real time access monitoring, statistics and analytics
Conceptual design of SEP and Digital catalogue	5	D2.6 - Conceptual design of SEP and Digital catalogue.
Definition of the digital workflow for access	6	D2.1 - Logical schemes for the Digital Work Flow and procedures for user access
Start of activity for the central coordination of the TLNet	7	D 2.8 - TLNet team building and operational modalities
Online publication of digital catalogue and SEP	8	D2.7 - First release of online SEP and catalogue
Definition of interoperability protocols	9	D2.2 - Protocols for sample transfer among nodes D2.3 - Nano-safety protocols
Setup of	10	D2.9 - Scientific evaluation working scheme

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Setup of scientific evaluation protocols for users' proposals	10	D2.9 - Scientific evaluation working scheme D2.10 - Appointment of first Access review Panel Chair and members

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Procedures for real-time monitoring	4	KPI 2.3 - # of compatibility tests on data of NFFA-Europe Pilot project
Conceptual design of SEP and Digital catalogue	5	KPI 2.4 - # of sections designed for SEP and digital catalogue
Definition of the digital workflow for access	6	KPI 2.1 - # of digital workflow steps defined
Start of activity for the central coordination of the TLNet	7	KPI 2.7 - # of digital functionalities of the TLNet digital dashboard
Online publication of digital catalogue and SEP	8	KPI 2.5 - # of functionalities of the SEP KPI 2.6 - # of items in the catalogue
Definition of interoperability protocols	9	KPI 2.2 - # of standardized procedures shared among the consortium
Setup of scientific evaluation protocols for users' proposals	10	KPI 2.8 - # of appointed Access Review Panel members

46 WP Intermediate Objectives:

IO Title	*Procedures for real-time monitoring*		
IO Bimestre	*4*	IO Costs	*13.664,97*

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Desciption

A new model for continuous real-time monitoring of all user-related activities to optimize the services to users

IO Title	*Conceptual design of SEP and Digital catalogue*		
IO Bimestre	*5*	IO Costs	*71.797,00*

IO Desciption

Conceptual design of SEP and Digital catalogue. Contract for SEP development signed. First payment completed.

IO Title	*Definition of the digital workflow for access*		
IO Bimestre	*6*	IO Costs	*26.835,60*

IO Desciption

A logical scheme for the Digital Work Flow will be developed for each step of the integrated access workflow: from proposal submission to technical and scientific evaluation, user-provider exchange, access data archiving and access monitoring

IO Title	*Start of activity for the central coordination of the TLNet*		
IO Bimestre	*7*	IO Costs	*32.202,72*

IO Desciption

The Technical Liaison Network (TLNet) is the technical backbone of the distributed infrastructure. A smooth integration of all nodes requires a timely and precise central coordination. The achievement of this IO implies that all schemes and procedures for central coordination are identified and tested through the sharing of information for filling the digital catalogue.

IO Title	*Online publication of digital catalogue and SEP*		
IO Bimestre	*8*	IO Costs	*71.797,00*

IO Desciption

A Single Entry Point (SEP) for user access will be implemented. Starting from the collection of user data at registration level on the web portal, it will allow proposal drafting, submission, evaluation, scheduling and finally monitoring of access activities. The digital catalogue will be a multi-level compendium of the NFFA-DI offer, including the possibility to access and compare technical specifications of the different instruments. Initial gate to the NFFA-DI RI, it will offer users the possibility to select the most appropriate techniques and methods for the preparation of a comprehensive research proposal through the SEP.

IO Title	*Definition of interoperability protocols*		
IO Bimestre	*9*	IO Costs	*26.835,60*

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Bimestre	*9*	IO Costs	*26.835,60*

IO Desciption

Development of protocols for ensuring interoperability among the different nodes, in view of a multi-disciplinary multi-site execution of complex experimental work-plans.

IO Title	*Setup of scientific evaluation protocols for users' proposals*

IO Bimestre	*10*	IO Costs	*6.708,90*

IO Desciption

Appointment of Access Review Panel members and chair, identification of a suitable evaluation scheme.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

At CNR-IOM:
-1 technologist to support the WP leader for CNR-IOM activities focusing in particular on activity A2.1 in this WP - rank Tecnologo III livello - 12 PM
-1 technologist to support coordination of the TLNet in activity 2.4 – 7.2 PM
AT AREA:
-3 PM of a project manager (TD tecnologo 3 livello)
At CNR-IFN@MI:
-1.5 person-month of a fixed-term researcher hired for the project

Scientific instrumentation and technological equipment, software licenses and patent

Cost description:

At UNIMI
-Setup and Maintenance of the Single Entry point and Digital Catalogue (110.000,00 € net cost + 24.200,00 € VAT)

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

Civil infrastructures and related systems

Cost description: N/A

Indirect costs

Cost description:

-Travel at CNR-IOM, AREA e CNR-IFN@MI
-Minor peripherals, accessories, components and consumables at UNIMI

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

-Minor peripherals, accessories, components and consumables at UNIMI

Training activities

Cost description: N/A

48 Activity title

Setup of the new integrated access scheme and interoperability protocols

49 Activity short name

A2.1

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The activity aims to implement the fully digital workflow for the user research projects with automatic settings and notifications and user-friendly graphic interfaces, allowing for an easy overview of the status of the full access path.
The workflow steps are: (i) users identification for first time users (ii) users proposal submission, (iii) technical feasibility evaluation, (iv) scientific evaluation, (v) final notification and best-suited assignment, (vi) access scheduling, (vii) access execution, (viii) final reporting, (ix) cost statements.
Actions are planned to fit advanced technologies in the e-services, to fit the needs of users and providers, to optimize multi-site and multi-competence synergies. Optimization of access steps provided by several alternative nodes, as well as optimization of access at different nodes to ensure the full spectrum of competences required by the user proposal, will imply considering logistics and multi-site access options for elaborating the final access schedule to propose and agree with the user.
A common set of definitions must be established for the metadata, as automatically generated together with the experimental data (FAIR-by-design, WP3) but also from the workflow, as technical aspects or scientific evaluations, which will make the final access data compliant with FAIR principles. Economic and administrative data will also populate the NFFA-DI database, with reserved access. Interoperability protocols demand periodic alignment of practices, e.g. standardization of sample transfer technology (UHV, protected atmosphere, commercial carriers), nanosafety protocols, remote access practices. In order to enforce this point initial and periodic round-robins will be performed involving all INSTALLATIONS and nodes. An important role in the optimisation of the user work-plans will be thus played by the interoperability status of the instruments, which will be part of the information data for the feasibility evaluation.

54 Activity budget

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.1 a. Cost of fixed term personnel specifically hired for the project

50.160,00 €

Cost description: 24 PM technologist (CNR- III level) for monitoring of the interoperability protocols and access scheme (50% of the time)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.511,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Development of a new real-time monitoring scheme for integrated access provision

49 Activity short name

A2.2

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The activity aims to implement an effective real-time monitoring of the access provided by the nodes integrated in a single digital multi-competence multi-site offer. Starting from data, dealers and actions of the access workflow identified in A2.1, schemes and related tools, will be developed and identified, respectively, in order to allow for monitoring the users access activity progress allowing prompt reaction to the user requests and to implement real-time mitigations to possible emerging criticalities.
Datasets will be identified for specific monitoring needs, and tools will be implemented to be used by properly trained personnel to respond to queries. Configurable dashboards will be implemented to generate and report periodic statistics and analytics of the whole access experience. Datasets, experimental protocols, and tools will constitute a common platform for all the parties, with the challenge to fit it with the specific platforms used by the different partners, who will have thus the added value of an effective tool for a direct internal accounting.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

12.771,00 €

Cost description: 3 PM of a project manager (TD tecnologo 3 livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

893,97 €

Cost description: travel

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Set-up and maintenance of the Single Entry Point (SEP) and Digital Catalogue

49 Activity short name

A2.3

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

The SEP will enable the user to register and navigate the online digital Catalogue that describes the RI technical offer. The user will be guided by SEP to compile a wish-list of techniques needed for her/his research therefore generating step-by-step, also through machine learning tools, the work-plan of the proposal an appropriate sequences of access to facilities of different nodes, to be finally evaluated and agreed. Special attention will be devoted to new users, or industrial users.
The Digital Catalogue will allow to navigate into the technical-scientific and data services and facilities. A higher level will provide the overview of the INSTALLATIONS and techniques for a given application; the intermediate level will describe typical usage, performances and availability at different sites; a lower level will provide and compare technical specifications of the available instruments.
The SEP will be the main source of information data to be managed by the integrated access scheme and interoperability protocols developed in activity A2.1. The SEP will support both users and nodes of NFFA-DI during the full execution of the access workflow, by means of automatic notifications, easy upload and download of documents (e.g. the user's agreed DMP of the experiment), sample tracking data, quick monitoring of the evaluation/scheduling/access status.
The Catalogue will be continuously updated for including new/upgraded methods and instruments and to account for the continuous upgrade programme of NFFA-DI developed in WP4/WP7, as well as to present the real-time monitored availability of the technical-scientific services (uptime statistics, current up/down time, programmed maintenance sessions, failures and repair). It will be used/updated by the local TLNet nodes, and implemented for the data-entry and the management of the individual instruments (technical specifications, applications and contact persons).

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

134.200,00 €

Cost description: Setup and Maintenance of the Single Entry point and Digital Catalogue

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

9.394,00 €

Cost description: Minor peripherals, accessories, components and consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Setup and coordination of a Technical Liaison Network (TLNet)

49 Activity short name

A2.4

50 Activity Start month and duration

Activity Start month	7	Activity Duration	24

51 OU in charge of the Activity

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The user access is based on the services of the Technical Liaison Network (TLNet), a concept of the NFFA FP7 Design Study implemented in NFFA-Europe, and subsequently in the Pilot project NEP as a unique platform for complying with the complexity of the multidisciplinary offer and proposals typology that imply the use of multiple INSTALLATIONS. The TLNet will be implemented as a distributed network consisting of a Central coordinating TLNet node (at the Coordinator headquarters) and Local TLNet nodes at the providers. It is the operative technical hub of NFFA-DI ensuring dialogue with users, local desk-service, technical support, feasibility checks, and processing of proposals. It establishes the technical feasibility of a given proposal through access to one or more nodes, and it formulates work-plans for the user projects and coordinates the interoperability of access to different providers. TLNet combines competences and scientific skills of the consortium in a single access service with a mechanism similar to the peer review system of an editorial board that collects technical evaluations from the NFFA INSTALLATIONS and nodes and formulates the best suited solution for the user project. Following the assignment, the local TLNet nodes will be in charge of access scheduling, and user support before, during, and after the approved user project takes place.
The Terms of reference for the TLNet will be agreed by all nodes and will include:
• technical feasibility must be evidence-based, complete, transparent, timely. It will be evaluated by the facility staff/responsible and must be shared using the dedicated e-tools and procedures
• local autonomous management of activities by each node
• the continuous alignment of best practices among the nodes
The Central TLNet liaises with all Local nodes, communicates to the ARP the list of technically feasible user proposals, and provides overall technical and organizational feedback to the network and to the users.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

30.096,00 €

Cost description: 1 TECNOL III livello - 7.2 PM

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.5 e. Indirect costs

2.106,72 €

Cost description: missions

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Setup of the scientific evaluation of users' proposals

49 Activity short name

A2.5

50 Activity Start month and duration

Activity Start month	19	Activity Duration	12

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The scientific evaluation of the user proposals will be carried out by the Access Review Panel – ARP – composed of independent experts with collective scientific knowledge in micro/nano science and technology. It operates with the spirit and practices of international scientific peer-review to assess the scientific merit of the user proposals. The Panel receives technical feasibility reports of the user projects from the TLNet and evaluation of technical appropriateness/sustainability of the amount of access demanded. The role of the Panel is to assess the scientific merit of user proposals. As a reference the overall (technical and scientific) NFFA-Europe proposal acceptance is 60-65%. When assessed of comparable merit, new users and female Principal Investigators will be given priority. In case of long-term proposals connected with research grants (ERC, PRIN etc.) the ARP will be alerted to consider the full scientific case. Measures will be in place to avoid one user group dominating the access to a given installation or technique.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP2 - New scheme for a Digital Operational Workflow]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

6.270,00 €

Cost description: 1.5 person-month of a fixed-term researcher hired for the project. The activity will be focused on the setup of the scientific evaluation of users' proposals

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

438,90 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	Cumulative Costs
5	Survey of current FAIRness of RI instrumentation and plan for action	181.709,54	181.709,54
9	Upgrade of ORFEO	2.219.180,00	2.400.889,54
9	First release of OFED	36.439,92	2.437.329,46
10	Metadata system for OU upgrade	63.274,81	2.500.604,27
10	First release of FAIR-by-design modules for all OU	355.684,41	2.856.288,68
13	Second release of OFED	27.329,94	2.883.618,62
14	Second release of FAIR-by-design environment for all OU	78.154,94	2.961.773,56
15	First set of FAIR-by-design research data	104.432,00	3.066.205,56

36 WP title

Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)

37 WP number

WP3

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	OU Name	Applicant
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica

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(The information provided in this section will be evaluated with reference to criteria C1-C5)

UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 3	CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 6	CNR-ISM - Istituto di Struttura della Materia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano

40 WP Leader

Stefano Cozzini (AREA)

41 Summary of the activities envisaged in the WP

This work package has the goal to create the integrated data management platform with the digital tools developed in other WPs, providing the integrated and unique set of services for all the users. The activity leverages on the results already achieved within the NFFA-Europe and NFFA-Trieste and further consolidates all of them in a digital ecosystem.
Through planning, developing and deploying the digital setup of the NFFA-DI RI and the Overarching Fair Ecosystem for Data (OFED), a flexible and modular modern architecture will be obtained.
This will represent one of the paramount milestone in a scenario of new digital innovative IT approach.
The platform, embedded with tools and interoperable services to collect, access, share and make available datasets produced within the RI accordingly to FAIR principles, is based on awareness and specific training actions in order to reach the highest levels of knowledge among users, according to the directions set in the Knowledge Management System (NFFA-DI-KMS).

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

users, according to the directions set in the Knowledge Management System (NFFA-DI-KMS).
FAIR approach within NFFA-DI infrastructures will be ruled by open defined and detailed procedures, recipes and guidelines, which will be specifically tailored, top-down classified and organized in a cloud-based document management system.
Both internal and external users will be able to use the contents of the platform, in keeping with the spirit of increasing knowledges among eco-system's users.
All the mentioned activities, strictly correlated and interleaved, will be coordinated and/or acted by AREA, the WP leader. As of today, groups defined are project management (PM), data engineering (DE), services integration (SI), data curation (DC), data scientist (DS).
Internally this will address the Operating Units (OU) team to develop a set of innovative procedures to implement the FAIR-by-design approach in scientific data collection.
The implementation of the FAIR principles should also extend beyond all data exchanged in this infrastructure, e.g. to publications, managing/administrative data and software, by implementing data analysis services, and by capturing the related metadata in order to offer a higher degree of reusability and reproducibility of the nanoscience data and protocols.
The first action (activity 3.1 – acted by PM, DE, SI) consists in planning and developing the overall digital setup to reach the required upgraded of IT Hardware infrastructures on ORFEO, the AREA Datacenter.
Subsequently, AREA staff (SI, DE, DC) will provide basic interoperable services to guarantee fully FAIR complaint approaches to all the scientific data management activities within the RI. Tools and procedures will be developed keeping in mind interoperability-by-design to ensure connection (PM) and compatibility with the European Open Science Cloud (EOSC) set of services.
This first core of OFED implementation will expose a set of interoperable services towards all the NFFA-DI experimental facilities, fully implemented in a FAIR-by-design data collection view.
Software services are built in a flexible, interoperable and modular fashion, in order to guarantee an easy setup of appropriate interfaces for all upgraded instruments and newly acquired scientific platform, while carrying out the project and beyond
The second action (activity 3.2), coordinated by WP Leader staff, will set innovative and state on-line data services and interfaces (PM, DS, DC) on OFED.
In particular, a "find-and-access metadata engine" will be implemented to feed automated data analysis services promoting interoperability and reusability.
In addition, it will be developed a software environment embedded with a set of innovative and state-of-the-art on-line data services, made available through Virtual Access (VA). All OUs will identify and scout data services that should be developed as interoperable modules for further enrichment of VA services for NFFA-DI users. This action will be just sketched in this WP and then completed in WP06.
Activities 3.3 to 3.13, performed by each OUs, aim to develop and deploy interfaces as custom tools and methods to implement FAIR-by-design approaches for any specific scientific infrastructure installed at OU's premises.
The tangible results, obtained step-by-step, are a set of FAIR by-design data acquisition procedures and automatic software methods for metadata enrichment, such as unsupervised procedures that retrieve, collect and assign automatically useful information.
This method will be consistent with "OFED services metadata schema" providing data quality check for any input.
All the mentioned activities and planned actions are part of the "Piano Nazionale della Scienza Aperta", which sets the conditions for a full and qualified participation of the Italian scientific community to the European and international processes toward Open Science.
In this context, this WP will strictly cooperate with the ICDI (Italian Computing and Data Infrastructure) of which AREA is a member. This will favour again European integration toward EOSC ecosystem.

42 WP inter-relation with other WWPP

WP3 interrelates with WP1, WP4, WP6 and WP7

43 Most relevant outcome:

The most relevant outcome is the setup of a complete open Overarching FAIR Ecosystem for Data (OFED) to store and share scientific nanoscience data produced on the NFFA-DI RI and interoperable with EOSC services.
This outcome is reached by means of a hardware upgrade of ORFEO datacenter. As of today, it's to highlight that is hosting all the main data services of NFFA-Trieste, NFFA-Europe Pilot and it offers computational and storage resources for the scientific community.
Hardware and software components of ORFEO datacenter IT facilities will be upgraded to easily satisfy the upcoming needs of the NFFA-DI RI at whole.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

upcoming needs of the NFFA-DI RI at whole.
The expansion of the ORFEO datacenter will be performed within activity 3.1. On one hand, a significant amount of the storage component will be updated. This will mainly involve the long-term storage partition, which will be set up to be easily enlarged, upgraded and renewed when needed in the future. Such arrangement will guarantee operability of the storage services over the whole period of the operation of the RI. In addition, the datacenter will be also upgraded in its cloud partition, in order to enlarge and empower the software infrastructure needed to host all the data services that are functional to the NFFA-DI development. The upgrade will also comprise the HPC component of the datacenter required by the activities of WP06. All the internal components of the facility will be connected to the existing ones through an extension/integration of the InfiniBand network.
On top of the IT infrastructure a complete software ecosystem will be made available and interoperable to offer seamless series of science services with consistent access protocols. In particular, interoperability is pursued at the data production and exploitation levels through the creation of FAIR by-design datasets and metadata for access and/or development of data analysis services. suitable for reuse and accessible through OFED ecosystem. Such protocols will define a clear roadmap towards a new model of digital research infrastructure. The relevant goal is to innovate the organization of research infrastructure services for nanoscience and nano-to-micro analysis in Europe. Most Partners will provide access to researchers outside of their usual collaboration circuits, therefore gaining in knowledges, awareness and feedback from new usage of their instruments.
Innovation for all partners and users come from the generalized adoption of the NFFA-DI Data Policy and repository of metadata that will align all laboratories making an overall contribution toward the implementation of the EOSC ecosystem.
It is of utmost importance in nanoscience to keep track of properly described synthesis, growth and post growth sample treatments: a proper data provenance adoption is therefore seen in collecting data and associated metadata using a FAIR approach. This will allow to find and reuse data collected by characterisation, fine analysis and theoretical simulations and analysis.
The definition of the Data Policy is of paramount importance, also with respect to the requirements of confidentiality and intellectual property which some businesses, SMEs among the others, should comply with.
For a fully successful outcome, a key asset is the educational program to prepare, looking forward, a new class of professionals for the upcoming challenges. The followings are the main fields:
FAIR practices: trained DC during educational events will increase awareness and knowledges among all scientists participating to the project;
OFED services: teams made by PM, SI, DE, DC, talented young IT professionals and scientists will focus on how to design, build, maintain and develop the ecosystem.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Survey of current FAIRness of RI instrumentation and plan for action	5	D3.1 - Report on the FAIRness of tools within the consortium and plan of action
Upgrade of ORFEO	9	D3.2 - Report on the upgrade of the ORFEO datacenter
First release of OFED	9	First available release of the OFED Digital Ecosystem and associated report
Metadata system for OU upgrade	10	D3.4 - Report of metadata schema developed and implemented

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Metadata system for OU upgrade	10	D3.4 - Report of metadata schema developed and implemented
First release of FAIR-by-design modules for all OU	10	D3.5 - First report on the implemented modules for experimental facilities
Second release of OFED	13	D3.6 - Second release of the OFED Digital Ecosystem
Second release of FAIR-by-design environment for all OU	14	D3.7 - Second report on the implemented modules for experimental facilities
First set of FAIR-by-design research data	15	D3.8 - Report on the first set of FAIR-by-design research data

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Survey of current FAIRness of RI instrumentation and plan for action	5	Number of laboratories interviewed and instruments catalogued
Upgrade of ORFEO	9	Percentage of increase of ORFEO storage capacity (max +30%)
First release of OFED	9	Number of services offered by OFED
Metadata system for OU upgrade	10	Number of metadata schema developed
First release of FAIR-by-design modules for all OU	10	Number of implemented modules
Second release of OFED	13	Number of services offered by OFED
Second release of FAIR-by-design environment for all OU	14	Number of implemented modules

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

environment for all OU		
First set of FAIR-by-design research data	15	Number of acquired datasets identified with unique Digital Object Identifier (DOI)

46 WP Intermediate Objectives:

IO Title *Survey of current FAIRness of RI instrumentation and plan for action*

IO Bimestre *5* IO Costs *181.709,54*

IO Desciption

The initial situation of NFFA-DI laboratories with respect to FAIRness of the instrumentation will be clarified. A plan for action to improve FAIRness to higher standards will be agreed. First tenders / purchase procedures are completed and advance payments / payments completed after specific invoices.

IO Title *Upgrade of ORFEO*

IO Bimestre *9* IO Costs *2.219.180,00*

IO Desciption

Upgrade of ORFEO data center with additional components in computing/storage and network capabilities. Hardware installed and configured. Invoices paid.

IO Title *First release of OFED*

IO Bimestre *9* IO Costs *36.439,92*

IO Desciption

A first set of basic services will be initially offered, on top of ORFEO infrastructure. It will comprise a first release of a tool to create data management plans and metadata schema editors to help scientists and experimental station owners and deployers to implement a FAIR-by-design approach.

IO Title *Metadata system for OU upgrade*

IO Bimestre *10* IO Costs *63.274,81*

IO Desciption

Metadata schema for NFFA-DI experimental techniques and instruments will be identified and collected to better define FAIR-by-design implementation.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Metadata schema for NFFA-DI experimental techniques and instruments will be identified and collected to better define FAIR-by-design implementation.

IO Title	*First release of FAIR-by-design modules for all OU*		
IO Bimestre	*10*	IO Costs	*355.684,41*

IO Desciption

This first release will comprise a set of modules developed by partners on the instruments that implements FAIR-by-design approach. Related purchase procedures are completed and paid after specific invoices.

IO Title	*Second release of OFED*		
IO Bimestre	*13*	IO Costs	*27.329,94*

IO Desciption

A second release of the NFFA-DI Overarching Fair Ecosystem for Data System (OFED) will make available a second set of innovative data services. This OFED release comprises the updated version of all services previously installed and provides the final digital ecosystem.

IO Title	*Second release of FAIR-by-design environment for all OU*		
IO Bimestre	*14*	IO Costs	*78.154,94*

IO Desciption

This second release will enlarge the initial set of modules developed by partners on the instruments that implements FAIR-by-design apprach

IO Title	*First set of FAIR-by-design research data*		
IO Bimestre	*15*	IO Costs	*104.432,00*

IO Desciption

Acquired datasets identified with unique Digital Object Identifier (DOI). These could be generated both in-house and from users' experiments involving one or more instruments available at RI. Last invoices are paid.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description: -24 months of 1 data engineering (TD tecnologo 3 livello) at AREA
-1 unit tecnologo III livello x 2 years at 40% at CNR-IOM

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description:

-24 months of 1 data engineering (TD tecnologo 3 livello) at AREA
-1 unit tecnologo III livello x 2 years at 40% at CNR-IOM
-1.5 person-month of a fixed-term researcher hired for the project. The activity will be focused on the implementation of fair-by design software and hardware on the experimental facilities upgraded at CNR-IFN@MI.
-4 person months of a researcher (III livello) to analyze equipment information to support the definition of metadata and FAIR software and coordinate with other OUs on WP3 at CNR-IFN@TN
-2 person month to sketch a first meta-data schema for each equipment; to define the procedure to colect metadata on selected stations and to deploy the interoperable interface at CNR-IMM@BO
-1Y for 1 III liv (Tec) unit CNR-IMM@CT
-1 month TD at CNR-ISM
-8 person months, as follows: one researcher (CNR rank: level III) for 2 months, one researcher (CNR rank: level III) for 2 months, one researcher (CNR rank: level III) for 2 months, one technologist (CNR rank: level III) for 2 months:): personnel focused on the implementation of fair-by design software and hardware on the experimental facilities upgraded at CNR-NANOTEC
-2 months experimentalist TD III livello, 2 months laboratory technician at CNR-SPIN
-4 person month of a technologist (T2) in charge of FAIR-by-design implementation at POLIMI

Scientific instrumentation and technological equipment, software licenses and patent

Cost description:

-upgrade Orfeo data Center at AREA (1.700.000,00 € net cost + 374.000,00 € VAT)
-sensors, instrumentation, software at CNR-IOM (280.000,00 € net cost + 61.100,00 € VAT)
-Hardware for the implementation of fair-by design protocol on the experimental facilities upgraded at CNR-IFN@MI. Equipment for the laboratory network and communication servers for instruments and implementation of a storage server at CNR-IFN@MI (15.000,00 € net cost + 3.300 € VAT)
-servers for data storage and deployment of web apps for cleanroom management and accessing data (15.000,00 € + 3.300,00 €VAT) ; software and service for FAIR software development for cleanroom equipment (20.000,00 + 4.400,00 € VAT)) at CNR-IFN@TN
-items for the FAIR data upgrade at CNR-SPIN (13.000,00 € net cost + 2.860,00 € VAT)
-data center for FAIR data management at POLIFAB (6.000,00 € net cost + 1.320,00 € VAT)
-FAIR-by-design compliant data-acquisition systems upgrade at UNIMI (60.000,00 € net cost + 13.200,00 € VAT)

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Civil infrastructures and related systems

Cost description: N/A

Indirect costs

Cost description:
-running costs and consumables and travel at AREA
-travel costs and consumables at CNR-IOM
-travel costs and consumables at CNR-INF@MI
-Management, running and access costs of the facility, consumables, maintenance, travel, dissemination at CNR-INF@TN
-travel costs at CNR-IMM@BO
-travel costs at CNR-IMM@CT
-travel at CNR-ISM
-travel at CNR-NANOTEC
-travel costs and consumables at CNR-SPIN
-travel costs at AREA
-upgrades for the data center room at POLIFAB
-minor peripherals, accessories, components and consumables at UNIMI

Training activities

Cost description: N/A

48 Activity title

The FAIR Data Division (FAIR-DD)

49 Activity short name

A3.1

50 Activity Start month and duration

Activity Start month	1	Activity Duration	12

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

Activity 3.1 contributes to the setup of the data infrastructure and the related data services of the OFED ecosystem that will be made available to the whole RI.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

available to the whole RI.
This will be established within the ORFEO datacenter installed in Area Science Park by means of storage and hardware expansion as detailed in the budget.
All above mentioned software services will be developed, tested and validated using existing datacenter infrastructure setup. As soon as the hardware expansion will be completed, the set of services will be migrated in the new setup and will operate in "production mode".
Hardware definition and tender release:
In the first phase of the activity requirements of the general architecture and the hardware components of the expansion will be gathered and compared with the market best match alternative in terms of performance, flexibility and integration.
Hardware installation and configuration:
This phase integrates the expansion of hardware components on the ORFEO datacenter and relevant software configurations to run services, setting storage infrastructures and related software layers.
Data services developed and deployed:
Once data services will be developed, tested and validated, last phase consists of deployment of the first release of the OFED on the storage infrastructure.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8 PM of a data engineering (TD tecnologo 3 livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

2.074.000,00 €

Cost description: upgrade Orfeo data Center

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

147.563,92 €

Cost description: running costs, consumables

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Advanced management of Research Data and Data services (including remote data analysis services)

49 Activity short name

A3.2

50 Activity Start month and duration

Activity Start month	6	Activity Duration	25

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

This activity plans to develop and deploy innovative data services into the OFED ecosystem, that will be made available to all the NFFA-DI users by means of Virtual Access and/or remote data analysis services.
Virtual Services will be designed to enable advanced data services connected to scientific data resources on the Overreaching Fair ecosystem.
The platform will host several virtual access services that can be classified in broad categories:
Data Services developed within specific experimental/computational techniques;
Data Services developed at a more general level to address specific class of scientific data (i.e. images, 3D archives).
The platform will be seamless integrated in the OFED data repository, allowing users or proposal user groups to access the services immediately and without any need of data transfer.
It will be fully operational starting from month 28 and it will represent the second release of the OFED ecosystem.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8 PM of a data engineering (TD tecnologo 3 livello) in charge of cooperating with Area members to develop and deploy the OFED second release OFED.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-IOM

49 Activity short name

A3.3

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The co-location of advanced analytical tools for the study of nanosystems with facilities for the growth and synthesis of complex materials, and with specific computer and simulation codes for supporting experimental activities, represents a benchmark for the development of FAIR-by-design activities within the project, building on the approach already developed in H2020 NFFA-Europe, in NFFA-Europe Pilot (NEP) and in NFFA-FOE (NFFA Trieste). Software, metadata acquisition and specific digital twins will be developed and

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Pilot (NEP) and in NFFA-FOE (NFFA Trieste). Software, metadata acquisition and specific digital twins will be developed and interfaced with OFED, integrating experimental and theoretical aspects of the infrastructure.
Collection of specific MetaData schema
Advanced metadata structure and appropriate training will be offered to the users, covering the full research cycle. It will expand the already developed automatic acquisition of key metadata (three laboratories at IOM) and create a data repository for future data access. Moreover, a metadata structure and metrology standard for a better definition of the protocols (growth, nanofabrication, physical measure) will be implemented. Data will be managed via FAIR by design interfaces, and tests will be performed on upgraded instrumentation following the consolidated approach adopted on existing instruments.
Development of software/hardware procedures for metadata and data acquisition:
A web-based software built on the MetaData scheme and completely FAIR compliant will be developed and integrated in the existing metadata acquisition scheme. Data analysis packages will be used in order to provide online tools. The overall software developed will be integrated to comply with users' needs (including non-experts). Appropriate documentation will be provided to install them and customize them accordingly to specific needs.
Create a interoperable interface with OFED data services:
Development and deployment of interfaces to the SEP and to OFED, to give an easy access to detailed and addressing information.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

40.128,00 €

Cost description: 1 TECNOL III livello for the implementation of FAIR-by-design metadata and data acquisition - 9.6 PM

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

341.600,00 €

Cost description: sensors, tools and software

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

26.720,96 €

Cost description: consumables, missions

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-IFN@MI

49 Activity short name

A3.4

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

This activity covers the implementation of FAIR principles within the CNR-IFN@MI laboratories.
The laboratories will be equipped with a centralized control and acquisition system that will produce standardized data, associated to proper metadata that describe the experimental configuration.

This goal will be reached by the following steps:
- Procurement and installation of a centralized control and acquisition system.
- Acquisition of network equipment and control server based on the TANGO distributed control system.
- Implementation of FAIR-data acquisition with metadata via instrument interfacing, and proper software development.

Furthermore, to extend the services available to users, two servers will be implemented and connected to the laboratory network. One server will be devoted to long-term data storage, providing remote access to users. The other server will support online analysis during experiments.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

6.270,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, will be focused on the implementation of fair-by design software and hardware on the experimental facilities upgraded at CNR-IFN@MI. The activity requests funding for 1,5 person months: one researcher (CNR rank: level III) for 1,5 months

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

18.300,00 €

Cost description: Hardware for the implementation of fair-by design protocol on the experimental facilities upgraded at CNR-IFN@MI.
Equipment for the laboratory network and communication servers for instruments and implementation of two servers, for storage and data analysis

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.719,90 €

Cost description: Travel, small consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for nanofabrication processes at CNR-IFN@TN

49 Activity short name

A3.5

50 Activity Start month and duration

Activity Start month	1	Activity Duration	24

51 OU in charge of the Activity

OU short name	UO 3	Participant	CONSIGLIO NAZIONALE DELLE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

NAZIONALE DELLE RICERCHE

52 Activity description

A nanofabrication process is made of several tenths or hundreds of steps, and R&D at low TRL level requires huge amount of time to tune new recipes. To support these activities and maximize the advantages given by the IR upgrade, a FAIR by design innovative software will be implemented to manage nanofabrication equipment data and processes and give Access, share and reuse of advanced nanofabrication setup and recipes in order to shorten the R&D time of innovative sensors. The software will be interfaced with OFED. Furthermore, interfaces between process flows and simulators will be possible, as an innovative implementation of the Digital Twin applied to nanotechnologies.
Collection of specific MetaData schema
In this phase, a fair-compliant metadata schema will be developed referred to cleanroom equipment and their role in nanofabrication, e.g.: material definition, patterning, etching,…to address high level vocabularies, recipes parameters, equipment functional parameters impacting on the process results. Besides elementary concepts, entities like process constraints, rules about moving samples among equipment and other nanofabrication specific rules will be coded. The data managed will be input to the equipment, and output from the processes, used by the equipment itself, or users or addressed to other "use points" – other equipment, the OFED, simulators.
Development of software/hardware procedure to manage nanofabrication metadata and data:
A web based software built on the MetaData schema and completely FAIR compliant, connecting to cleanroom nanofabrication and characterization equipment, managing equipment master data, functioning parameters, recipe parameters, process output data, material characterization information, specific equipment process rules and constraints.
Create a interoperable interface with OFED data services:
Development and deployment of interfaces to the SEP and to OFED, to give an easy access to detailed and addressing information.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

16.720,00 €

Cost description: 4 person months of a researcher (III livello) to analyze equipment information to support the definition of metadata and FAIR software and coordinate with other OUs on WP3

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

42.700,00 €

Cost description: servers for data storage and deployment of web apps for cleanroom management and accessing data (30k€ + 6.6k€VAT) ; software and service for FAIR software development for cleanroom equipment (35k€+7.7k€ VAT))

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

54.5 e. Indirect costs

4.159,40 €

Cost description: Management, running and access costs of the facility, consumables, maintenance, travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-IMM@BO (CNR-IMM@BO)

49 Activity short name

A3.6

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Regarding fair by design inter-operability, IMM-BO will implement data interoperability between its own in-house developed web-interface based Clean room Activity Management System (CAMS, built on the open-source jam-py framework in python and JavaScript) and the NFFA-DI central database, by including TCP/IP based data transfer and automatic database synchronization modules.
In phase 1, IMM-BO will share with CNR-IOM and AREA the metadata field descriptors, as stored within its CAMS database, for the different pre-existing techniques (e.g. lithography, etching, deposition, growth etc.). If strictly necessary, the pre-existing data fields can be modified to enable more effective inter-node interoperability. For new techniques and equipment which will be acquired within the WP4 upgrade, the necessary metadata fields will be defined by the experts within the NFFA-DI network to directly implement homogeneous database descriptors within the node's software packages.
In phase 2, IMM-BO will add specific custom code within its CAMS web-application server to enable data exchange and synchronization between the IMM-BO node and the NFFA-DI central FAIR database. Depending on the complexity of the database interactions, this task will be performed directly by IMM-BO personnel or in collaboration with CNR-IOM and AREA experts if

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

interactions, this task will be performed directly by IMM-BO personnel or in collaboration with CNR-IOM and AREA experts if needed. This code will be compliant with the interoperable interface implemented in activity 3.3 and enable the implementation of FAIR-by-design principles within NFFA-DI.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: 2 person month to sketch a first meta-data schema for each equipment; to define the procedure to collect metadata on selected stations and to deploy the interoperable interface

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

585,20 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-IMM@CT

49 Activity short name

A3.7

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Objective of the present activity is the complete implementation of the FAIR guidelines provided by AREA on the experimental facilities upgraded at CNR-IMM@CT and detailed in activity 4.6. This work will address the complete realization of the DFFA-DI FAIR concepts on the data generated by the UO after the preliminary interfacing of the machines proprietary databases formats. An extensive use of open software resources is foreseen at this stage whereas any particular licensing issues will be solved at the procurement/commissioning stage of the upgrades (costs are included in the equipment cost).
Preliminary assessment of the proposed MetaData schema, the effectiveness of metadata scheme proposed with the 3.1 activities of the AREA group will be tested and the schema validated with data produced by already present instruments that will be made partially fair-compliant. In this stage, the automatic generation of the metadata will be humans-assisted for the part which cannot be completed due to the limited interfacing. Test of extension to the processed samples for the "F", "A", "I" and "R" attributes will be performed with ad-hoc metadata schema.
Development of software/hardware procedure for the automatic collection metadata: The second phase will be dedicated to develop the additional procedures allowing the automatic generation of the metadata according the schemes previously assessed. This objective will be obtained thanks to the maturity of the development of API interfaces on some installed upgrades obtained in the A4.6. A modular approach will guarantee that the method can be extended to additional module/instrumentation.
Create an interoperable interface with OFED data services: This phase deploys the interoperable interface in order to make the whole procedure interoperable with OFED.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

50.160,00 €

Cost description: 12 months for 1 III liv (Tec) unit

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.511,20 €

Cost description: missions

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-ISM

49 Activity short name

A3.8

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 6	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The laboratories will be equipped with a centralized control and acquisition system that will produce standardized data, associated to proper metadata describing the experimental configuration. FAIR-by design software will be implemented on both the existing and the upgraded instruments.
Development of software/hardware procedures for metadata and data acquisition:
-Procurement and installation of a centralized control and acquisition system.
-Acquisition of network equipment
-Collection of specific MetaData schema
-Advanced metadata structure and appropriate training will be offered to the users, covering the full research cycle

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

-Advanced metadata structure and appropriate training will be offered to the users, covering the full research cycle
-Implementation of FAIR-data acquisition with metadata via instrument interfacing, and proper software development
-Implementation of the existing protocol of data and metadata collection

Create a interoperable interface with OFED data services:
Development and deployment of interfaces to the SEP and to OFED, to give an easy access to detailed and addressing information.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

4.180,00 €

Cost description: 1 month fixed term researcher

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

292,60 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-NANOTEC

49 Activity short name

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

A3.9

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

FAIR by design software and hardware module will be implemented on the experimental facilities upgraded at CNR-NANOTEC and detailed in activity 4.9. Work will be done in strict collaboration with data management team of Area that provides guidelines and input if needed. The steps foreseen for each station are the following:
Collection of specific MetaData schema:
In this phase, a fair-compliant metadata schema will be developed for upgrades listed in WP4, i.e.: upgraded MBE, Multi-Beam SEM, 3D X-ray Microscope, upgraded SEM with serial block-face, upgraded SEM and Cross Beam (FIB/SEM). The schema will identify their role for research activity, e.g.: material growth, surface characterization, volume characterization,…. to address high level vocabularies, recipe parameters, equipment functional parameters impacting on the process results. The outcome of this first phase is to have examples of data and metadata associated with experimental techniques. To shorten the next software development, first tests will be done on available equipment, to go ahead when the equipment of the upgrade will arrive.
Development of software/hardware procedure to collect metadata:
In this second phase, a procedure/software will be designed to collect metadata (completely FAIR compliant) from some selected upgrades mentioned above. It will be then engineered with the help of a dedicated team and/or with external support. The goal is to develop it by means of a modular approach that allows an easy integration of further modules once new instruments will be added at later stage on the whole infrastructure.
Create a interoperable interface with OFED data services:
This phase aims to develop the interoperable interface in order to make the whole procedure interoperable with OFED and to give an easy access to detailed and addressing information.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

33.440,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, will be focused on the implementation of fair-by design software and hardware on the experimental facilities upgraded at CNR-NANOTEC. The activity requests funding for 8 person months, as follows: one researcher (CNR rank: level III) for 2 months, one researcher (CNR rank: level III) for 2 months, one researcher (CNR rank: level III) for 2 months, one technologist (CNR rank: level III) for 2 months.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.340,80 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at CNR-SPIN

49 Activity short name

A3.10

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The activities of the CNR-SPIN-NA UO will all start with the growth of a sample. While some samples might be brought to the external environment after a single deposition step, others might have a complex history of successive growths and characterizations, in

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

external environment after a single deposition step, others might have a complex history of successive growths and characterizations, in different chambers, before they are brought outside the UHV cluster. At this point, some samples might go through further characterization (XRD) or microfabrication processes before moving do other nodes. Others might be transferred to other nodes directly, possibly travelling in inert gas or in UHV. The final aim of the fair-by-design data/metadata management is to guarantee Findability, Accessibility, Interoperability, and Reuse of all growth/characterization data concerning the history of each individual sample produces in our Unit.
FAIR-by-design software and hardware modules will be implemented on the experimental facilities upgraded at CNR-SPIN-NA and detailed in activity 4.10 . Work will be done by a dedicated team in strict collaboration with data management team of Area that will provide general guidelines guaranteeing the interoperability of data produced in every single node, as well as support for specific problems.
In a first phase, we will focus on identifying the metadata scheme that makes the data from our present "MODA" system, as described in 4.10, FAIR-compliant.
This exercise will be of help to clarify all software and hardware aspects relevant to the overall design of specific modules for each operational chamber of our UHV growth/characterization platform. We aim at a modular approach that allows an easy integration of further modules each time a new operational chamber will be added. The same will apply for ex-situ operations (XRD, microfabrication) and of operations performed in the other nodes of NFFA-DI.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

15.706,67 €

Cost description: 2 month experimentalist TD III livello, 2 months laboratory technician

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

15.860,00 €

Cost description: items for the FAIR data upgrade

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.209,67 €

Cost description: missions and consumables

54.6 f. Training activities

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at AREA

49 Activity short name

A3.11

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

FAIR by design software and hardware module will be implemented on the upgraded experimental facilities managed by the AREA OU and detailed in activity 4.11 . Work will be done in strict collaboration with the data management team of Area, which will provide guidelines and input if needed. The steps foreseen for each station are the following:
Collection of specific MetaData schema
In this phase data produced by operating instruments will be made fair-compliant, at least partially, in order to identify and sketch a first metadata schema for each specific experimental technique. The outcome of this first phase is to associate examples of data and metadata with several experimental outputs and to implement the foreseen upgrades in strict cooperation and their foreseen upgraded implementation and will be conducted in strict cooperation with activities 3.1 and the AREA team.
Development of software/hardware procedure to collect metadata:
In this second phase a procedure will be designed to collect metadata on the experimental stations. It will be then engineered with the help of a dedicated team and/or with external support. The goal is to develop the procedure by means of a modular approach, allowing an easy integration of further modules once new instruments will be added at later stages on the whole infrastructure
Create a interoperable interface with OFED data services:
This phase deploys the interoperable interface in order to make the whole procedure interoperable with OFED.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: no. 1 data engineering who will cooperate with Area members to develop and deploy the fair-bt-design software in collaboration with Area Microscopist team. The effort is estimated in 8 months

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at POLIMI

49 Activity short name

A3.12

50 Activity Start month and duration

Activity Start month	7	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Polifab staff will implement a FAIR by design approach to data treatment applied to cleanroom machines for fabrication and experimental stations upgraded within WP4 (A4.12). This activity will be done mainly in collaboration with OUs CNR-IFN, CNR-IMM, CNR-Nanotec for cleanroom machines, and with AREA, CNR-IOM for experimental stations.
The steps for each machine/station (starting from new ones and extending protocols to pre-existing tools) are described below:
Collection of specific MetaData schema
With other cleanrooms involved in the project we'll define the structure of metadata describing each process: equipment type, material properties, entities like process constraints, rules about moving samples among equipment and other nanofabrication specific rules will be coded. In parallel the structure of metadata for each experimental station will be defined, by adopting the same scheme for each technique available at different nodes of the consortium.
To shorten the design test and the software development, first test will be done on available equipment, to go ahead when the equipment of the upgrade will arrive.
Development of software/hardware procedure to manage metada and data:
Polifab will adopt and test a custom web based software built on the MetaData schema and completely FAIR compliant, developed by CNR-IFN (Activity 3.4), to handle data and metadata from equipment involved in nanofabrication processes. Experimental stations for fine analysis will be made fair-compliant by customizing software developed for similar purposes by CNR-IOM and AREA, in order to favor interoperability.
Create a interoperable interface with OFED data services:
In this last step, interfaces to OFED will be created to provide easy access to crucial information enabling interoperability among nodes.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

15.500,00 €

Cost description: 4 person month of a technologist in charge of FAIR-by-design implementation at POLIMI

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

7.320,00 €

Cost description: Data center for FAIR data management

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.597,40 €

Cost description: Upgrades of the data center room

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Fair-by-design implementation. Modules for experimental facilities at UNIMI

49 Activity short name

A3.13

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

In close collaboration with the Data-Management team of Area, the UNIMI upgraded facilities of INSTALLATION 1,2, and 3 will implement the FAIR by design concept so that all steps and parameters of the sample preparation, conditioning, treatment and modifications are fully described and traceable. For theory UNIMI will agree with other INSTALLATION 4 nodes on the standard protocol for sharing refined input/output files of numerical simulations, and for collecting all data background related to the calculated quantities. A first step for this process will be a thorough review and analysis of past experience and current trends at the state of the art in using the techniques of interest.
Development of software/hardware procedure to manage nano-fabrication and analysis metadata and data:
The Metadata schema as discussed and consolidated with the nodes will be implemented in web-based tools for reliable alignment and linkage with the process and analysis data produced by newly acquired and upgraded existing portfolio of instrumentation and theoretical tools. Custom hardware/software tools are required and will be developed with the support of external services.
Create a interoperable interface with OFED data services:
Development and deployment of interfaces to the SEP and to OFED.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP3 - Digital Structure of NFFA-DI and Overarching Fair Ecosystem for Data System (OFED)]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

73.200,00 €

Cost description: FAIR-by-design compliant data-acquisition systems upgrade

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

5.124,00 €

Cost description: Minor peripherals, accessories, components and consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
5	Complete overview on tender/procurement status	9.951,00	9.951,00
6	Suppliers identified for all tender procedures, orders issued and advance payment (40%) completed	9.926.178,82	9.936.129,82
7	Completion of the acquisition procedures for items under 139 keur (NET) delivered by M12	905.562,40	10.841.692,22
9	Intermediate payment (40%) for instrumentation that passed the factory test by M17	2.608.231,43	13.449.923,65
10	Installation and commissioning of instruments above 139 keur NET value delivered by M19	1.231.178,81	14.681.102,46
11	Preparation of the premises for the new instrumentation	583.825,60	15.264.928,06
12	Intermediate payment (40%) for instrumentation that passed the factory test in M18-23	323.886,15	15.588.814,21
12	Completion of the acquisition procedures for items under 139 keur (NET) delivered after M12	277.076,50	15.865.890,71
13	Installation and commissioning of instruments above 139 keur NET value delivered in M20-25	91.378,00	15.957.268,71
14	Intermediate payment (40%) for instrumentation that passed the factory test in M24-28	7.187.673,47	23.144.942,18
15	Installation and commissioning of all	3.687.219,91	26.832.162,09

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

15	Installation and commissioning of all remaining instruments	3.687.219,91	26.832.162,09
15	Definition of the needs for a constant technical upgrade of the facilities	4.472,60	26.836.634,69

36 WP title

Upgrade of NFFA instrumentation

37 WP number

WP4

38 **Start month**(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	OU Name	Applicant
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 3	CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 6	CNR-ISM - Istituto di Struttura della Materia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

	Nanotecnologia	RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano

40 WP Leader

Giorgio Rossi (UNIMI)

41 Summary of the activities envisaged in the WP

WP4 has the Specific Objective of strengthening NFFA by upgrading to the international state of the art the technical capabilities and services offered by all nodes (Operating Units) by consistent capital-investment in upgraded and new instrumentation. The coherent upgrade plan will strengthen the 5 interoperable INSTALLATIONS that describe the technical resources devoted to user service and research: 1) Lithography and Patterning; 2) Growth and Synthesis; 3) Advanced Characterization and Fine Analysis; 4) Theory and Simulation; 5) Upscale to intermediate TRL. All nodes of the RI will perform locally the upgrades, coherently with their own specialization within the RI, with specific Activities all concurring to one or more INSTALLATIONS of NFFA-DI. The integration and interoperability of NFFA-DI will stem from the systematic adoption of FAIR-by-design technology on all new or upgraded instrumentation, as well as from implementation and adoption of common standards of sample exchange among remote instruments.
WP4 must therefore coordinate the full process of instrumental upgrade from procurement to commissioning and initial production of science services, within the deadline of month 30, and at the latest of end of 2023.
WP4 activities includes: a) procurement of new instrumentation or of the upgrades to the state-of-the art of operational instrumentation; b) design and procurement of technologies enabling sample exchange under proper conditions and smooth research work-flows involving headquarters and nodes; c) "personalized" adoption of FAIR-by-design technology on all upgraded instrumentation; d) continuous monitoring and timely reporting of state of advancement in strict connection with WP1 for optimizing cash-flow and administrative workload.
All upgrades will become accessible online as new items of the Digital Catalogue shortly after commissioning and post-commissioning test experiments (WP7) at the node, and will be therefore open to early users through the Single Entry Point web-submission procedure (WP5) in time for one or both the test calls at month 21 and 26.
Upgrade of INSTALLATION -1 Lithography and Patterning This upgrade will create the most advanced interoperable distributed open facility for nano-lithography and patterning on semiconductors and 2D materials, at EU level. Most UOs contribute with specialised or unique upgrades as detailed in the activities of each node, building on and strengthening local competences and existing service facilities.
Upgrade of INSTALLATION -2 Growth and Synthesis; This upgrade will create a most competitive, integrated, open facility at EU level for multi-scale growth of semiconductors, metal oxides and new functional materials with single layer accuracy, providing high definition of the interfaces between different materials, also by hybrid approaches in nanofabrication.
Upgrade of INSTALLATION -3 Advanced Characterization and Fine Analysis This upgrade will create the most advanced interoperable open facility for advanced characterization and fine analysis in EU. Spatial resolution from atomic scale to nanoscale, energy resolution at the meV level and time resolution reaching the few fs scale in spectroscopy will be implemented as open user facilities connecting the most advanced research-level methods to user services. Diversity and complementarity of methods of INSTALLATION-3 will become interoperable by specialised, largely automated, sample exchange among instruments and nodes as well as user access modes upgraded to pilots of remote control.
Upgrade of INSTALLATION -4 Theory and Simulation

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Upgrade of INSTALLATION -4 Theory and Simulation
This upgrade will create the most advanced integrated open facility for theory and numerical simulation on nanosystems. It will be synergistic with the Center for HPC, in particular for Artificial Intelligence applications and Digital Twin prototypes of selected developments, also included in WP7 aiming to explore the feasibility of augmented services to experimental research and in-silico simulations.
Upgrade of INSTALLATION -5 Upscale to intermediate TRL
This NFFA upgrade will complete the translational platform capable of upscaling the most promising results on new low dimensional materials to industry standards. The gap between research-level material samples and technology grade wafer processing is addressed by NFFA-DI by establishing 6" facilities available for exploratory combinations of nanosystems and their interfaces with CMOS-standard substrates and processing methods. 6" wafers are compatible with 8" industrial processes and are a most favourable solution for transferring basic science results to intermediate TRL applications.
The set of WP4 Activities addressing the different aspects of the upgrade are:
Activities A4.1-A4.2 are under responsibility of CNR-IMM@BO and UNIMI impact the whole WP4 and concern, respectively the identification of the technical needs of all UOs for the new setups and the coordination of the procurement, tender and commissioning of all nodes.
A4.1: Identification of technical needs and synergies (CNR-IMM@BO). Description: Definition of technical needs of the overall network, for the constant technical upgrade of the facilities aiming at the continuous improvement of user services and research activities that the RI can offer. This will be performed with the aid of The Scientific and Technical Committee (STC).
A4.2: Coordination of the RI strengthening (UniMI). Description: Work Plan for implementing the upgrade, coordination of procurement, coordination of commissioning and online availability of all upgrades.
Activities from A4.3 to A4.13 are each one under responsibility of the corresponding UO and describe the procurement, delivery, commissioning, and invoice payment of each item of the upgrade.

42 WP inter-relation with other WWPP

WP4 is the core of the upgrade and is strictly connected with WP2, WP3, WP5, WP7 and monitored by WP1

43 Most relevant outcome:

The most relevant outcome of WP4 will be the readiness of NFFA-DI to operate the upgraded RI with capital-intensive instrumentation and capabilities in all operating units (nodes) forming a unique distributed facility set for long-term operation of advanced user services. NFFA-DI will be ready to accept proposals and deliver the requested services to carry out nanoscience and nanotechnology research projects from the lowest to the intermediate TRL. Interoperability will extend from adoption of unified sample exchange technologies to implementation of FAIR-by-design technology and data management in a common database .
Upgrades of INSTALLATION 1 - Lithography and Patterning
NFFA-DI will become a unique facility for integrated photolithographic processes from research-grade samples to 6" wafers. Wafer bonder (IMM-BO); 3D profiling (IMM-CT); dry etching (IFN@TN); Focused Ion Beam for magnetic nanostructures (UNIMI), and sample preparation for FIB-SEM (POLIMI)
Upgrade of INSTALLATION 2 - Growth and Synthesis
NFFA-DI will become a uniquely versatile facility for layer-by-layer growth of semiconductors and quantum materials (carbon-based, oxides, calcogenides, topological, multiferroic) and low dimensional nanostructures as research grade samples and as interfaces on electronic industry standard wafers. The main assets are: PLD, CVD (IOM); MBE semiconductors (NANOTEC); sub-cluster for PLD, ALD, CVD and MBE (POLIFAB); PLD large area (2"), and UHV deposition of metals and organic (SPIN).
Upgrade of INSTALLATION 3 - Advanced Characterization and Fine Analysis
NFFA-DI will became a uniquely integrated facility for advanced characterization of materials and fine analysis experiments based on electrical transport measurements, structural and spectroscopic measurements with high energy, space and time resolution. The main assets are: optical spectro-microscopy and transport focussing elements for Xray spectroscopy, LEEM/PEEM micro-spectroscopy, integration of VT-STM and X-ray spectroscopy (IOM); micro-MOKE (POLIFAB); HHG EUV femtosecond beamline (INF-MI); ultrafast XUV transient absorption (INF-MI); ultrafast IR-VIS-UV transient absortion (ISM); ultrafast THz spectroscopy (IFN-MI); 4D-STEM and EELS

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

MI); ultrafast IR-VIS-UV transient absorption (ISM); ultrafast THz spectroscopy (IFN-MI); 4D-STEM and EELS (AREA), multi-beam SEM (NANOTEC); ARPES-XPS-HAXPES sources (IOM, SPIN, POLIFAB); upgrade of Spin Polarized SEM/SFEMPA magnetic surface microscopy (UNIMI).
Upgrade of INSTALLATION 4 - Theory and Simulation
The activities related to this installation do not imply capital investment under WP4
Upgrade of INSTALLATION 5 - Upscale to intermediate TRL
NFFA-DI will pioneer the integration of upscaling facilities with research-grade facilities in order to transfer to intermediate TRL application/technology development projects the most promising low TRL results. Growth, nanofabrication and analytical protocols will be upscaled to 6" wafer standards with dedicated instrumentation co-located with low TRL research facilities. The main assets are: cluster growth for heterostructures on 6" (POLIFAB); PLD growth facilities (4") (SPIN), additive manufacturing laboratory for prototyping for demonstrator devices, 3D profiling laboratory (IMM-CT), IR and XAS for high TRL (AREA).

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Complete overview on tender/procurement status	5	D4.1 - Report on status of foreseen tender/procurement processes
Suppliers identified for all tender procedures, orders issued and advance payment (40%) completed	6	D4.2 - Report on tender notices, tender assignments and advance payments for instrumentation items above 139 keuro value
Completion of the acquisition procedures for items under 139 keur (NET) delivered by M12	7	D4.6 - Report on instrumentation (sotto soglia) delivered and commissioned in the first project year
Intermediate payment (40%) for instrumentation that passed the factory test by M17	9	D4.3 - Report on first batch of factory tests
Installation and commissioning of instruments above 139 keur NET value delivered by M19	10	D4.9 - Report on installation and commissioning of first batch of ordered instruments above 139 keur NET value
Preparation of the premises for	11	D4.8 - Plan for integration of the new major upgrades in the existing facilities

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Preparation of the premises for the new instrumentation	11	D4.8 - Plan for integration of the new major upgrades in the existing facilities
Intermediate payment (40%) for instrumentation that passed the factory test in M18-23	12	D4.4 - Report on second batch of factory tests
Completion of the acquisition procedures for items under 139 keur (NET) delivered after M12	12	D4.7 - Report on instrumentation (sotto soglia) delivered and commissioned in the second project year
Installation and commissioning of instruments above 139 keur NET value delivered in M20-25	13	D4.10 - Report on installation and commissioning of second batch of ordered instruments above 139 keur NET value
Intermediate payment (40%) for instrumentation that passed the factory test in M24-28	14	D4.5 - Report on third batch of factory tests
Installation and commissioning of all remaining instruments	15	D4.11 - Report on installation and commissioning of third batch of ordered instruments above 139 keur NET value
Definition of the needs for a constant technical upgrade of the facilities	15	D4.12 - Report on needs for the long-term technical upgrade of the infrastructure

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Complete	5	KPI4.1 - # of tender/procurement process started

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Complete overview on tender/procurement status	5	KPI4.1 - # of tender/procurement process started
Suppliers identified for all tender procedures, orders issued and advance payment (40%) completed	6	KPI 4.2 - # of tender procedures completed KPI 4.3 - # of contracts signed after tender completion KPI 4.4 - # of advance payments completed
Completion of the acquisition procedures for items under 139 keur (NET) delivered by M12	7	KPI 4.6 - # of contracts (sotto soglia) signed KPI 4.7 - # of instruments delivered KPI 4.8 - # of instruments installed KPI 4.9 - # of invoices paid
Intermediate payment (40%) for instrumentation that passed the factory test by M17	9	KPI 4.5 - # of successful factory tests
Installation and commissioning of instruments above 139 keur NET value delivered by M19	10	KPI 4.11 - # of instruments above 139 keur NET fully paid
Preparation of the premises for the new instrumentation	11	KPI 4.10 - # of premises prepared
Intermediate payment (40%) for instrumentation that passed the factory test in M18-23	12	KPI 4.5 - # of successful factory tests
Completion of the acquisition procedures for items under 139 keur (NET) delivered after M12	12	KPI 4.6 - # of contracts (sotto soglia) signed KPI 4.7 - # of instruments delivered KPI 4.8 - # of instruments installed KPI 4.9 - # of invoices paid

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Installation and commissioning of instruments above 139 keur NET value delivered in M20-25	13	KPI 4.11 - # of instruments above 139 keur NET fully paid
Intermediate payment (40%) for instrumentation that passed the factory test in M24-28	14	KPI 4.5 - # of successful factory tests
Installation and commissioning of all remaining instruments	15	KPI 4.11 - # of instruments above 139 keur NET fully paid
Definition of the needs for a constant technical upgrade of the facilities	15	KPI 4.12 - # of needs identified

46 WP Intermediate Objectives:

IO Title *Complete overview on tender/procurement status*

IO Bimestre *5* IO Costs *9.951,00*

IO Desciption

As part of Activity A4.2, a complete overview on the status and timeline of all envisaged procurement procedures (via tenders or direct acquisitions) is sketched.

IO Title *Suppliers identified for all tender procedures, orders issued and advance payment (40%) completed*

IO Bimestre *6* IO Costs *9.926.178,82*

IO Desciption

For all tenders for acquisition of instrumentation items costing more than 139 keur NET (sopra soglia) , the tender procedure is completed, orders are issued and a 40% advanced payment is completed after specific invoices

IO Title *Completion of the acquisition procedures for items under 139 keur (NET) delivered by M12*

IO Bimestre *7* IO Costs *905.562,40*

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Bimestre	*7*	IO Costs	*905.562,40*

IO Desciption

Acquisition procedures completed, instrumentation installed and commissioning completed for instrumentation items below 139 keur NET value that were delivered in the first year of the project. Related invoices paid.

IO Title	*Intermediate payment (40%) for instrumentation that passed the factory test by M17*

IO Bimestre	*9*	IO Costs	*2.608.231,43*

IO Desciption

Intermediate payment (40%) for instrumentation that passed the factory test by M17, after issuing of specific invoices, and related start of integration work in the laboratories

IO Title	*Installation and commissioning of instruments above 139 keur NET value delivered by M19*

IO Bimestre	*10*	IO Costs	*1.231.178,81*

IO Desciption

Installation and commissioning of instruments above 139 keur NET value delivered by M19, balance payments completed

IO Title	*Preparation of the premises for the new instrumentation*

IO Bimestre	*11*	IO Costs	*583.825,60*

IO Desciption

Civil infrastructure, reorganization and distribution of the room, integration with existing instruments

IO Title	*Intermediate payment (40%) for instrumentation that passed the factory test in M18-23*

IO Bimestre	*12*	IO Costs	*323.886,15*

IO Desciption

Intermediate payment (40%) for instrumentation that passed the factory test in M17-M23, after issuing of specific invoices, and related start of integration work in the laboratories

IO Title	*Completion of the acquisition procedures for items under 139 keur (NET) delivered after M12*

IO Bimestre	*12*	IO Costs	*277.076,50*

IO Desciption

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Acquisition procedures completed, instrumentation installed and commissioning completed for instrumentation items below 139 keur NET value that were delivered in the second year of the project. Related invoices paid.

IO Title	*Installation and commissioning of instruments above 139 keur NET value delivered in M20-25*		
IO Bimestre	*13*	IO Costs	*91.378,00*

IO Desciption

Installation and commissioning of instruments above 139 keur NET value delivered in M20-25, balance payments completed

IO Title	*Intermediate payment (40%) for instrumentation that passed the factory test in M24-28*		
IO Bimestre	*14*	IO Costs	*7.187.673,47*

IO Desciption

Intermediate payment (40%) for instrumentation that passed the factory test in M24-M28, after issuing of specific invoices, and related start of integration work in the laboratories

IO Title	*Installation and commissioning of all remaining instruments*		
IO Bimestre	*15*	IO Costs	*3.687.219,91*

IO Desciption

Installation and commissioning of all other ordered instruments above 139 keur NET value, balance payments completed

IO Title	*Definition of the needs for a constant technical upgrade of the facilities*		
IO Bimestre	*15*	IO Costs	*4.472,60*

IO Desciption

Analysis of possible synergies among nodes, identification of constant upgrade needs and plans for the 10-year operation phase per INSTALLATION

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

–3 PM 1 TD researcher (III livello) at CNR-IMM@BO
–12 PM of 1 High-qualification Research Technologist or fixed-term Researcher at UNIMI
–24 PM of 1 High-qualification Research Technician at UNIMI
–12 PM each for 4 researchers/technologists (III livello); 24 months for 2 technicians at CNR-IOM

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

technicians at CNR-IOM
–2PM of 1 researcher (III livello) at CNR-IFN@MI
–6 PM each for 2 researchers at CNR-IFN@TN
–24 PM for one researcher (Tec) at CNR-IMM@CT
–14 person months, as follows: one researcher (CNR rank: level III) for 3 months, one researcher (CNR rank: level III) for 3 months, one researcher (CNR rank: level III) for 4 months, one technologist (CNR rank: level III) for 4 months. At CNR-NANOTEC
–8 PM each from 2 TD III livello; 16 PM for 1 laboratory technician and 17 months 1 management technician; at CNR-SPIN
–24 PM microscopist (TD ricercatore III livello) + 18 PM technologist (TD tecnologo III livello) at AREA
–28 PM divided among 3 technologists at POLIFAB

Scientific instrumentation and technological equipment, software licenses and patent

Cost description:

CNR-IOM
- LEEM/PEEM setup (1.350.000,00 € net cost + Vat)
- Analyser (360.000,00 € + Vat)
- Upgrade Cluster MASK (609.310.33€+Vat)
- Microfocus LE HE (585.000,00€+Vat)
- Cryogen free cryomagnet (350.000,00 €+Vat)
- Transfer systems and shuttles (50.000€ +Vat)

CNR-IFN@MI
- 2 laser sources (500.000,00 €+Vat)

CNR-IFN@TN
- Dry etching system (850.000,00 +vat)

CNR-IMM@BO
- Wafer bonder (6") (390.600,00 €+Vat)

CNR-IMM@CT
- 3D profiling tool with atomic resolution (3.000.000,00 €+Vat)

CNR-ISM
- Laser system (157.000,00 €+Vat)

CNR-NANOTEC
- Upgrade of correlative microscopy facility via high-throughput scanning electron microscopy Multi-Beam SEM (mSEM) (4.000.000,00 €+Vat)

CNR-SPIN
- Transfer UHV system connecting different UHV chambers, including pumps and manipulators for transfer from/to the chambers (250.000,00 €+Vat)
- X-ray 4-circle diffractometer for epitaxial thin films , including x-ray source and area detector (375.000,00 €+Vat)
- PLD System for deposition on 2" substrates, including laser, laser beamline and RHEED (650.000,00 €+Vat)
- UHV chamber for metals deposition (120.000,00 €+Vat)
- UHV chamber for evaporation of organic materials (120.000,00 €+Vat)
- Glove box (60.000,00 €+Vat)

AREA
- Dual Beam FIB-SEM workstation for TEM sample preparation equipped with micromanipulator for in situ lift out of TEM lamellae (1.194.550,00 €+Vat)
- Other UPGRADES Preparative TEM and TEM microscope (600.000,00 €+Vat)

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

- Other UPGRADES Preparative TEM and TEM microscope (600.000,00 €+Vat)
POLIFAB
- Cluster tool for material synthesis on 6" (Confocal Sputtering, PLD, ALD, CVD) (1.776.000,00 €+Vat)
- UHV systems for MBE on small samples, XPS/UPS, ARPES (1.140.000,00 €+Vat)
- RF station (probe-station, VNA) (90.000,00 €+Vat)
- Vacuum suitcases for sample transfer to Elettra and IFN beamlines (60.000,00 € +Vat)
- Time resolved polarization microscope (Micro-MOKE, FE domains dynamics, GHz-THz range) (250.000,00 €+Vat)
UNIMI
- Raman upgrade (220.000,00 €+Vat)
- UHV shuttles and docking stations (130.000,00 € +Vat)
- Upgrade SEM software (55.901,64 € +Vat)

Open Access, Transnational Access, FAIR principle implementation

Cost description:

CNR-IMM@CT
-consultants for interface API developments and upgrade local network connections for the UO allowing ultra-fast access to the machines (56.393,00 €+VAT)

Civil infrastructures and related systems

Cost description:

CNR-IMM@CT
- Realization of the site for the TEM lab (57.377,00 €+VAT)
CNR-SPIN
- Laboratory setup inside existing buildings (49.600,00 €+VAT)
UNIMI
- Local ISO7 environment around upgraded apparatus (100.000,00 €+VAT)

Indirect costs

Cost description:

–Consumables, cryogenics and extraordinary maintenance, plant adaptation for CNR-IOM
–Consumables connected with the commissioning of the upgrades.; other running costs connected with the commissioning of the upgraded ultrafast spectroscopy beamlines; maintenance of laboratory equipment serving the spectroscopy facility (chillers, uninterruptible power supply (UPS) systems, air conditioning and filtration systems); travel and dissemination costs. At CNR-IFN@MI
–Management, running and access costs of the facility, consumables, maintenance, travel, dissemination at CNR-IFN@TN
–Travel, expenditure for new gas lines, new connections to existing clean room utilities (vacuum, water, compressed air, refrigeration circuit,…) for the installation of new equipments, running costs at CNR-IMM@BO
–Consumables for the commissioning at CNR-IMM@CT
–Optics, small diagnostic instruments, consumables at CNR-ISM
–Consumables and other running costs at CNR-NANOTEC

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

–Consumables and other running costs at CNR-NANOTEC
–Running costs at CNR-SPIN
–Consumables and other running costs at AREA
–maintenance contracts; contribution to the upgrade (gas lines, antivibration platforms, e.m. field screening, etc) of spaces dedicated to new equipment; participation in conferences, travels to other nodes: 4000 € for 10 people (PI, RTDA, Technologist, 4 post-docs, 3 PhD); substrates, pure materials, reagents, process gas, spare parts for the commissioning phase. At POLIFAB
–Consumables, components and fittings for UHV and high-purity gases ; optical components; pulsed solid-state optical source; travel at UNIMI

Training activities

Cost description: N/A

48 Activity title

Identification of technical needs and synergies

49 Activity short name

A4.1

50 Activity Start month and duration

Activity Start month	13	Activity Duration	18

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The main action of this activity will be the definition of technical needs of the overall network, for the constant technical upgrade of the facilities aiming at the continuous improvement of user services and research activities that the RI can offer. This will be performed with the aid of The Scientific and Technical Committee (STC). A great effort will also be dedicated to the optimization of the synergies among nodes, in order to strengthen the connections and to overcome the limitations of locally available resources, enforcing the multi-node approach of research. The main activities will be:

- *Identification of technical needs for optimal setting at all UOs of the upgraded/ new instrumentation in order to understand if critical preparation of laboratories must be performed and monitored to guarantee timely commissioning*
- *Identification of the synergies among the nodes for each INSTALLATION and prioritization of sample exchange protocols in order to design specific work-flows to be fed to the SEP access optimization procedures*
- *Identify the constant upgrade needs and plans for the 10-year operation phase per INSTALLATION*
- *Define prototype work-flows with examples for all INSTALLATIONS*

These activities will be performed in cooperation with CNR-IOM (activity A2.4), in charge of the development of interoperability practices.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

practices.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

4.180,00 €

Cost description: 1 person month to define constant technical upgrade of the facilities and innovative protocols to be implemented

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

292,60 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Coordination of the RI strengthening

49 Activity short name

A4.2

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

The intense procurement activity of the first year shall be monitored by constant update of the GANTT planning of tenders and direct assignments/ market analysis for goods up to 139k€. At t=0 the status of tender preparation, i.e. of technical specification documents for all major instruments and service contracts shall be monitored and opportunities for cumulative tenders shall be explored. Some upgrades belonging to the same class of products could be tendered once for all the concerned nodes, if this will appear to be a favourable solution. The three deadlines for tenders as indicated in WP4, at bimesters 1, 2, 3, as determined based on the expected delivery time of different goods, will be monitored and mitigation actions in case of delays will be proposed. This activity shall be completed by end of year 2023, with all executors identified, as required by the Avviso.
The delivery times shall be continuously monitored and updated in the period between bimesters 6 and 12. A survey of installation conditions at all nodes of upgrades and novel equipment shall also de performed before bimester 8, to monitor the readiness for setup, after delivery and the timing of commissioning. The commissioning of upgrades shall be coordinated by recording the timing of test of different instruments, and identifying those of the same typology as well as the needs to be interfaced with existing laboratories. Acceptance tests shall, whenever possible, be also comparative between instruments of same typology installed at different nodes e.g by exchanging commissioning data and using as benchmark for all the best registered performances. All the commissioning data, as well as the data from in-house upskill experiments (WP7), shall integrate the online digital Catalogue (WP2) as soon as available. The coordination of the availability of new resources for call 1 and 2 shall be reflected in the SEP offer.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

9.300,00 €

Cost description: 12 months at 20% FTE of one High-Qualification Technologist or fixed-term Researcher for coordinating the Upgrade activities related to installations 1,2,3 (with the role of Laboratory Manager)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.5 e. Indirect costs

651,00 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-IOM on installations 2-3 for digital growth, multiscale analytics of 1D/ 2D systems

49 Activity short name

A4.3

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement and commissioning of upgrades and full integration of facilities strengthening the current NFFA services with advanced interoperability:
INSTALLATION 2: upgrade of the NFFA combined MBE/PLD/CVD digital growth cluster, with new effusion cells and CVD with volatile precursors;
INSTALLATION 3: a) upgrade of the Scanning Tunneling Microscopy and Spectroscopy (STM-STS) facilities integrated with X-ray photoelectron spectroscopy (XPS) and microscopy (PEEM), Low-Energy Electron Microscopy (LEEM) and photoelectron (PEEM) to enhance in-operando investigation of surface chemistry from the atomic- to the meso-scale; b) upgrade of analytical facilities of the NFFA cluster with monochromatic x-ray source, dedicated electron analyser, micro-cryo-MOKE; c) upgrade of LE-APE and APE-HE end-stations with in-situ capillary microfocus and cryostat/manipulator with 6 degrees of freedom; d) upgrade of Quantum Transport Laboratory for magneto-electrical characterization of 2D systems, with 9T cryomagnet, extended temperature range (50 mK to 1000 K), combined magnetometry and susceptivity module
ALL INSTALLATIONS: a) upgrade of local and internode sample transfer platform and UHV shuttle sample exchange systems; b) implementation of FAIR-data and metadata acquisition.
Development of digital-twin for ARPES in collaboration with WP4, Center for HPC, WP8.

54 Activity budget

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.1 a. Cost of fixed term personnel specifically hired for the project

376.960,00 €

Cost description: The activity will concern the preparation and monitoring of present installations and commissioning of the upgrades. The activity requests funding for 4 researchers (CNR rank: level III) for 50% time (6 man months per year per person) and two technicians full time, all for two years.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

4.031.258,60 €

Cost description: Analyser, Upgrade Cluster MASK, microfocus LE HE, LEEM/PEEM set up, cryogen free cryomagnet set up, transfer systems and shuttles.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

308.575,30 €

Cost description: consumables, cryogenics, periferical electric plants, extraordinary maintenance

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-IFN@MI on installation 3 for advanced ultrafast time-resolved spectroscopy

49 Activity short name

A4.4

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement, acquisition, commissioning of upgrades and their integration with existing instrumentation for the realization of an advanced laboratory for the characterization of ultrafast dynamics in extended systems, combining approaches beyond state-of-the-art and representing a unique facility in the Italian framework of nanoscience research (all concerning INSTALLATION 3)
- Upgrade of Beamline for ultrafast THz spectroscopy: Optical Pump – THz (2-30 meV) probe setup. Moving of the existing THz spectroscopy beamline in a dedicated laboratory. Acquisition of a new laser source. Interfacing of the setup with the new laser source.
- Upgrade of Beamline for HHG spectroscopy in solids. Acquisition of a dedicated laser source. Commissioning of the new laser source and interfacing with the existing HHG beamline for spectroscopy in solids.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: 2 person-month of a fixed-term researcher hired for the project. The activity will concern the monitoring of installation and commissioning of the upgrades.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

610.000,00 €

Cost description: 2 amplified fs laser systems

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

43.285,20 €

Cost description: Consumables connected with the commissioning of the upgrades. Other running costs connected with the commissioning of the upgraded ultrafast spectroscopy beamlines. Maintenance of laboratory equipment serving the spectroscopy facility (chillers, uninterruptible power supply (UPS) systems, air conditioning and filtration systems). Travel and dissemination costs.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-IFN-TN on installation 1 for um-nm-fabrication and fast prototyping

49 Activity short name

A4.5

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 3	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement, acquisition, commissioning of upgrades and their integration with existing instrumentation for the realization of an advanced micro-nano fabrication facility for the development and fast prototyping of integrated photonics circuits, photonic structures, photon sensors beyond state-of-the-art on different material platforms and representing a unique facility in the Italian framework of nano-science research, all concerning Installation 1.
Upgrade of the micro-nano fabrication capabilities: a) upgrade of reactive ion etching capabilites for transferring the micro and nano patterns with the highest flexibilitym fidelity and selectivity, and with extreme smoothness of the etched structures, given the demanding requirements of this parameter in integrated photonics devices. Systems will be selected in order to allow processing different item types, from pieces of material to 8" wafers
FAIR principle implementation. procurement and installation of servers for data storage and deployment of the applications (according to WP3).

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

50.160,00 €

Cost description: 6 person months of two researchers (III livello), dedicated to the preparation, installation, acceptance and commissioning of the RIE instruments, running of tests for the validation of the 'standard' methodologies and production of reports.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

1.037.000,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

1.037.000,00 €

Cost description: Nanopatterning (e.g. via EBL) and the definition of nanostructures on devices, require to be able to complete the process with flexible etching setups suited to items of different dimensions; for this reason, a highly performing and flexible dry etching system is planned; main assets to be acquired: Reactive Ion Etching system

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

76.101,20 €

Cost description: Management, running and access costs of the facility, consumables, maintenance, travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of IMM-BO on installation 1/2/5 for research on advanced nanoscience and nanotechnology

49 Activity short name

A4.6

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

52 Activity description

Procurement, acquisition, commissioning of all upgrades and their interfacing with existing instrumentation. Commissioning of the FAIR-by-design technology upgrades and interoperability tests within the node and cross node. Commissioning of the internode sample transfer (round robins) in the framework of the NFFA-DI INSTALLATIONS:
INSTALLATION 1)
Upgrading of photolithographic processes in ISO 5 clean room facility to 6" wafers: a) Direct Laser Writing system for rapid prototyping (feature size 600 nm, write speed up to 600 mm 2 / min for 2 mm feature size (acquired with other funds and made available also for this project); b) wafer bonder equipment for fabrication of MEMS systems, (bonding temperature up to 450°C and bonding force up to 20 kN); c) upgrade and integration of the existing clean room instrumentation
INSTALLATION 2)
Upgrades for: a) physical vapor deposition and chemical deposition/growth of thin film- and nano-materials for electronics and MEMS applications; b) in the thermal evaporation system for metal and oxides deposition; c) sputtering deposition equipment for metals, oxides or other composite films (co-sputtering deposition); d) furnaces for insulating layers growth and thermal annealing. (acquired with other funds and made available also for this project)
INSTALLATION 5)
Upscaling of the MEMS line to 6" wafer complying to the standard of the growth facilities, will improve technology transfer and boost the volume foundry services for SME and companies to intermediate TRL. Use of maskless (laser) lithography with high precision permits to fabricate 3D micro- and nano-structures speeding up R&D, reducing time to prototyping and facilitating the achievement of new products at intermediate TRL.
ALL INSTALLATIONS Commissioning of interoperability tests within the node and cross node, and of the internode sample transfer. Upgrade and commissioning of FAIR-protocol acquisition and sharing with the other nodes.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: 2 person month to prepare the installation of the equipment, to test the equipment installed and to define the main processes

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

476.532,00 €

Cost description: Wafer bonder (6 inches)

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33.942,44 €

Cost description: expenditure for new gas lines, new connections to existing clean room utilities (vacuum, water, compressed air, refrigeration circuit,…) for the installation of new equipment, running costs

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-IMM@CT for research on INSTALLATION 1,2,3,4 for 3D elemental profiling, SEM and TEM

49 Activity short name

A4.7

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

INSTALLATION 1): upgrade of prototyping laboratory, for designing and fabrication of demonstrator devices to increase TRL level. Integration of the synthesis facilities for fabrication of low dimensional materials and nanomaterials (for example, graphene, carbon nanotubes, TiO2, ZnO, TCO, SiGe, MoO3, ..). The upgrade consists in adapting existing samples' handling tools for aligning sample transfer protocols to NFFA-DI interoperability strategy.

INSTALLATION 2): upgrade of X-ray diffraction laboratory for the remote acquisition and analysis of the data.. The upgrade consists in adapting the data acquisition cards of the existing equipment to allow their networking in NFFA-DI.

INSTALLATION 3): upgrade of 3D elemental profiling laboratory facility, to deliver high precision elemental and isotopic space distribution analyses with increased ease-of-use and productivity. The 3D profiling tool equipment consists of mass spectrometer based approach allowing atomistic resolution and is will be optimized for glass, metals, ceramics, IV-group- III-V-groups- and II-VI-groups-based devices. The upgrade consists in procuring of additional instrumentation with 3D features and adapting the data acquisition cards of the existing tools and new one to allow their networking in NFFA-DI.

INSTALLATION 4): upgrade of the Electron Microscopy Laboratory with high resolution Scanning and Transmission Electron Microscopes (SEM and S-TEM) for the correlative structural, chemical, electrical and optical characterization of soft and inorganic matter. The upgrade consists in adapting the data acquisition cards of the existing equipment to allow their networking in NFFA-DI.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

ALL INSTALLATIONS: a) implementation of FAIR-data and metadata acquisition. Dedicated API will be developed for the automatic conversion and storage to all the necessary information in the NFFA-DI standardized data format.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

100.320,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at the overall operative project preparation and realization for the integration of the upgrades in the existing IR at the CNR-IMM@CT. Part of the activity will be dedicated to the new equipment installation, the remaining will be dedicated to guarantee the local interoperability and to obtain "ready-to-FAIR" installations. Also, the activity will concern the monitoring of installation and commissioning of the upgrades. The activity requests funding for one Technicians III Liv. for 24M. (24 PM total)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

3.660.000,00 €

Cost description: 3D profiling tool - Upgrade of elemental and charge profile facilities with 3D elemental profiling laboratory facility, to deliver high precision elemental and isotopic space distribution analyses with increased ease-of-use and productivity. The 3D profiling tool equipment consists of mass spectrometer based approach allowing atomic resolution and will be optimized for glass, metals, ceramics, IV-group- III-V-groups- and II-VI-groups- based devices.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

68.799,46 €

Cost description: Consultant for the easy implementation of FAIR-data and metadata acquisition. Irrespective to the processes and measurements data format dedicated API will be developed for the automatic conversion and storage to all the necessary information in the NFFA-DI standardized data format.
Consultant for projecting and realizing the necessary modification of the local ultra-fast connections of the UO.

54.4 d. Civil infrastructures and related systems

69.999,94 €

Cost description: Realization of the vibration insolation and other laboratory adaptations for the 3D profiling tool. A specific budget is required for the lab in consideration of: (i) the appropriate amount of space required to accommodate the whole instrumentation, (ii) external vibrations minimization and (iii) supplying of air compressed and water cooling system.

54.5 e. Indirect costs

272.938,36 €

Cost description: Consumables for the commissioning

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Upgrading of CNR-ISM on installation 3 for high rep. rate u.fast transient absorption spectroscopy

49 Activity short name

A4.8

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 6	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement and commissioning of upgrades and full integration of facilities within the NFFA-DI infrastructures, for the realization of an advanced laboratory for high repetition rate ultrafast transient absorption spectroscopy within the EuroFEL Support Laboratory (all concerning INSTALLATION 3).
Upgrade of laser facility with new fs high repetition rate laser source to meet the in operando conditions of materials and devices: Laser System: 10W, repetition rate 200KHz, time resolution < 200 fs for pump-probe measurements, operating at high repetition rate both in transmission and reflection mode for devices based on 2D materials flakes, nanoparticles, and nanowires. Upgrade of local and internode sample transfer platform and exchange systems; b) implementation of FAIR-data and metadata acquisition.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

191.540,00 €

Cost description: The upgrade of the existing facility will be performed by the acquisition of a high repetition rate fs laser source (10W, 200 KHz, 200 fs) to access a wide range of excited carrier densities.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

13.407,80 €

Cost description: consumables and small diagnostic instruments for the realization of the upgraded facility (optics and laser powermeter).

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-NANOTEC for research on Advanced Correlative Microscopy (installation 3)

49 Activity short name

A4.9

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement, acquisition, commissioning of all upgrades (WP4), and full integration with existing instrumentation for completion of the facility and enhanced users' access.
INSTALLATION 3): Upgrade of correlative microscopy facility via high-throughput scanning electron microscopy Multi-Beam SEM (mSEM), with highest-ever acquisition speed at nanometer resolution (<10nm). The mSEM will be crucial for modern materials whit functionalities determined by their structuring at nanometre scale and by distribution over millimetre or centimetre scales. The upgrade includes an automated system for serial sectioning enabling 3D imaging of hard and soft materials through mSEM up to unprecedented large volumes ≤1mm3. The upgrade includes also a software/hardware upgrade for existing SEM Zeiss Merlin and Zeiss Cross Beam Auriga (Focused Ion Beam/SEM) in order to provide them additional functionality. This upgrade enables FIB tomography up to

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Auriga (Focused Ion Beam/SEM) in order to provide them additional functionality. This upgrade enables FIB tomography up to maximum volumes of 40×40×40 µm3. Also, the existing SEM Zeiss Sigma will be upgraded with a serial block-face system (SBF) for obtaining images (3D data) for maximum volumes of 100x100x100 µm3.
ALL INSTALLATIONS: a) upgrade of local and internode sample transfer platform and of glovebox/UHV shuttle sample exchange systems; b) implementation of FAIR-data and metadata acquisition.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

58.520,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at preparing the experimental facilities of CNR-NANOTEC with the proper technological equipments for installation of the mentioned upgrades. Also, the activity will concern the monitoring of installation and commissioning of the upgrades. The activity requests funding for 14 person months (58.520,00 €), distributed as follows:
a.one researcher (CNR rank: level III) for 3 months,
b.one researcher (CNR rank: level III) for 3 months,
c.one researcher (CNR rank: level III) for 4 months,
d.one technologist (CNR rank: level III) for 4 months

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

4.880.000,00 €

Cost description: Upgrade of the Correlative Microscopy Facility.
The upgrade of the correlative microscopy laboratory consists of
a) a Multi-Beam SEM that achieves the highest-ever acquisition speed at nanometer resolution (<10nm). The Multi-Beam SEM is complemented by an automated system for material serial sectioning enabling 3D imaging. Furthermore, the technological equipment for Multi-Beam SEM commissioning is included.
b) a hardware/software upgrade of operating SEM Zeiss Merlin and Zeiss Cross Beam Auriga (FIB/SEM) systems. It will make existing SEM Zeiss Merlin and Zeiss Cross Beam Auriga (FIB/SEM) systems compatible with the existing correlative microscopy platform of CNR-NANOTEC. These instruments will benefit from additional functionality, improved performance and extended lifetime. In particular, the cross beam upgrade will extend its functionality toward material tomography processes.
c) a Serial Block-Face (SBF) system, it is an automated system for obtaining serial block face images and 3D data by using the existing single beam SEM Zeiss Sigma. It consists of an ultramicrotome to be integrated within the existing single beam SEM chamber.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

345.696,40 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: Consumables connected with the commissioning of the upgrades for correlative microscopy facility
Other running costs connected with the commissioning of the upgrades for correlative microscopy facility:
Maintenance of systems serving the correlative microscopy facility as: chillers, uninterruptible power supply (UPS) systems, air conditioning and filtration systems.

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of CNR-SPIN for research on epitaxy and heterostructures of nanomaterials

49 Activity short name

A4.10

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Procurement and commissioning of upgrades and full integration of facilities for research on epitaxial films and heterostructures of inorganic and hybrid materials
INSTALLATION 1: a) Upgrade for photolithography facility. b) Upgrade of fabrication of micro-size devices.
INSTALLATION 2: a) infrastructural setup/upgrade of the laboratory; b); upgrade of the "Modular facility for Oxide Deposition and Analysis" (MODA, a multichamber UHV system comprising RHEED-assisted PLD, XPS/UPS, SPA-LEED and AFM/STM), by creating of a large UHV cluster composed of growth and characterization chambers. The chambers to be connected to the cluster are described below; a) MODA itself; b) new large area (4") UHV PLD deposition chamber for oxides and other inorganic materials, including a new high-pressure RHEED and laser; c) UHV chambers for metallic and for organic films; d) a glove box.
INSTALLATION 3: a) upgrade of the XRD laboratory, with new diffractometer equipped with parallel beam, 4+ circles and area detector.
INSTALLATION 5: Upgrades and upscaling of growth facilities to wafer standard with 2" PLD within Installation 1 can also be considered as an upscaling upgrade.
ALL INSTALLATIONS: a) infrastructural setup/upgrade of the laboratory (ventilation, climatization, filtering, gas lines, gas cabinet, electrical installation, floating pavement, open office walls, chiller and water pipes, primary vacuum pipeline…); b) commissioning of a UHV tunnel equipped with a trolley running on rail and connecting all growth and characterization chambers; c) Procurement of Glove Box for clean handling of as-grown samples and their preservation and transport in inert gas; d) Upgrade of an internode sample transfer platform; e) implementation of FAIR-data and metadata acquisition.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

188.100,00 €

Cost description: 8 PM for a researcher (III livello). The hired resource will be an experimentalist mainly dedicated to the preparation, installation, acceptance and commissioning of the UHV transfer system of the UHV growth and characterization cluster, 33.440 €
8 PM for a researcher (III livello). The hired resource will be an experimentalist mainly dedicated to the preparation, installation, acceptance and commissioning of the large sample area PLD chamber the UHV growth and characterization cluster, 33.440 €
16 PM for 1 technician at CNR-SPIN. The hired resource will be mainly dedicated to the setup of the control software and electronics of the UHV growth/characterization, 58.773 €
17 PM for 1 technician at CNR-SPIN. The hired resource will support the Institute in all project management and reporting duties, 62.447 €€

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

1.921.500,00 €

Cost description: Major items:
- Transfer UHV system connecting different UHV chambers, including pumps and manipulators for transfer from/to the chambers
- X-ray 4-circle diffractometer for epitaxial thin films , including x-ray source and area detector
- PLD System for deposition on 2" substrates, including laser, laser beamline and RHEED. Base vacuum in the low 10^-9 range. The system will be connected to a UHV transfer system
- UHV chamber for metals deposition
- UHV chamber for evaporation of organic materials
- Glove box

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

60.512,00 €

Cost description: Laboratory setup inside an existing room currently employed for a different use and not equipped as a lab

54.5 e. Indirect costs

151.907,84 €

Cost description: running costs

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

48 Activity title

Upgrading of AREA on installation 1/3/5 for materials analysis across the full TRL scale

49 Activity short name

A4.11

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

We propose the procurement and commissioning of upgrades of existing facilities concurring to NFFA-DI, and the adoption of FAIR-by-design technology and interoperability solutions of the node and with the entire NFFA-DI infrastructure. In detail:
INSTALLATION 1: Procurement for the upgrade of TEM sample preparation by a Focused Ion Beam Dual Beam instrument with in-situ micromanipulators for TEM specimen preparation and UHV docking station for sample transfer and interoperability with other NFFA-DI facilites.
INSTALLATION 3: a) upgrade of electron microscopy facility with procurement for the acquisition of an expansion for in situ/in operando characterization and combined 4DSTEM imaging and UHV loading stage for pristine cross-sectional samples for in-situ/in-operando experiments on materials for research and for developing solutions of industrial interest in the domains of energy, environment, catalysis and biomedicine. Upgrade of TEM sample preparation with all the tools needed for mechanical polishing and thinning (grinder, dimpler, tripod, ultrasonic cutter, diamond saw, multiprep polishing system) and with a procurement for the acquisition of a Precision Ion Polishing System with cryo-attachment for high precision thinning of TEM specimens under different geometries.
ALL INSTALLATIONS: synergetic collaboration with the Center for HPC and its facilities for upgrading user services of remote interactive access to facilities.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

178.794,00 €

Cost description: 24 PM microscopist (TD ricercatore III livello) + 18 PM technologist (TD tecnologo III livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

2.189.351,00 €

Cost description: Pixelated 4DSTEM detector, In-situ holder, Focus Ion Beam Dual Beam station for TEM sample preparation, equipped with STEM and EDS, Precision Ion Polishing System with Cryo attachment, Tools needed for TEM specimen preparation (multiprep polishing system, grinder, dimpler, tripod, ultrasonic cutter, diamond saw,…)

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

(multiprep polishing system, grinder, dimpler, tripod, ultrasonic cutter, diamond saw,…)

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

165.770,15 €

Cost description: running costs, consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upgrading of Polifab-POLIMI on installations 2-3-5 for "wafer-scale" research on advanced materials

49 Activity short name

A4.12

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

In parallel to the new cleanroom (1200 m2, by 2026) equipped with state-of-the-art fabrication facilities and a 8" pilot line for MEMS (in collaboration with STMicroelectronics), Polifab will potentiate capabilities for research and wafer-scale integration of advanced materials thanks to upgrades and full integration of facilities strengthening the current NFFA services.
INSTALLATION 2-5: Procurement and commissioning of tools for combined deposition of heterostructures on 6" (standard of other NFFA cleanrooms): (a) cluster for PVD-CVD techniques (PLD, CVD, ALD); (b) UHV cluster with a versatile MBE system on small samples (2"). Common features: (i) separate access to all deposition chambers; (ii) sample manipulation system for deposition both

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

small samples (2"). Common features: (i) separate access to all deposition chambers; (ii) sample manipulation system for deposition both on small samples and on wafers.
INSTALLATION 3: Procurement and commissioning of: (a) an electron spectroscopy tool (XPS, ARPES (UV-lamp, 2D detector)), coupled to the MBE; (b) Station for RF measurements, with high-frequency VNA (40 GHz) and electromagnet, suitable for materials and MW device investigation; (c) time-resolved polarization microscope for the in-operando investigation of the dynamics of excitations in ferroic materials (ferromagnets, antiferromagnets, ferroelectric, piezoelectrics).
ALL INSTALLATIONS: a) upgrade of local and internode sample transfer platform and of Glove Box/UHV shuttle sample exchange systems; b) implementation of FAIR-data and metadata acquisition.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

108.500,00 €

Cost description: Technologist T1: 12 MM. Procurement and commissioning of the cluster tool for combined growth
Technologist T2: 10 MM. Procurement and commissioning of the UHV system (MBE + electron spectroscopy chamber)
Technologist T3: 6 MM. Procurement and commissioning of components (fs laser, microscope, etc.) related to time-resolved polarization microscope, RF station

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

4.045.520,00 €

Cost description: Cluster tool for material synthesis on 6" (PLD, ALD, CVD); Vacuum suitcases for sample transfer to Elettra and IFN beamlines; UHV systems for MBE on small samples, XPS/UPS, ARPES; RF station (probe-station, VNA); Time resolved polarization microscope (Micro-MOKE, FE domains dynamics, GHz-THz range).

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

290.781,40 €

Cost description: maintenance contracts; contribution to the upgrade (gas lines, antivibration platforms, e.m. field screening, etc) of spaces dedicated to new equipment; participation in conferences, travels to other nodes: 4000 € for 10 people (PI, RTDA, Technologist, 4 post-docs, 3 PhD); substrates, pure materials, reagents, process gas, spare parts for the commissioning phase.

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Upgrade of UniMI NFFA-DI node for fabrication and analysis of magnetic/plasmonic nano-materials

49 Activity short name

A4.13

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

Procurement, acquisition, commissioning of all upgrades and their interfacing with existing instrumentation. Commissioning of the FAIR-by-design technology upgrades and interoperability tests within the node and cross node. Commissioning of the internode sample transfer (round robins) in the framework of the NFFA-DI INSTALLATIONS:
INST. 1)
Procurement of docking station for direct transfer of FIB samples to UHV magnetic analysis with SEMPA and SFEMPA of UniMI. FAIR-protocol data acquisition and sharing of metadata and data.
INST. 2)
Upgrade of cluster source for composition control of deposited nanoparticles via accurate mixing of the process gas (thus expanding the offer of nanoparticle integration to oxides, sub-stoichiometric oxides and doped particles).
Adapt deposition apparatus to docking station and vacuum shuttle for sample transferability. FAIR-protocol data acquisition and sharing of metadata and data
INST. 3)
Procurement of Upgrades of SEMPA and SFEMPA apparatuses. Upgrade of SEM control system on existing Hitachi and JEOL SEMPA columns. Upgrade of STM UHV apparatus for UHV sample exchange with SEMPA and other analytical instrumentation at all nodes (2 UHV Shuttles and 3 docking stations). Installation of a confocal setup (laser and spectrometer) along one UHV instrument ports for optical excitation and structural characterization of samples correlating with spin imaging.
Commissioning of upgraded SEMPA and SFEMPA facilities, interoperability tests, FAIR-protocol data acquisition and sharing of metadata and data. Upgrade for sample transferability of XPS/analytical UHV facility with docking station for sample transferability, interoperability tests.
Procurement and commissioning of UHV micro-Raman imaging setup for chemical and structural analysis of thin films and magnetic opto-plasmonic devices as in situ correlative technique in a dual beam electrons, Xe-ions microscope (SEM- FIB) suitable for patterning magnetic surfaces.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

130.200,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP4 - Upgrade of NFFA instrumentation]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: 12 months at 80% FTE of one High-Qualification Technologist or Research Fellow for the development of Upgrade activities related to installations 1,2,3; 24 months at 100% FTE of one High-Qualification Technologist or Research Fellow

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

495.200,00 €

Cost description: UHV micro-Raman imaging setup structural and functional materials analysis; UHV shuttles and docking stations; confocal setup for optical excitation and spectral investigation of opto- and -plasmon spintronic devices

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

122.000,00 €

Cost description: Local ISO7 environment upgrade around SEMPA and SFEMPA facilities

54.5 e. Indirect costs

52.318,00 €

Cost description: Consumables, components and fittings for UHV and high-purity gases; optical components; pulsed solid-state optical source

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
7	Completion of the TLNet structure	12.861,40	12.861,40
9	Technical information for pre-upgrade instrumentation uploaded in the digital catalogue	28.350,36	41.211,76
9	Personalized laboratory DMPs	28.350,36	69.562,12
10	First test call for access	31.308,20	100.870,32
12	Technical information for a first set of upgraded/new instruments uploaded in the digital catalogue	81.001,14	181.871,46
15	Second test call for access	86.368,26	268.239,72

36 WP title

Commissioning of access to the upgrades and community building

37 WP number

WP5

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	**OU Name**	**Applicant**
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 3	CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 6	CNR-ISM - Istituto di Struttura della Materia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano

40 WP Leader

Massimo Cuscunà (CNR-NANOTEC)

41 Summary of the activities envisaged in the WP

The Specific Objective of WP5 is the Strategy for opening access to the upgraded facilities, for the continuous update and expansion of the Catalogue, for the continuous upgrade of the RI services
The access to the upgraded NFFA-DI will start progressively as the first upgrades are commissioned (WP4) and tested by upskill in-house experiments (WP7). We call this phase "commissioning of the access" because it will lead to the stress-test of the new organization (SEP, Catalogue, TLNet, ARP) and the FAIR-data management plan (WP2, WP3) together with the novel instrumentation that will be FAIR-data ready (WP4, WP8) with the two test calls for users. The Technical Liaison Network will be setup, with a centralised coordination and contacts at all nodes. The central TLNet will build on the experience of NFFA-Europe (2015-2026) that has implemented the original concept of the FP7 NFFA Design Study (2008-2010). A data base of all instrumentation and competences and their operational status are the basic reference for the feasibility analysis of projects also. The TLNet will operate as an editorial board with all nodes contributing to the local feasibility analysis and availability of access time for a given research proposal. After the instrument level analysis (technical feasibility of all steps in the proposal) the possibility of combining more research steps at a given node of the RI is evaluated along with the possibility of transferring samples to another nodes to perform subsequent analysis or fabrication steps. The proposal is assigned a permanent identifier linking to the database. The TLNet will communicate feasibility data with the user concurring to define the most effective workflow and schedule of access to the proper INSTALLATIONS. The contact

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

TLNet at each node (the "editors") will meet virtually and exchange FAIR data sets. The TLNet will also upload timely information on the Catalogue,as the addition of newly commissioned instruments of an INSTALLATION. Each Catalogue item will be specified as available to the users in hands-on mode, in assisted mode, in remote "sample mail-in" mode or in interactive remote access, with real-time remote participation and/or remote control of instruments and computing codes. Each node will also develop and adopt laboratory-specific Data Management Plans (DMP) by implementing the DMP models developed by WP1-2 to the specific laboratories and instruments. Each node will progressively increase the interoperability of NFFA-DI. Pre-access simulations and round-robins will be performed for hardware and software upgrades within nodes and across nodes, e.g. UHV transfer of "research grade sample", conserving the quality that will allow to integrate the data obtained in both laboratories. Safety rules for user access will be aligned to International regulations and good practices, and constantly updated following recent advances also in the field of nano-safety. The final commissioning of access will take place with two test calls for proposals on month 21 and month 26 when a number of upgraded instruments and FAIR-data system will be operational. The general stress test of NFFA-DI will feed to the regular call process (4 per year) of the following 10 years.
The set of foreseen activities includes: A5.1: Community building (CNR-SPIN) Description: Engaging with users of NFFA-DI establishing a communication channel, also using social media, are important aspect of public relations strategy adopted by large research infrastructures. NFFA-DI is well connected to all European user infrastructures and the NFFA-Europe network which can provide a broad horizon to develop competitive research projects as well as to build career paths for young researchers. Outreach to new potential users from diverse disciplines and for the industrial sector will be pursued by creating open communication channels on the progress of the upgrade.
From A5.2 to A512: each UO will perform Commissioning of Access. Description: Provision of technical information and instrumentation-commissioning data for filling the online Digital Catalogue for the relevant INSTALLATIONS; upload of updates of instrument data and status as the upgraded instruments go online; Performance of pre-access simulations (interoperability tests with round-robins of sample transfer and metadata); Implementation of Laboratory-Specific DMPs; Alignment of nanosafety rules to common NFFA-DI standards; Internal inter node access to enforce interoperability through experiments or data analysis BIM; test calls 1 and 2.

42 WP inter-relation with other WWPP

WP5 interrelates with WP2, WP3 and WP4.

43 Most relevant outcome:

The innovative access model of NFFA-DI will be tested through 2 test-open-calls planned at month 21 and month 26. The test calls will open to the users the available NFFA-DI resources at the time of the call though the fully digital upgraded submission and evaluation procedure.
In order to prepare the test calls several activities must be carried out in advance:
The interface of NFFA-DI will be the Single Entry Point portal and its services build in th framework of WP2 and WP3. Of paramount importance is the exhaustive compilation of the online digital Catalogue of services. The model of the Catalogue will be an evolution of that adopted by NFFA-Europe. It is a multi-level database describing the INSTALLATIONS (ensemble of methods/instruments concurring to a research step) then the methods and techniques offered, then the instruments with their specifications and location at the different nodes of the RI, and the peculiarities of the laboratory environment of those instruments. One most relevant outcome of WP5 will be the full information of technical and operational specfications of all instrumental and methodological offer, further completed by commissioning data and continuusly updated with new calibration data of performances and reference research data. The careful population of accurate data and reliable information willturn out as kay assets for the intropera bility. The contents of the SEP Catalogue shall be uploades as prescribed by WP2/WP3. The contents will be constantly updated including the ONLINE / OFFLINE / COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
One most relevant outcome will be the setup of the Technical Liaison Network, with a centralised coordination and contacts at all nodes, enhancing the experience of NFFA-Europe. The TLNet will operate as an editorial board with all nodes contributing to the local feasibility analysis and availability of access time for a given research proposal. It will be instrumental for the technical evaluation of the proposals to establish their feasibility and the best workflow

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

will be instrumental for the technical evaluation of the proposals to establish their feasibility and the best workflow through the most appropriate nodes of NFFA-DI. The TLNet will also be the technical neural system of the research infrasrtucture, sharing the best practices, the knowledge and protocols, and training the staff to the highest performance of the digitally integrated alboeit distributed RI.
One further most relevant outcome will be the commissioning of a nation-wide exchange of samples under appropriate conditions to continue the research at different nodes and directly compare the data.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Completion of the TLNet structure	7	D5.1 - TLNet structure
Technical information for pre-upgrade instrumentation uploaded in the digital catalogue	9	D5.2 - Digital catalogue of pre-upgrade instrumentation
Personalized laboratory DMPs	9	Second release of the Data Management Plan including the first batch of laboratory DMPs
First test call for access	10	D5.4 - Report on first test call for access
Technical information for a first set of upgraded/new instruments uploaded in the digital catalogue	12	D5.5 - Digital catalogue of post-upgrade instrumentation
Second test call for access	15	D5.6 - Report on second test call for access

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Completion of the TLNet structure	7	Number of appointed TLNet members
Technical information for pre-upgrade instrumentation	9	Number of pre-upgrade entries in the catalogue

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

pre-upgrade instrumentation uploaded in the digital catalogue		
Personalized laboratory DMPs	9	Number of completed laboratory DMPs
First test call for access	10	Number of submitted proposals
Technical information for a first set of upgraded/new instruments uploaded in the digital catalogue	12	Number of upgraded entries in the catalogue
Second test call for access	15	Number of submitted proposals

46 WP Intermediate Objectives:

IO Title *Completion of the TLNet structure*

IO Bimestre *7* IO Costs *12.861,40*

IO Desciption

The TLNet is structured in a central coordinating node and local nodes at the premises of provider nodes. In case of big provider nodes, offering several installations with many techniques, can be structured with more local contacts, in charge to provide technical information and evaluations for group or even single instruments. The achievement of this IO means that all the structures of the TLNet, overall network as well as local node structures is completed, in order to be ready to supply all the technical support necessary for operational implementation of the digital catalogue and of the interoperability protocols for both pre-upgrade and upgraded/new instrumentation.

IO Title *Technical information for pre-upgrade instrumentation uploaded in the digital catalogue*

IO Bimestre *9* IO Costs *28.350,36*

IO Desciption

The local TLNet contacts are expected to provide all the necessary technical information and specification and operational data of pre-upgrade instrumentation to be included in the SEP and in the Digital Catalogue. At this phase the first level of the Catalogue navigation (group of techniques overview) and second level (technique brief description and location) must be completed for all the offered methods and services.

IO Title *Personalized laboratory DMPs*

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Title	*Personalized laboratory DMPs*		
IO Bimestre	*9*	IO Costs	*28.350,36*

IO Desciption

Data Management Plans at laboratory level.

IO Title	*First test call for access*		
IO Bimestre	*10*	IO Costs	*31.308,20*

IO Desciption

First call for users' access, to be considered as stress test of the fully Digital distributed infrastructure.

IO Title	*Technical information for a first set of upgraded/ new instruments uploaded in the digital catalogue*		
IO Bimestre	*12*	IO Costs	*81.001,14*

IO Desciption

The local TLNet contacts are expected to provide all the necessary technical information and specification and commissioning data of upgraded/ new instrumentation already installed, to be included in the SEP and in the Digital Catalogue. At this phase, all the 3 levels of the Catalogue navigation, therefore including also the detailed technical specification of the instruments are included in the Catalogue.

IO Title	*Second test call for access*		
IO Bimestre	*15*	IO Costs	*86.368,26*

IO Desciption

Second test call for access, building on the analysis of results of the first call and trying to smoothen all the mechanisms.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

-1 month each from the theorist TD III livello and from the management technician at CNR-SPIN
-7.2 PM of TECNOL III livello at CNR-IOM
-1.5 PM of a fixed-term researcher hired for the project at CNR-IFN@MI
-6 PM of a researcher (III livello) at CNR-IFN@TN
-2 PM to define the procedure for external access at CNR-IMM@BO
-12 PM of one technologist (CNR rank: level III) at CNR-IMM@CT

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

-2 PM to define the procedure for external access at CNR-IMM@BO
-12 PM of one technologist (CNR rank: level III) at CNR-IMM@CT
-2 PM of a fixed-term researcher at CNR-ISM
-1 PM for 1 researcher (CNR rank: level III), and 1 PM of 1 technologist (CNR rank: level III) at CNR-NANOTEC
-4 PM TD III livello at CNR-SPIN
-16 PM microscopist (TD tecnologo 3 livello) at AREA
-2 MM of technolgists T3 for commissioning of access to Polifab
-12 months at 20% FTE of one High-Qualification Technologist or fixed-term Researcher Commissioning of access related to installations 1,2,3 (with the role of Laboratory Manager) at UNIMI

Scientific instrumentation and technological equipment, software licenses and patent

Cost description: CNR-SPIN
•Computer hardware, software licenses (3500€+VAT)

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

Civil infrastructures and related systems

Cost description: N/A

Indirect costs

Cost description: -Consumables and travel at CNR-SPIN
-Travel at CNR-IOM
-Travel at CNR-IFN@TN
-Travel at CNR-IMM@BO
-Travel at CNR-IMM@CT
-Travel at CNR-ISM
-Travel at CNR-NANOTEC
-Travel, dissemination at AREA
-Travel at POLIFAB
-Travel at UNIMI

Training activities

Cost description: N/A

48 Activity title

Commissioning of access to the upgrades and community building

49 Activity short name

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

A5.1

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

In order to guarantee the success of NFFA-DI, as well as any scientific infrastructure, building a wide and tightly connected community of users will become essential. This requires the spreading of a general awareness in the wider community of potential users of the scientific services NFFA-DI will offer as well as the capability of keeping contact with the users after their first access.
CNR-SPIN will be engaged in building a user community around NFFA-DI. Within the wider target of national and international potential users, we will dedicate a specific effort in spreading awareness in the scientific community active in southern Italy.
Beside contributing to the NFFA-DI website, actions will be taken to spread the information on social media, during conferences (e.g. by getting a desk as sponsors, distributing brochures and possibly give a presentation), in dedicated webinars targeting local, national and international research institutions, as well as through personal contacts.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

7.853,33 €

Cost description: 1 month each from the theorist TD III livello and from the management technician

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

4.270,00 €

Cost description: Computer hardware, software licence

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.5 e. Indirect costs

848,63 €

Cost description: travel and consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to CNR-IOM for digital growth and multiscale analytics of 1D/2D systems

49 Activity short name

A5.2

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-IOM will contribute to the NFFA-DI online Catalogue offering a wide range of methods and services in installations 1, 2, 3, and 4:
Inst. 1: lithography, wet and dry etching (EBL, FIB), (UV/EUV/EVU-IL)
Inst. 2: molecular beam epitaxy (metal oxide MBE, high mobility MBE), physical, pulsed and chemical vapor deposition (PVD, CVD, PLD)
Inst. 3: photon/electron spectroscopies with visible, UV and X-ray sources, synchrotron and free electron laser radiation (Elettra and Fermi), table-top laser sources. Electron and scanning probe microscopies (AFM, STM)
Inst. 4: theory/simulation methods
Funds will bring the present instruments, developed and operated by groups with a long living expertise, to top capabilities for the sake of national research groups.
The details on each machine/technique will be formatted as the SEP Catalogue from WP2/WP3 and will be updated providing the operational status of the nodes at the time of user proposal submission.
At CNR-IOM, co-located with two large facilities, a local TLNet coordinator will be in charge of managing the TLNet contribution from all the CNR-IOM scientists, who will have direct access to the SEP platform to provide evaluations and technical contributions.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

from all the CNR-IOM scientists, who will have direct access to the SEP platform to provide evaluations and technical contributions. The local coordination will inform about deadlines, will monitor the timeline of due contributions, and will manage critical assessments arranging new evaluations in order to provide timely alternative access in a different NFFA-DI node.
Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (sample transfer, remote data/protocol access)
The experience of CNR-IOM to deal with chemical and particulate hazards will contribute to the definition of NFFA-DI nano-safety standards for staff and users, ensuring the application of the agreed protocols.
Each laboratory will adopt its specific Data Management Plans (DMP) consistently with the overall NFFA/DI DMP developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

30.096,00 €

Cost description: 7,2 PM of a technologist (III livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.106,72 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to IFN@MI in installation 3 (time-resolved spectroscopy of extended systems)

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

49 Activity short name

A5.3

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-IFN@MI will contribute to the NFFA-DI online digital Catalogue offering three advanced beamlines for ultrafast spectroscopy in materials within INSTALLATION 3. The ultrafast THz spectroscopy will implement optical pump pulses, broadband THz probe, capability for transmission and reflection geometry, and measurements in water-free environment. The beamline for ultrafast XUV transient absorption spectroscopy will feature an XUV source based on HHG driven by few-cycle mid-IR pulses, a state-of-the-art high-resolution XUV spectrometer, and UHV interaction chamber for transient measurements in transmission and reflection geometry. The beamline for HHG spectroscopy in solids will be upgraded with a new driving laser source, a high-energy mid-IR OPA, and a spectrometer and polarimeter. All the three beamlines will have capability for temperature-dependent measurements. This combination of instruments for advanced ultrafast spectroscopy is unique in Italy, with only a handful of similar facilities in the world. The contents will be formatted as prescribed by the SEP Catalogue provided by WP2/WP3 and will be constantly updated including the ONLINE / OFFLINE / COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
CNR-IFN@MI will appoint and instruct a local contact for the TLNet according to the prescriptions of WP2. The local contact will assess the feasibility of the proposed experiments on the CNR-IFN@MI beamlines. Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (e.g. sample transfer, remote data/protocol access, etc.)
CNR-IFN@MI will adhere to the nanosafety standards adopted by NFFA-DI concerning sample handling.
CNR-IFN@MI will also establish and adopt its laboratory-specific Data Management Plans (DMP) consistently with the overall NFFA/DI DMP as developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

6.270,00 €

Cost description: 1.5 person-month of a fixed-term researcher hired for the project. The fixed term personnel will work as the local contact for the commissioning of integrated access activities.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

438,90 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to IFN@TN for micro-nano-fabrication, fast prototyping/integrated photonics

49 Activity short name

A5.4

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 3	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The requested upgrade is going to ensure an important asset in the proof-of-concept and prototyping phases of micro-nano devices. The Facility is already equipped with a dual (ion and electron) beam tool (FIB/SEM) dedicated to nanofabrication R&D. The instrument

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Facility is already equipped with a dual (ion and electron) beam tool (FIB/SEM) dedicated to nanofabrication R&D. The instrument is equipped with a Liquid Metal Alloy Ion Source (eutectic alloy based on gold) and it is hence placed in our MEMS cleanroom where the widest variety of materials and sample size (the instrument can only effectively work with cm2 pieces) is used. The CMOS-like cleanroom (mainly dedicated to radiation sensors and integrated photonics) is currently limited with the CD obtainable with our stepper (~350 nm). Maskless lithography (electron beam lithography-EBL and direct laser write lithography) will soon be available to allow the drastic reduction in the critical dimension achievable (<20 nm) and, through the combination of the two technologies, such critical dimension will be available for large area devices as for example is requested for integrated photonics.
With the requested upgrade a general nano on micro integration will be available and also offered as a service. To this purpose, a tool allowing the definition of the nanostructures as well as a conformal passivation is required. To this purpose an upgrade in the dry etching capabilities is also requested and the acquisition.CNR-IFN@TN will appoint and instruct a local contact for the TLNet according to the prescriptions of WP2. The local contact will assess the feasibility of the proposed experiments on the CNR-IFN@TN nanofabrication line. Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (e.g. sample transfer, remote data/protocol access)
CNR-IFN@TN will adhere to the nanosafety standards adopted by NFFA-DI concerning sample handling and will also establish and adopt its laboratory-specific Data Management Plan (DMP) consistently with the overall NFFA/DI DMP as developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

25.080,00 €

Cost description: 6 person months of a researcher (III livello) for the commissioning of the integrated access activities, coordinating with the other nodes

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.755,60 €

Cost description: travel

54.6 f. Training activities

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to CNR-IMM@BO for research on advanced nanoscience and nanotechnology

49 Activity short name

A5.5

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The commissioning of access to the CNR-IMM@BO node will be designed to provide tailored support to both academic and industrial (SMEs or Startup companies) users, in order to meet research demands needing medium/low TRL applications.
The commissioning consists in:
•Construction of a new Digital Catalogue for CNR-IMM@BO nano-processsing technology offer in INSTALLATIONS 1, 2 and 5, and its continuous update throughout the project lifetime as the upgraded instruments go online. In the meantime, pre-access simulations on interoperability tests with round-robins of sample transfer and metadata exchange will be performed together with the project partners to optimize the inter-node and external user access procedures.
•Laboratory-Specific Data Management Plans (DMPs) in accordance to the models defined in WP1 and 2 will be implemented, in compliance with the FAIR-by-design criteria developed in WP3.
•Exchange of expertise with other nodes under central NFFA-DI coordination through meetings and on-line workshops, to optimize homogeneity of the different DMPs, define common criteria for "research grade samples" and prepare for the two access test calls for proposals on month 21 and month 26.
•Alignment of safety rules to common NFFA-DI standards.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: 2 person month to define the procedure for external access

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

585,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access and community building at CNR-IMM@CT for Installations 1/3/5

49 Activity short name

A5.6

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

52 Activity description

Provision of technical information for filling the online Digital Catalogue for INSTALLATIONS 1, 2, 3, 4 (Additive prototyping, Small to Wide angle X-Ray Scattering, 3D elemental profiling, Dynamic transmission and multipurpose scanning electron microscopy) and for its continuous update as the upgraded instruments go online. Performance of pre-access simulations (interoperability tests with round-robins of sample transfer and metadata). The specific information of the upgrades will be integrated to the ones of existing facilities in order to assist the user choices in the phase of proposal preparation and submission. Laboratory-Specific DMPs will be implemented re-addressing the past DMPs towards the NFFA/DI DMP as developed by WP1 and WP3.
Safety standards of the UO are already fully aligned to the national regulations and some more restricted rules with respect these regulations are already applied for some use protocols. An analysis of the local standard and the new NFFA/DI standards will be performed whereas the eventual dynamic towards less stringent ad-hoc regulation will be considered as a critical issue. The central coordination of the local expertise of the nodes during the staff and user accesses will facilitate the rules alignment
The final commissioning of access will be validated with two test calls for proposals on month 21 and month 26.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

50.160,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, will be focused on the Commissioning of access for the CNR-IMM@CT UO. The activity requests funding for 12 person months of one technologist (CNR rank: level III)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.511,20 €

Cost description: travel

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Commissioning of access to CNR-ISM for high rep. rate ultrafast transient absorption spectroscopy

49 Activity short name

A5.7

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 6	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

In installation 3 the CNR-ISM will offer a complete characterization by means of optical spectroscopy. The offer will encompass steady-state and time resolved spectroscopies in the IR-Vis-UV wavelength range. In particular, the upgrade (new high repetition rate laser system, new spectrometer+microscope and flash photolysis equipment) will complement the existing pump-probe transient absorption spectroscopy equipment (1 kHz, 50 fs, 4 W) and will increase the repetition rate (up to 100s kHz), widen the excited carrier density range (from 1015 to 1020 cm-3), extend the delay time range (from fs up to ms) and improve the spatial resolution. The local TLNet activity will be divided into pump-probe transient spectroscopy which will be upgraded with the new system and fluorescence spectroscopy (steady-state and time resolved). The local TLNet will be in close contact with the other nodes of the installation to offer efficient solutions to characterize optoelectronic properties of materials and devices, in particular with the nodes employing high-energy time resolved spectroscopies, which are complementary to those used in this node.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: The activity of the fixed term researcher (level III) will aim at working as local TLNET contact in the commissioning of the access to the facility. The activity requests funding for 2 person months

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

585,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to CNR-NANOTEC for research on MBE and Advanced Correlative Microscopy

49 Activity short name

A5.8

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The activity of CNR-NANOTEC will consist in preparing the content that must fulfill the online digital catalogue with the own offer related to the following INSTALLATIONS: 1) Multi-Beam SEM along with an automated system for serial sectioning, 2) Serial Block-face-SEM, 3) Upgraded SEM and Cross Beam (FIB/SEM). The Multi-Beam SEM will be an outstanding key enabling technology for NFFA-DI users over the next years by providing the highest-ever acquisition speed at nanometer resolution (<10nm).

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

technology for NFFA-DI users over the next years by providing the highest-ever acquisition speed at nanometer resolution (<10nm). The contents for the online digital catalogue will be formatted as prescribed by the SEP Catalogue provided by WP2/WP3. The contents will be constantly updated including the ONLINE/OFFLINE/COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
A local contact for the TLNet will be identified and instructed according to the prescriptions of WP2 (central TLNet coordination).
CNR-NANOTEC aims to define a local working group comprising the heads of the upgrades in order to easily give feedback to requests and questions by users from first explorative contact to data management, mainly for access to the correlative microscopy platform embracing different expertise of the local staff.
Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (e.g. sample transfer, remote data/protocol access, etc.).
CNR-NANOTEC will contribute to the definition by TLNet of NFFA-DI, nanosafety standards for staff and users, and ensure the application of the agreed protocols. Also, CNR-NANOTEC is engaged to derive design strategies for even safer nanomaterials.
Each node will also establish and adopt its laboratory-specific Data Management Plans (DMP) consistently with the overall NFFA/DI DMP as developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: one researcher (CNR rank: level III) for 1 month, one technologist (CNR rank: level III) for 1 month, as local TLNet contact for the commissioning of integrated access activities.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

585,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to CNR-SPIN for research on epitaxy and heterostructures of nanomaterials

49 Activity short name

A5.9

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The node will mainly offer access for experiments that, being based on the use or INST. 2 or 5, will be extended to INST. 1 or 3. Direct access to INST. 1, 3 with samples produced elsewhere will typically not be in our policy. The upgrade will endow us with a single cluster of UHV-connected chambers in which growth of films, heterostructures and devices made of many different materials (oxides, hybrids, organics and metals) will be performed. Within the same cluster, in-situ characterization by ARPES, low-T STM, core-level XPS and SPA-LEED will be available. Support by our theorist in the interpretation of the data collected in this and in other nodes will represent a crucial part of the services offered to users.
A local contact for the TLNet will be identified and instructed according to the prescriptions of WP2 (central TLNet coordination). The local contact will act as joining link between the central TLNet, the personnel working the node in addressing the users requests.
The present safety standards will be upgraded to NFFA-DI standards.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

16.720,00 €

Cost description: 4 months TD III livello

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.170,40 €

Cost description: Missions

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to AREA for materials analysis across the full TRL scale

49 Activity short name

A5.10

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The Activity of AREA will consist in preparing the content (technical specifications and commissioning data) that must fulfill the online digital Catalogue relative to its offer in INSTALLATION 1,3,5. The contents shall be formatted as prescribed by the SEP Catalogue provided by WP2/WP3. The contents will be constantly updated including the ONLINE / OFFLINE / COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
A local TLNet AREA contact will be identified and instructed according to the prescriptions of WP2 (central TLNet coordination).
Alignment with other nodes to prepare the access programme will also include establishing operational interfaces with the other nodes, e.g. by adopting the NFFA-DI sample exchange standard at all experimental stations and participating to round-robins to test the interoperability. Local user access protocols will be established aligning with NFFA standards.
AREA will contribute to the definition by TLNet of NFFA-DI nanosafety standards for staff and users, and enforce the agreed protocols in its own laboratories.
AREA will define Data Management Plans (DMP) for the three installations consistently with the general DMP established under WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

68.112,00 €

Cost description: 16 PM microscopist (TD tecnologo 3 livello)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

4.767,84 €

Cost description: travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to PoliFAB for "wafer-scale" research on advanced materials

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

49 Activity short name

A5.11

50 Activity Start month and duration

Activity Start month	13	Activity Duration	18

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

POLIFAB will contribute to the NFFA-DI online digital Catalogue offering advanced micro-nanofabrication techniques (Installation 1) already available to POLIFAB users (see online digital catalogue of Polifab at https://www.polifab.polimi.it/equipments/) and under installation in the framework of the creation of the novel research and innovation infrastructure in collaboration with STMicroelectronics. Funds from the present project will allow to expand Polifab capabilities on advanced materials thus adding specific equipment/techniques to NFFA-DI:
- Installation 2-5: Cluster tool for combinatory growth (PLD, CVD, ALD) on 6" wafers
- Installation 3: (i) In-situ investigation of electronic structure (XPS, ARPES) on small samples grown with wafer-scale growth machines; (ii) RF station for material and device analysis; (iii) time-resolved polarization microscope.
The details on each machine/technique will be formatted as prescribed by the SEP Catalogue from WP2/WP3 and will be constantly updated including the ONLINE / OFFLINE / COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
POLIFAB will appoint and instruct a local contact among the staff for the TLNet according to the prescriptions of WP2. In agreement with standard access policies of Polifab, the local contact will assess the feasibility of the proposed fabrication processes/experiments.
POLIFAB will adhere to the nanosafety standards adopted by NFFA-DI concerning sample handling, and also adopt a specific Data Management Plans (DMP) consistently with the overall NFFA/DI DMP as developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

7.750,00 €

Cost description: 2 MM of technolgists T3 for commissioning of access to Polifab

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

542,50 €

Cost description: upgrade of Polifab informatic infarstructure for users access

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Commissioning of access to UniMI for fabrication and analysis of magnetic/plasmonic nano-materials

49 Activity short name

A5.12

50 Activity Start month and duration

Activity Start month	15	Activity Duration	16

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

The Activity of UNIMI will consist in preparing the content that must fulfil the online digital Catalogue relative to their offer in INSTALLATION 1,2,3,4. The contents shall be formatted as prescribed by the SEP Catalogue provided by WP2/WP3. In particular UNIMI will upgrade its cluster growth facility and install a all-new capability in magnetic and plasmonic optical characterization. The speciality of UNIMI in surface magnetic microscopy will greatly enhance state of the art sample fabrication. The contents will be constantly updated including the ONLINE / OFFLINE / COMMISSIONING status flags that give evidence of the operational status of the nodes at the time of user proposal submission.
A local contact for the TLNet will be identified and instructed according to the prescriptions of WP2 (central TLNet coordination). Two TLNet UNIMI contacts will be identified: one for the ensemble of experimental services, and one for theory and computation services. Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (e.g. sample transfer,

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP5 - Commissioning of access to the upgrades and community building]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Alignment with other nodes to prepare the access programme will also include round-robins to test the methodology (e.g. sample transfer, remote data/protocol access, etc.)
Contribution to the definition by TLNet of NFFA-DI nanosafety standards for staff and users, and ensure the application of the agreed protocols. Nanosafety standards will be elaborated, including direct in-UHV sample handling between patterning and microscopy analysis.
UNIMI will establish and adopt its own laboratory-specific Data Management Plans (DMP) consistently with the overall NFFA/DI DMP as developed by WP1 and WP3.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

9.300,00 €

Cost description: 12 months at 20% FTE of one High-Qualification Technologist or fixed-term Researcher Commissioning of access related to installations 1,2,3

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

651,00 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
6	Design of the IRA procedures	27.329,94	27.329,94
8	Graphical interfaces for simulation tools for NFFA-DI community	53.671,20	81.001,14
9	Virtual Access Services 1 : Semi-automatic classification service	27.329,94	108.331,08
9	Helpdesk Set Up	9.109,98	117.441,06
12	IRA guideline	27.329,94	144.771,00
14	Standardized simulation workflows for NFFA-DI community for standard properties calculations	53.671,20	198.442,20
14	Setup of the Digital portfolio	45.549,90	243.992,10
15	Virtual Access Services 2 : Ready-to-use Neural Networks	13.664,97	257.657,07
15	AI-augmented research infrastructure facility available	13.664,97	271.322,04

36 WP title

Research Support Services: Access provision through advanced methods and technology ; Intellectual P

37 WP number

WP6

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

OU Short Name	OU Name	Applicant
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE

40 WP Leader

Alessio Ansuini (AREA)

41 Summary of the activities envisaged in the WP

WP6 is devoted to implement a class of new diverse services to support the wide research communities addressed by the NFFA-DI RI. The range of services is vast and involves not only technical services but also services for the valorization of research results and knowledge transfer to the productive world, with the aim of promoting the NFFA-DI long-term sustainability.
Activities 6.1 and 6.2 will develop and deploy services to favour interactive remote access (IRA) to the infrastructure and services implemented by other WPs.
Taking advantage of lessons learned in recent times, access will be designed to face changes of habits in mobility of the post COVID-19 era: IRA, already available on some experimental facilities, will be further generalized in this WP along with innovative Virtual Access by leveraging on some specific pilots of FAIR-by-design data generation.
Entering in contact with a multimodal virtual experience, users will be able to access methodologies specifically designed to increase their involvement, thus favouring an enlargement of the whole NFFA-DI community.
Activity 6.3 is focused on setting-up the Intellectual Property & Marketing (IP&M) Helpdesk, which will raise NFFA-DI scientists' awareness of the business potential of their own inventions. To this aim, Area Science Park will make available its PatLib Centre to the NFFA-DI community, offering information about patents and patent filing procedures, verifying the novelty of the results achieved conducting prior-art searches on patent documents and providing information about research results global market potential and trends.
Activity 6.4 is aimed at building, establishing, and consolidating contacts, relationships, and collaboration with companies, applying Area Science Park business intelligence competences and tools to find NFFA-DI industrial targets to be contacted and conveyed through EP.
Activities 6.5 and 6.6 intend to establish an AI and simulations-enabling computational facility for nanoscience applications, leveraging on the upgrade of the existing computational infrastructures of the AREA-Basovizza site with a significant increment of both data storage and computing capabilities, specifically designed for current and future challenges in AI for computational nanoscience. This facility is tailored to integrate the upgraded NFFA-DI installations: on the one hand researchers will have immediate access to post-processing of the data of each experiment, on the other hand they will interact with a composite data and computational ecosystem that will enable large-scale statistical analysis together with AI-based analysis, transversal to experiments as well as to simulations. The Activities of WP6 will be coordinated by Area Science Park, but a strong commitment and involvement by all the Partners will be fundamental for reaching the objectives which will be beneficial for the overall open research and innovation environment.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

reaching the objectives which will be beneficial for the overall open research and innovation environment.
WP6 Activities 1 to 2 will not require large investments, since they are complementary with activities in WP3.
WP6 activity 5 to 6 require instead a large IT infrastructure investment that will be performed by WP3 through activity 3.1.
Activities 6.3 and 6.4 will not require large investments, since they are aligned with Area Science Park overall mission and existing competences in IP Management and Research Valorization. Nevertheless, NFFA-DI needs a customized approach which will be guaranteed by adding one additional staff unit.

42 WP inter-relation with other WWPP

WP3: data and computational platform; WP5: innovative way to provide interactive remote access; WP7: innovative work of partners

43 Most relevant outcome:

The outcome of this WP is a complete portfolio of integrative ready-to-use services for the research community.
We are facing a digital transformation, speeded up also by recent events, which, for its nature it's also involving research and the way it will be performed in the years to come.
In addition to common ways to perform research on-site, this WP will develop IRA, a flexible method to break down the wall between physical and digital worlds running experiments.
Remote access, virtualization, in a multi-channel approach, will provide the community the accessibility to the facilities and tools wherever they are.
In addition, the WP will try to deploy a live interaction platform to run experiments from remote with the support of on-site personnel and by means of digital dashboards.
This will drastically reduce the distances among resources while improving the quality and productivity of many collaborative projects, enabling therefore a fully participative users research also during possible long-lasting mobility restrictions.
Overall sustainability level of the community and the relevant ecosystem will benefit, and they will contribute to a more sustainable society.
NFFA-DI, thanks to activities 6.1 and 6.2, will set the basis to the overall goal, increasing the resilience of research infrastructures while reducing their ecological footprint also considering the reducing of commute and travel to the minimum necessary.
NFFA-DI will be accessible for research, training, and commercial purposes.
Each installation, instrument, options of access and relevant tools will be presented using an indexed portfolio: standard in-presence (both hands-on and hands-off) and remote access as usual, plus IRA when available.
The portfolio will be live, always updated, to allow users to access the latest implementations and related IRA protocols available.
Activities 6.3 and 6.4 will stimulate NFFA-DI to act as a supplier of new knowledge and innovation, developing both technology push processes, developing functions more commonly linked with technology transfer, such as patent licensing, and demand pull processes to engage with potential industrial partners and customers.
To complement the WP, activity 6.5 will deploy and develop pipelines of deep learning algorithms to increase the automation in postprocessing of data and improve the reconstruction of results obtained from the experimental techniques. Advanced statistical analysis of multiplexing data produced and automatic classification techniques will be available for several experimental sources.
The opening of NFFA-DI facilities will create a broad range of scientific complementary competences and skills that could act as supply side of new knowledge and as effective testbeds of innovative technologies.
Activity 6.6 will develop and apply computational HPC tools for the simulation of materials properties based on density functional theory and will make them available to the experimental and theoretical communities of users of large-scale facilities. These HPC applications will allow to perform numerical modelling on HPC resources with the use of web applications to assist experimental groups in the planning and interpretation of their measurements.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Objectives:

Title	Bimester	Deliverables
Design of the IRA procedures	6	D6.1 - Report and specification document of the Protocol of IRA procedures
Graphical interfaces for simulation tools for NFFA-DI community	8	D6.2 - Report on graphical interfaces for simulation tools
Virtual Access Services 1 : Semi-automatic classification service	9	D6.3 - Design of the semi-automatic classification service
Helpdesk Set Up	9	D6.4 - IP&M Helpdesk guidelines
IRA guideline	12	D6.5 - Report and specification document of the Protocol of IRA procedures
Standardized simulation workflows for NFFA-DI community for standard properties calculations	14	D6.6 - Report on graphical interfaces for simulation tools
Setup of the Digital portfolio	14	D6.7 - Report on the installation the Portfolio
Virtual Access Services 2 : Ready-to-use Neural Networks	15	D6.8 - Report on ready-to-use Neural Networks for scientific image classification
AI-augmented research infrastructure facility available	15	D6.9 - Report on the AI-augmented research infrastructure

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Design of the IRA procedures	6	Number of cost models defined

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IRA procedures		
Graphical interfaces for simulation tools for NFFA-DI community	8	Number of graphical tools in the interface application
Virtual Access Services 1 : Semi-automatic classification service	9	Number of datasets automatically classified
Helpdesk Set Up	9	Number of researchers asking advisory services to the Helpdesk (target 10 at BIM15)
IRA guideline	12	Number of OUs adopting IRA platforms
Standardized simulation workflows for NFFA-DI community for standard properties calculations	14	Number of experimental techniques/systems addressed with the developed workflows
Setup of the Digital portfolio	14	Number of services identified (target >5)
Virtual Access Services 2 : Ready-to-use Neural Networks	15	Number of instruments for which deep learning algorithms, aimed at facilitating usage, are designed and deployed
AI-augmented research infrastructure facility available	15	Number of experimental sources successfully considered for advanced ML analysis on multiplexing data

46 WP Intermediate Objectives:

IO Title *Design of the IRA procedures*

IO Bimestre *6* IO Costs *27.329,94*

IO Desciption

The objective focuses on the definition of terms and conditions to access IRA with the definition of the cost models to give evidence of operating running costs each Partner will incur.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

operating running costs each Partner will incur.

IO Title	*Graphical interfaces for simulation tools for NFFA-DI community*		
IO Bimestre	*8*	IO Costs	*53.671,20*

IO Desciption

The goal of Activity 6.6 is to develop new software, graphical tools and interfaces to facilitate the use of theoretical approaches based on density functional theory. The target users of these tools are experimental groups performing measurements at NFFA-DI. This first objective is the successful development of graphical interfaces to enable the user-friendly set up of input files, structure generation and structure editing.

IO Title	*Virtual Access Services 1 : Semi-automatic classification service*		
IO Bimestre	*9*	IO Costs	*27.329,94*

IO Desciption

Develop tools for retrieval of several advanced features including, but not limited to, tools to sort/group images by similarity, size to organize it in structured DB

IO Title	*Helpdesk Set Up*		
IO Bimestre	*9*	IO Costs	*9.109,98*

IO Desciption

The focus of the IO is to setup the helpdesk. The function of the Helpdesk is crucial to raise awareness on technology transfer strategies to exploit NFFA-DI research results and bring academic inventions to the market.

IO Title	*IRA guideline*		
IO Bimestre	*12*	IO Costs	*27.329,94*

IO Desciption

The spefication will be implemented in a set of IRA procedures. The IRA guideline will allow the community to understand structures, tools and procedures implemented and made available.

IO Title	*Standardized simulation workflows for NFFA-DI community for standard properties calculations*		
IO Bimestre	*14*	IO Costs	*53.671,20*

IO Desciption

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

The goal of Activity 6.6 is to develop new software, graphical tools and interfaces to facilitate the use of theoretical approaches based on density functional theory. The target users of these tools are experimental groups performing measurements at NFFA-DI. This second objective is the successful design of computational recipies and workflows to simulate a variety of experimental measurements (i.e. STM images, ARPES, …).

IO Title	*Setup of the Digital portfolio*		
IO Bimestre	*14*	IO Costs	*45.549,90*

IO Desciption

The "Digital Portfolio" represents the essential tool to decline NFFA-DI offer for the business world, allowing the development of applied research projects. Investigation potentiality is organized in its possible industrial applications (including case studies), in order to guide and support companies in identifying, choosing and applying for both stand-alone services and multi-technique investigations offered by NFFA-DI.

IO Title	*Virtual Access Services 2 : Ready-to-use Neural Networks*		
IO Bimestre	*15*	IO Costs	*13.664,97*

IO Desciption

Deployment of deep learning algorithms for image analysis and/or automatic classification

IO Title	*AI-augmented research infrastructure facility available*		
IO Bimestre	*15*	IO Costs	*13.664,97*

IO Desciption

The main objective of Activity 6.5 will be, in the top of the upgraded Orfeo computational facility to establish an AI- augmented research infrastructure that enables the experimental stations of NFFA-DI to exploit state-of-the- art machine learning algorithms for nanoscience and materials.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:
AREA
-24 PM of 1 Data engineer
-12 PM of 1 project manager
CNR-IOM
-24 PM of 1 researcher (III livello)

Scientific instrumentation and technological equipment, software licenses and patent

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

Civil infrastructures and related systems

Cost description: N/A

Indirect costs

Cost description: AREA
•Travel, dissemination
CNR-IOM
•Travel

Training activities

Cost description: N/A

48 Activity title

Innovative procedure for interactive remote access

49 Activity short name

A6.1

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The commitment of all providers will be devoted to implement Interactive Remote Access – IRA - defined as a set of the best communication protocols and interactive modes to ensure continuity in research flow also in case of restrictions of mobility.
IRA will enable control of the execution of the experiments by the users having direct video contact with the facility operators, immediate access to the acquired data and tools for quick-analysis to steer the remote operations leading to success of the research as close as possible

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

to in-presence customary practices. This implies extra effort on the provider side, but it may bring to overall advantages in economic terms and in CO2-footprint of access to the RIs. Moreover, RA will be offered also for theory (access to simulation codes) and for scientific data services (searching, on-line analysis of data generated by the user proposal).
IRA tools will be developed both at the interactive remote communication level and at the remote piloting capabilities for at least some of the instruments of the portfolio, granting the possibility to share with remote users the dashboard locally operated by the laboratory staff.
The IRA protocols address:
1.set-up of instruments, sample loading, sample treatments, growth protocol development, growth sequences, characterisation parameters and sequences ;
2.direct remote setting and starting of data acquisition by instruments or real-time sharing of the acquisition dashboard locally operated by the facility staff interacting with remote user;
3.remote data processing and interpretation (which can begin in parallel with data collection and continues afterwards) which will provide through easy and quick pre-formatted preview of result enabling the user an overview to take stock of the situation of the work plan.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8 PM We plan to hire a fixed time development scientist for 24 months period. The profile is a data engineer with a sound competence in the field of software engineering, high performance computing, development of data services and data-centric-AI and MLOP. He will work on activities 6.1 6.2 and 6.5

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: travel

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Virtual Access Services for NFFA-DI user community

49 Activity short name

A6.2

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The activity has the goal to create several virtual access services that can be classified in broad categories:
–Specific Data Services, developed within well-defined experimental/computational techniques addressed mainly to their developers and users ;
–Generic Data Services, developed to cover wide range of general purpose for specific class of scientific data, i.e. images, 3D archives and so on
Services will be seamless integrated and linked to the OFED data repository: this will allow scientists to run directly the services using live data available and already stored, avoiding any useless data transfer and/or uploading/downloading.
Looking forward, with some prior data quality validation, it will also accept users' external dataset.
Overall, the activity 6.2 will provide several advanced features including, but not limited to, tools to sort/group images by similarity, size (automatically detected by metadata and/or by OCR procedure), to organize it in structured DB, to process semi-automatic classification, to harvest metadata automatically, etc.
On top of these, the community will benefit from an advanced platform for scientific image classification, based on already trained and ready-to-use Neural Networks, that can be integrated with users' ML classificatory, if trained and built with their own labelled set of images and categories.
AREA data engineering team will guarantee the quality of virtual access, in term of software quality, stability of the workflows and high availability and scalability of the hidden IT layers on the top of which the services are offered.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8 PM - We plan to hire a fixed time development scientist for 24 months period. The profile is a data engineer with a sound competence in the field of software engineering, high performance computing, development of data services and data-centric-AI and MLOP. He will work on activities 6.1, 6.2 and 6.5

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

MLOP. He will work on activities 6.1, 6.2 and 6.5

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Intellectual Property & Marketing (IP&M) Helpdesk for NFFA-DI community

49 Activity short name

A6.3

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste -

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

e Tecnologica di Trieste -
Area Science Park

52 Activity description

NFFA-DI will bring together a wide diversity of expertise and interests to look for solutions to many challenges that material science is facing today. The relationship between scientific excellence, innovation and Intellectual Property Rights (IPRs) must therefore be addressed in order to assess and exploit NFFA-DI own research results.
IPRs, especially patents, play a crucial role in technology transfer, providing a framework to establish correct relationships with partners capable to bring academic inventions to the market.To this aim, it's necessary to raise the awareness of NFFA-DI community on how to transform research results into economically viable forms of technology.
Area Science Park PatLib Centre will act as "Helpdesk" within the NFFA-DI community, providing information about patents, patentability and filing procedures. The IRA protocols will be consistent with following an outline broadly like standard experiments completed as of today. Verifying the novelty of the results obtained conducting prior-art searches on patent documents and managing IP in accordance with the contributions of NFFA-DI inventors.
It is worth to notice that this Activity, with particular reference to the searches conducted on patent documents, is strictly linked with Business Development, both providing information about the state of the art of the technologies than identifying leaders and competitors, which are exactly the target of NFFA-DI scientific and technological offer.Moreover, the Helpdesk will integrate patent documents with other reliable references, including business intelligence database and tools, in order to assess the technologies market landscape and to identify possible licensees, or partners in their further development.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

25.542,00 €

Cost description: A project manager will be involved in 6.3 and 6.4 activities for 6 month each. The position requires a STEM background, at least 1 year of experience in Project Management or Technology Transfer and standing communication skills

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

1.787,94 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Business development

49 Activity short name

A6.4

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The aim of the Business Development Activities is to define NFFA-DI industrial target and to establish contacts with potential partners or clients.
The first step is to clearly define the industrial applications of NFFA-DI facilities (e.g development of nano-structured materials) and then identify more specific targets (e.g companies developing smart coatings), both for the single facilities and for the NFFA-DI integrated offer.
This task will be achieved by the dedicated team at Area Science Park, conducting analysis mixing primary (information gathered from scientists of NFFA-DI facilities) and secondary sources, including patent and business intelligence database and tools fed within activity 6.3.
Meanwhile, the integrated offer of the NFFA-DI has to be organized with particular reference to the main industrial application of technologies and facilities, in order to be presented to companies both as stand-alone services (e.g providing access to specific scientific instrumentation) and as a complete value chain (e.g. NFFA-DI acting as a Contract Research Organization for characterization of nano-structured materials).
This will have the final aim to develop an interactive digital portfolio, to be promoted among target companies identified with the abovementioned business intelligence activities.
The Business Development strategy will be implemented using both web channels that direct promotion to companies, and also through Area Science Park affiliation to national and international networks (e.g. Enterprise Europe Network could provide support in searching potential business partners arranging meetings in international matchmaking events, which bring together businesses and

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

research organizations looking for partners alongside international trade fairs and conferences).

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

25.542,00 €

Cost description: 6PM - A project manager will be involved in 6.3 and 6.4 activities for 6 month each. The position requires a STEM background, at least 1 year of experience in Project Management or Technology Transfer and standing communication skills

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.787,94 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

AI augmented experimental platform

49 Activity short name

A6.5

50 Activity Start month and duration

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Activity Start month	6	Activity Duration	25

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

The objective of Activity 6.5 is the development of an AI-augmented research infrastructure aimed at enhancing the results and at integrating the findings of other WPs.
The activity will rely on a cutting-edge computational architecture specifically tailored for modern AI applications.
Based on the expertise of RET research group, state-of-the-art machine and deep-learning (ML and DL) algorithms for nanoscience and material applications will be deployed, and ad-hoc implementations based on most recent AI approaches will be specifically designed.
Powered by selected instrumental outputs, tailored ML and DL methods will assist experimental design, enhance the quality of the results, allow the integration of diverse data sources while speeding up the relevant analysis.
The focus points of the activity are deeply rooted in the latest achievements of the data-driven revolution in nano and material sciences introduced by AI:
–deploy and possibly further develop deep learning algorithms aimed at facilitating instrument usage by automating the postprocessing of data, and improving the reconstruction of results obtained from the experimental techniques;
–perform advanced statistical analysis of multiplexing data produced by several experimental sources other WPs
–assist human annotation and understanding of experimental large data sets through automatic classification techniques.
In close collaboration with the other WPs, this activity will foster the harmonization of the diverse workflows of the laboratories to speed up discovery ensuring safety, performance and reliability.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8PM - We plan to hire a fixed time development scientist for 24 months period. The profile is a data engineer with a sound competence in the field of software engineering, high performance computing, development of data services and data-centric-AI and MLOP. He will work on activities 6.1, 6.2 and 6.5

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

In-silico experimental platform

49 Activity short name

A6.6

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Theoretical approaches based on density functional theory allow for accurate calculations of a large number of properties which can be measured at large scale facilities (LSF) and advanced characterization facilities. Examples include the band structure of a solid, optical absorption and NMR spectra of molecules, core level excitations, STM images of surfaces. Many of these calculations are now routine tasks that can be computed with minimal knowledge of the technicalities of computational approaches.
We plan to enable the use of robust, general-purpose flagship DFT codes to the vast community of experimental users of NFFA-DI to expedite the calculation of target properties on the materials of interest.
To this end, we need to develop a series of new tools:
-graphical interfaces to enable easy user uptake;
-novel workflows to automatize the calculation of standard properties;
-interfaces with existing materials databases and clouds to retrieve and store data in compliance with FAIR principles.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP6 - Research Support Services: Access provision through advanced methods and technology ; Intellectual P]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

-interfaces with existing materials databases and clouds to retrieve and store data in compliance with FAIR principles.
To achieve these goals, we will develop a web portal with a graphical user interface to either select the material from a database of existing crystal or molecular structures or to upload such structures.
We will develop a structure builder to define the atomic structure of specific surfaces of the material, to adsorb or manipulate molecules.
Users will then be able to select specific properties to compute, and to automatically generate the corresponding input files for DFT codes.
The calculations will then be deployed to HPC infrastructures, and, online, the results will be automatically visualized, processed and archived in a database.
Activity 6.6 will focus mainly on two widely used experimental techniques for materials characterization:
-STM images of adsorbates on metallic surfaces
-angle resolved photoemission spectroscopy

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

100.320,00 €

Cost description: 1 RIC III livello for two years for the development and enhancement of highly scalable, optimized codes and workflows towards an ecosystem of HPC applications aimed at assisting and supporting experimental infrastructures and research

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

7.022,40 €

Cost description: travel

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
6	Organization and start of the purchase procedure for innovative equipment	176.945,90	176.945,90
9	First deliveries of instrumentation for exploratory research, protocol design and innovative methods	463.780,80	640.726,70
12	Further deliveries of instrumentation for innovative research, start-up of research activities for a	638.458,30	1.279.185,00
14	Start of research with the new instrumentation/developmen ts	276.654,92	1.555.839,92
15	Completion of innovative research test activities for the use of the new instrumentation	524.728,00	2.080.567,92

36 WP title

Strengthening competence and leadership in research services through in-house research

37 WP number

WP7

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	5	WP Duration	26

39 OU(s) participating to the WP

OU Short Name	**OU Name**	**Applicant**
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

	facility of Politecnico di Milano	
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 3	CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 6	CNR-ISM - Istituto di Struttura della Materia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori,	APPLICANT: CONSIGLIO NAZIONALE DELLE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano

40 WP Leader

Giancarlo Panaccione (CNR-IOM)

41 Summary of the activities envisaged in the WP

The Specific Objective of WP7 is the strengthening of NFFA competence and leadership in research services exploiting the upgraded laboratories at all nodes in order to reach full benefit from the new/upgraded methods and instruments, also setting the basis for the continuous upgrade programme of NFFA-DI. There is need of an in-house research activity programme that will complete the technical commissioning of the upgraded laboratories in order to warrant the internal acquisition of skills and deep knowledge of the new methods/instruments to be put at work as NFFA-DI services to users. We call this action strengthening of competences through research enabled by the upgraded facilities as it does complete the upgrade programme with the necessary up-skills of researchers and technical operators by carrying-out experiments pushing to the limit the performances of the new instruments, round-robin tests of the new instrumentation with complementary resources of the RI (all nodes), and tests of the interoperability by in-house NFFA-DI research that will also simulate the future user proposal needs. This is not intended as a continuation of ongoing institutional in-house research activities that can marginally benefit from the upgrade, but an upgrade-enabled disruptive way of performing frontier experiments exploiting all the upgraded INSTALLATIONs and their unique interoperability (sample exchange and FAIR datasets). Each node will concentrate on early in-house experiments, beyond commissioning of the upgrade, and in parallel to opening to user access accelerating the readiness and quality of the online services. Those in-house experiments will involve the complementary exploitation of several INSTALLATIONS and their unique resources present at other nodes of NFFA-DI. Altogether this will be a research-based scientific commissioning of the whole NFFA-DI, including staff upskill, therefore complementing and bringing to much higher level the outcomes of the basic commissioning performed under WP4 for acceptance of delivery.

NFFA-DI must have a permanent programme of upgrade of methods and instruments, closely tracking the evolving state-of-the-art, also based on explorative developments that may result in all-new services to users. This was the logic of the Joint Research Activities in EC-funded RIs, like NFFA-Europe. Some nodes contribute to this methodological research, focusing on research-based instrumental developments that cannot be procured on the market of scientific instrumentation. The frontiers of instrumentation development to meet with the needs of research in nanoscience include pushing to the physical limits the energy, space, time, electron-spin resolution in probes of the structure of matter, and the simultaneous performance of the high-resolution measurements on reproducibly identified nanostructures (accurate repositioning, atomically accurate sample replicas). Such developments require specific in-house research, prototyping, testing and upscaling to user-friendly facility items. This type of research activity, possibly involving external users along with NFFA-DI staff, shall start under NPPR and be carried on beyond the 30-month term, projecting on the 10-year NFFA-DI minimum expected lifetime.

WP7 activities will therefore concern all the 5 interoperable upgraded INSTALLATIONS: 1) Lithography and Patterning; 2) Growth and Synthesis; 3) Advanced Characterization and Fine Analysis; 4) Theory and Simulation; 5) Upscale to intermediate TRL.

WP7 activities includes: 7a) Headquarters and nodes perform the upgrades under WP4, and will strengthen their competences in the new methods and instrument operation also with ad-hoc in-house research programmes, in view of the full upgrade of RI service to users. Marginal costs of this post-commissioning research activity will be covered by the indirect cost budget, as well as combination with early usage (WP6).

7b) Headquarters and nodes may perform research on explorative developments of methods and instrumentation technology addressing critical shortcoming of the state-of-the-art technologies for research in nanoscience. This activity may imply procurement of elements for building novel instrumentation with a development schedule that should start now but possibly extend beyond the 30-months of PNRR, into the 10-year operation-phase.

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into the 10-year operation-phase.
Strengthening competences of all INSTALLATIONs
A7.1: Identification of synergies in the strengthening among nodes of competence programme (POLIFAB). Description: This activity will favour emerging the synergies among all upgraded nodes through post-commissioning testing by in-house research and training activity. Organization of round-robin experiments for testing interoperability e.g. on exchanged samples. The advise of The Scientific and Technical Committee (STC) will be taken as guidance.
A7.2: Coordination of the RI post-commissioning strengthening of skills (CNR-IOM). Description: Advanced experimental work plan for testing the performances of the upgraded RI, the FAIR data and metadata system, and the interoperability-enabled research. The results will become an internal benchmark for further operation.
From A7.3 to A7.13 all nodes contribute to Upskill by post-commissioning research of own staff and equipment.
Description: Research with upgraded instruments and combination with other methods/nodes to exploit/enforce interoperability on in-house research themes that will push to the limits the performances of the upgraded laboratories.
From A7.14 to A7.20 several nodes contribute to Exploratory developments by research. Description: Development of new instrumentation and methods addressing critical shortcoming of the state-of-the-art technologies for research in nanoscience.

42 WP inter-relation with other WWPP

WP7 is connected to WP4, WP3 and WP5

43 Most relevant outcome:

The most relevant outcome of WP7 will be the combination between the research enabled by the upgrade and the exploratory activity looking toward 10-year activity. Research enabled by the upgrade will enhance the capability of the RI, forming a unique distributed facility set for long-term operation of advanced user services. Full maturity of protocols, operation and service to users will be reached across all the installations and in particular for UHV exchange of samples, advanced analytical tool for microscopy and spectroscopy, for growth, synthesis and micro-nano fabrication of 1D and 2D systems, including devices. Furthermore, the full deployment of FAIR-by-design in all upgraded systems will provide a completely new mode of operation and data analysis, for full exploitation of the experimental and theoretical capacity of the nodes (operating units). Staff collaboration with NFFA-DI partners and early users, will upscale the service-standard of the advanced method. Finally, an overall outcome of the whole RI will be the development of ad-hoc research programmes to enforce interoperability intra-node and inter-nodes, for optimization of users' access and integrated services of NFFA-DI.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Organization and start of the purchase procedure for innovative equipment	6	D7.1 - Report on tenders/procurement procedures for innovative instrumentation
First deliveries of instrumentation for exploratory research, protocol design and innovative methods	9	D7.1 - Report on tenders/procurement procedures for innovative instrumentation

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methods		
Further deliveries of instrumentation for innovative research, start-up of research activities for a	12	D7.3 - First report on instrumentation delivered and commissioned for exploratory research
Start of research with the new instrumentation /developments	14	D7.4 - First report on upskill of staff on usage of upgraded instrumentation/methods
Completion of innovative research test activities for the use of the new instrumentation	15	D7.5 - Second report on upskill of staff on usage of upgraded instrumentation

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Organization and start of the purchase procedure for innovative equipment	6	Number of tender/procurement processes started
First deliveries of instrumentation for exploratory research, protocol design and innovative methods	9	Number of tender/procurement processes started
Further deliveries of instrumentation for innovative research, start-up of research activities for a	12	Number of instruments installed Number of invoices paid Number of research activities with new instrumentation started (experiments/methodological developments planned or training sessions on similar equipment ongoing)
Start of research with the new instrumentation /developments	14	Number of test experiments with upgraded instrumentation/methods

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instrumentation /developments		
Completion of innovative research test activities for the use of the new instrumentation	15	Number of laboratories with upgraded instrumentation ready to provide user access

46 WP Intermediate Objectives:

IO Title *Organization and start of the purchase procedure for innovative equipment*

IO Bimestre *6* IO Costs *176.945,90*

IO Desciption

An overview on the modalities, status and timeline of all envisaged procurement procedures is sketched.

IO Title *First deliveries of instrumentation for exploratory research, protocol design and innovative methods*

IO Bimestre *9* IO Costs *463.780,80*

IO Desciption

First acquisition procedures completed, instrumentation installed and commissioning completed. Invoices paid.

IO Title *Further deliveries of instrumentation for innovative research, start-up of research activities for a*

IO Bimestre *12* IO Costs *638.458,30*

IO Desciption

Further acquisition procedures completed, instrumentation installed and commissioning completed for all instrumentation. Invoices paid. Upskill and exploratory research started.

IO Title *Start of research with the new instrumentation/developments*

IO Bimestre *14* IO Costs *276.654,92*

IO Desciption

Test experiments pushing to the limit the performances of the new instruments/methods. Round-robin tests of the new instrumentation with complementary resources of the RI.

IO Title *Completion of innovative research test activities for the use of the new instrumentation*

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IO Title	*Completion of innovative research test activities for the use of the new instrumentation*		
IO Bimestre	*15*	IO Costs	*524.728,00*

IO Desciption

Test activities for innovative research making use of the new instrumentation and newly developed methods are completed as in-house research, in order to simulate the future user proposal needs. Tests of interoperability are completed.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

CNR-IOM
-12 PM of TECNOL III livello for support to coordination
-12 PM each for 4 researchers/technologists for upskill
-12 PM each for 2researchers (III livello) for exploratory research
CNR-IFN@MI
-4 PM of a fixed-term researcher
CNR-IFN@TN
-9 PM of a researcher (III livello) and 6 PM of a second researcher (III livello)
CNR-IMM@BO
-9 PM of 1 researcher (III livello)
-5 PM of TD researcher
CNR-IMM@CT
-84 PM for 3 researchers and one technician
-18 PM of researchers
CNR-ISM
-9 PM of 1 researcher
CNR-NANOTEC
-12 PM distributed among three researchers and one technologist
-5 PM each for 2 researchers at CNR-NANOTEC
CNR-SPIN
-6+9 PM, respectively, from two experimentalists TD III livello; 9 PM theorist TD III livello; 6 PM from the laboratory technician, 6 PM from management technician
-2 + 5 months, respectively, from two experimentalist TD II livello, overall 12 months from the theorists TD III livello
AREA
-8 PM microscopist (TD tecnologo 3 livello)
POLIFAB
-10 MM of Technologist T1 for identification of synergies in the strenghtening among nodes of comptence program
-18 MM of technologists (T1-T3) for upskill and post-commissioning research
-6 MM of technolgist T2 for exploratory developments
UNIMI
-12 PM at 30% FTE of one fixed-term Researcher
-12 months at 50% FTE of one High-qualification Research Technologist or

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-12 months at 50% FTE of one High-qualification Research Technologist or fixed-term Researcher and 24 months at 100% FTE one High-qualification Research Technologist or fixed-term Researcher

Scientific instrumentation and technological equipment, software licenses and patent

Cost description:

CNR-IMM@CT
-1 medium size servers (256 cores, 8Gb REM per core, 16Tb total storage in total for the 3 servers) (20.000,00 € net cost, 4.400,00 € VAT)
-Productivity Enhancements for 3D profiling tool (90.000,00 € net cost + 19.800,00 € VAT)
CNR-IOM
-laser equipment (50.000,00 € + VAT)
-fast-electronics for STM/STS (33.000,00 € + VAT)
CNR-SPIN
-Hardware and software for connecting data analysis with theory and computation (30.000,00 € net cost + 6.600,00 € VAT)
POLIFAB
-Exploratory development of a 2D Spin Polarimeter (vacuum components, electronic instrumentation, etc.) (20.500 € net cost + 4.510,00 € VAT)

Open Access, Transnational Access, FAIR principle implementation

Cost description:

POLIFAB
•4 publications open access from in-house research (6000€ + VAT)

Civil infrastructures and related systems

Cost description:

N/A

Indirect costs

Cost description:

-travel and dissemination at POLIFAB
-travel at CNR-IOM
-travel at CNR-IFN@MI
-travel and dissemination at CNR-IFN@TN
-travel at CNR-IMM@BO
-travel and consumables at CNR-IMM@CT
-travel at CNR-NANOTEC
-travel at CNR-ISM
-travel at CNR-SPIN
-travel and dissemination at AREA
-substrates, pure materials, reagents, process gas, spare parts for the upskill phase; contribution to the upgrade (gas lines, antivibration platforms, e.m. field screening, etc) of spaces dedicated to new equipment; participation in conferences, travels to other nodes during upskill: 2000 € for 10 people (PI, RTDA, Technologist, 4 post-docs, 3 PhD) at POLIFAB
-travel at UNIMI

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Training activities

Cost description: N/A

48 Activity title

Identification of synergies in the strengthening among nodes of competence programme

49 Activity short name

A7.1

50 Activity Start month and duration

Activity Start month	18	Activity Duration	13

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

This activity will favor synergies among all upgraded nodes through post-commissioning test of interoperability by in-house research and training activity.The following steps are foreseen, with some peculiarities for nano-foundry and fine-analysis related activities.Nano-foundry: Cleanrooms and growth-facilities distributed in all nodes will identify a set of samples made of standard materials with defined specifications and launch a round-robin test on them. Cleanrooms will also select a fabrication process and define specs for related samples to be realized.Each participating node will produce nominally identical samples, and perform the same measuring, testing and analysis tasks in the same time period. Samples produced by each node will be collected and compared at Polifab. For absolute accuracy evaluation, reference measurements by the national institute for metrology (INRIM) will be usedFine Analysis: For analytical techniques available in multiple nodes, we will identify a set of experiments to be carried out on the very same samples. Identical samples will be produced in a single node and distributed to the other nodes; experimental results will be comparatively evaluated to assess resolution, precision and accuracy.Overall, round-robin tests will be to be used for building-up a coherent portfolio of services to NFFA-DI users.Process flows involving different nodesNano-foundry: For the very same processes used in round-robin tests, we will identify protocols to exchange wafers among nodes. Subsequent steps will be performed in different nodes and the final fabricated samples will be compared to those realized in each node. Fine analysis: With reference to analytical techniques requiring sample handling in controlled environmental conditions during the transfer from the growth machine to the experimental station we will perform tests of experiments on samples produced and analyzed in different nodes.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

38.750,00 €

Cost description: 10 MM of Technologist T1 for identification of synergies in the strenghtening among nodes of comptence program

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

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(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.712,50 €

Cost description: Travels to other nodes for strenghtening the synergy

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Coordination of the RI post-commissioning strengthening of skills

49 Activity short name

A7.2

50 Activity Start month and duration

Activity Start month	18	Activity Duration	13

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

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52 Activity description

The co-location of advanced analytical tools for the study of nanosystems with a) facilities for the growth and synthesis of complex materials, b) large scale facilities for fine analysis, c) theoretical tools and d) micro-nano fabrication is an added value with no equivalent in Italy and in Europe. Such peculiarity, once improved by the upgrade, must be consolidated by specific coordinating actions.
The objectives of this activity are, in the phase of post-commissioning of the upgraded facilities, i) to integrate the skills and the capacity of laboratories/nodes, ii) to connect facilities and expertise available across the consortium, iii) to develop/coordinate actions for reaching common metrology and protocols (implementing round robin measurements), and iv) to fully implement the FAIR data and metadata approach and use. Use of the TLNet will be important not only to optimize access but also to define standards of protocols/measurements, based on the transversal approach of NFFA, where different installation act to generate overlaps and new methodologies. A special effort will be devoted to the identification of relevant research activities enabled by the upgrade, able to widen access both to expert users and new-comers. Exploratory research results will become an internal benchmark for further operation.
The underlying rationale will be to improve the use of existing resources by optimising operation and building synergies and complementary capabilities. This will produce efficient use of the whole infrastructure both internally and as a distributed user-facility. The presence of exploratory activities, as described in the present WP, will develop in-house research programmes to expand the capacity by complementary methods, measurements and/or calculations, as for example digital-twin for spectroscopy, development of 1D and 2D device, high-throughput microscopy analysis, ultrafast spectroscopy on solids, with the common denominator of FAIRness.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

50.160,00 €

Cost description: one Technologist for total 12 PM

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.511,20 €

Cost description: Travel

54.6 f. Training activities

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0,00 €

Cost description: N/A

48 Activity title

Upskill and post-upgrade commissioning research of CNR-IOM: digital growth and multiscale analytics

49 Activity short name

A7.3

50 Activity Start month and duration

Activity Start month	5	Activity Duration	26

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Post-upgrade commissioning activity (WP4) of the open-access platform for low TRL users through in-house test experiments for strengthening competences. The upskill through research of growth, analytical and theory competences will enable exploitation of the in-situ multi-probe setups. Staff collaboration with NFFA-DI partners and early users, will bring to service-standard the advanced method enabled by the WP4. Namely: a) analytical test experiments on electric carrier density and mobility, quantum transport effects in as-grown heterostructures and devices (graphene-like nanomaterials, transition metal dichalcogenides, ultrathin 2D-oxides), and magnetic phase transitions; analysis of phase transitions in multiferroic systems, transient collective excitations in complex heterostructures (oxides, 2D magnets); b) upskill experiments based on the combination of scanning probe microscopy, spectroscopy and diffraction techniques (STM-LEEM) on 2D model systems and device prototypes, exploiting the spatial range from the mesoscale to atomic and the energy range from hundredths to hundreds of eV, with high purity to doped or biomimetic-coated ultrathin films, with real-time and in-operando capabilities. Upskill in-house experiments on growth and analytical (cluster) facilities on thin films and single atomic layers of oxides.Upskill activities for protocol developments for sample transfer – intranode and internode – via gloveboxes and UHV shuttles.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

200.640,00 €

Cost description: four Technologists (III livello) for 12 PM each, for upskill and commissioning research of post-upgrade spectroscopy/microscopy/growth activities

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

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0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

14.044,80 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-upgrade commissioning research at CNR-IFN@MI for advanced ultrafast spectroscopy

49 Activity short name

A7.4

50 Activity Start month and duration

Activity Start month	5	Activity Duration	26

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

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Post-upgrade commissioning and upskill research activities will focus on the three beamlines (WP4) for ultrafast dynamics research on solids. Benchmark experiments to test the capabilities of these setups will be performed on test systems with sample transfer protocols developed within the NFFA-DI network (intranode and internode). Advanced method and spectroscopy will be enabled on, namely: a) THz beamline: the ultrafast carrier dynamics in semiconductors b) HHG-based temperature-dependent experiments on type II transition metal dichalcogenides (TMD) and Weyl semimetals exploring phase transition processes. c) For soft-X transient spectroscopy, temperature-dependent measurements of GaAs (M edges <180eV) below 40K, where excitons are stable; the transient soft-X response will open the access to hole-electrons Coulomb interaction studied for the first time in the few fs-scale.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

16.720,00 €

Cost description: The activity requests funding for one researcher (CNR rank: level III) for 4 months for strenghtening competences and preparing the fully upgraded beamlines for ultrafast spectroscopies

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.170,40 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-upgrade commissioning research of CNR-IFN-TN for devices and prototyping

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(The information provided in this section will be evaluated with reference to criteria C1-C5)

49 Activity short name

A7.5

50 Activity Start month and duration

Activity Start month	11	Activity Duration	20

51 OU in charge of the Activity

OU short name	UO 3	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Post-upgrade commissioning and upskill research activities will focus on the integration of nanolithography and the reactive ion-etching system into the complete micro-nanofabrication process to offer a complete prototyping service for the technological platforms present in the clean-room which will be upgraded. The activity will involve tests for the fabrication of micro-nano structures both with positive and negative resist and the transfer of such patterns on the material layers involved in the different technological platforms.
The tests will verify and try to optimise critical parameters for the different applications such as mimimum feature size that can be defined and transferred vs the thickness of the layer involved in the process (aspect ratio), quality of the transfer in terms of slope and roughness of the walls, quality of the edges, roughness of the horizontal surfaces involved in the etching process, uniformity over the whole wafer.
Specific in-house research activities will deal with the combination of optical lithography (stepper instrument with 350 nm critical dimension) with the EBL technique to achieve large devices with specific 'functional' structures with critical dimension down to the sub 100 nm range as ideally requested. Typical devices addressed are ring resonators with integrated photonic bandgap crystals for optical radiofrequency filters (Si-on-Insulator photonic platform).
Another activity will deal with feasibility studies of advanced exposition schemes such as grey-scale lithography where different electron beam energies are used to penetrate differently into the resist in different areas.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

62.700,00 €

Cost description: 9 person months of a researcher (III livello) and 6 months of a second researcher (III livello). Integration of the new instruments in the current processes, mix and match optical-EBL lithography, development of specific methodologies for different technological platforms available in the upgraded facility

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

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0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

4.389,00 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research of IMM-BO for advanced nanoscience and nanotechnology

49 Activity short name

A7.6

50 Activity Start month and duration

Activity Start month	20	Activity Duration	11

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Acquisition of upgraded instrumentation on this project (WP4) or using funds from other projects, together with collaboration with other nodes will strengthen competences and enable research concerning:
a) Expansion of the 2D-lines providing INSTALLATIONS 1 (Lithography and Patterning) and 2 (Growth and Synthesis) for the fabrication of hybrid devices (with low/medium TRL) based novel 2D materials (graphene and beyond-graphene materials) and technologies at reasonable costs. b) development of a platform for fabrication of customized MEMS structures, and of sensing, hybrid devices for photovoltaics and photocatalysis applications. c) growth and control of novel 2D materials (obtained by ALD or by chemical

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devices for photovoltaics and photocatalysis applications. c) growth and control of novel 2D materials (obtained by ALD or by chemical vapor deposition, like nitrides, transition metal dichalcogenides, oxides, sulfides) and their related interfaces. d) upskill experiments and development of protocols for ALD films with high conformal coating and excellent step coverage in MEMS systems with high aspect ratio, to deposition of high quality 2D materials, or for protective layers on 2D materials.
CNR-IMM@BO will support the formation of expert-groups within NFFA-DI for the rapid scale-up of competences in the development of novel materials, advanced nano-technology processes and devices, strengthening the cooperation between the nodes, with the aim to have a major impact on the different technological fields, and to develop new high-level applications. Integration within nodes of the characterization and synthesis expertise within NFFA-DI, creating cross-work and enabling strong synergies between the nodes. Upskill activities for protocol developments for sample transfer – intranode and internode –.
Implementation of FAIR-data and metadata acquisition. data interoperability between its own in-house developed web-interface based clean room activity management system and the NFFA-DI central database, by including TCP/IP based data transfer and database synchronization modules.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

37.620,00 €

Cost description: TD researcher for 9 months to work on the development of processes for deposition of nano-materials

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.633,40 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

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(The information provided in this section will be evaluated with reference to criteria C1-C5)

48 Activity title

Upskill and post-commissioning research of CNR-IMM@CT on nano science prototyping

49 Activity short name

A7.7

50 Activity Start month and duration

Activity Start month	7	Activity Duration	24

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The combination of the previous competences and existing instrumental park with upgraded instruments (WP4) will allow the pursuing of in-house researches which could be barely accomplished without the planned installations. The successful achievement of the objectives of the activity A7.6 will be demonstrative examples of the offer available to users. Advanced methods and upskill research, in combination with NFFA-DI partners, will be enabled. Namely: a/1) Devices' types demonstrators based on low dimensional and nanostructured materials (graphene, carbon nanotubes, TiO2, ZnO, Al2O3, TCO, SiGe, MoO3, Ga2O3…) The nano-systems' development will be assisted by Virtual Design of Experiments (V-DoE) using multi-scale (from the equipment-scale to the nano-scale) simulations of critical processes. Optimal material synthesis based on combined ALD/PVD/CVD/C-PVD/MBE with Plasma Enhanced features. b/2) Digitally aided characterization of new atomic complexes with QT functionalities combining multiple characterization analysis (3D profiling HR-TEM, PE, NanoRaman, Nano-CL, ODMR, EPR) and DFT/MD studies of the atomic/electronic structures. c/3) Nano-second and nano-meter mapping of optically active centers. Time resolved electron microscopy with pulsed electron beam will allow control over the electron dose on electron beam sensitive and soft-materials (polymers, metal-organic perovskites, nano-composites).
Upskill activities for protocol developments for sample transfer – intranode and internode – , and FAIR by design data and metadata acquisition will be integrated with all NFFA-DI partners.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

351.120,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at exploiting the upgrades to strengthen competences through ad-hoc in-house research preparing for the fully upgraded RI services. The activity requests funding for 84M as it follows: 3 III liv. units, one (Res) dedicated to the Devices demonstrators activity, one (Res) dedicated to the Digital characterization of new atomic centers with QT functionalities, one (Res) dedicated to the Nano-second Lifetime and nano-meter mapping of optically active centers activity.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

24.400,00 €

Cost description: 1 medium size server (256 cores, 8Gb REM per core, 16Tb total storage in total for the 3 servers) for supporting tool development and the go-to-FAIR activities in the 3 joined theoretical/experimental in house researches.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

26.286,40 €

Cost description: Consumables, travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research of CNR-ISM for ultrafast transient absorption spectroscopy

49 Activity short name

A7.8

50 Activity Start month and duration

Activity Start month	10	Activity Duration	21

51 OU in charge of the Activity

OU short name	UO 6	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

RICERCHE

52 Activity description

Research with upgraded instruments (WP4) and integration with other methods/nodes for the fully upgraded RI service. The upgraded facilities will characterise steady state and excited state dynamics, also spatially resolved with an existing microscope with a reduction of temporal resolution, of nanopatterned structures with plasmonic properties and nanostructured semiconductors. Research will enable: a) high repetition rate ultrafast spectroscopy allowing one to access a large range of excited carrier densities, reaching low carrier densities (1014-1017cm-3), not available with the present source, meeting the in operando regime for materials and devices; b) ultrafast transient spectroscopy at the sub µm applied to single 1D nanowires and single 2D flakes, single nanoparticles, and materials domains; c) application of photoexcitation to in operando conditions, including efficiency measurements of devices, performances, damage and ageing, defects; d) transient absorption spectroscopy on 1D and 2D materials (semiconductor nanowires and perovskites); e) analytical test experiments on nanophotonics (waveguides, light emitting diodes, and lasers), energy storage. Research will benefit from a holistic approach to optical characterization present in the node. The flexibility of optical spectroscopy will allow one to characterize in steady and time resolved fs-ns range an extended class of materials and heterostructures. The steady state and time resolved optical device characterization will be available to investigate charge separation, hot carriers, defects, ageing.
Ad-hoc research and pilot experiments to enforce interoperability intra-node and inter-nodes, protocols to sample transfer and FAIR data and metadata approach.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

37.620,00 €

Cost description: The activity of the fixed term researcher (level III), hired for the project, will be focused on the use of the upgraded ultrafast transient absorption facility for experiments on nanostructured samples (nanoparticles, 1D and 2D semiconductors) and devices (photovoltaic cells) to consolidate competences through in-house research and to prepare the full operation of the facility. The activity requests funding for 9 person months

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

2.633,40 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research of CNR-NANOTEC on Advanced Correlative Microscopy

49 Activity short name

A7.9

50 Activity Start month and duration

Activity Start month	18	Activity Duration	13

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-NANOTEC will exploit the upgraded correlative microscopy facility (upgrades listed in WP4) to strengthen competences through ad-hoc in-house research preparing for the fully upgraded RI service. Namely:
Development of upskills experiments based on the upgraded correlative microscopy facility (comprising conventional light microscopy, 3D X-ray microscopy, SEM, serial block-face-SEM, FIB tomography and the high-speed high-resolution mSEM) with aim at establishing an effective workflow for getting the most out of correlative microscopy. Such a workflow defines in what order a sample will be studied by the different microscopy instruments, how regions of interest (ROIs) on the sample will be selected and identified in different instruments, and how the resultant data will be collected, stored and processed. An effective workflow will enable the scientific user communities to exploit the proposed state-of-the-art correlative microscopy platform from the start with the highest efficiency, in order to address frontier research in several fields as electronic, optoelectronic, nanophotonic and energy.
Ad-hoc research programmes concerning sample preparation and FAIR-by-design data and metadata processing will be implemented and shared to enforce interoperability within NFFA-DI infrastructure. Upskill activities for protocol developments for sample transfer – intranode and internode – via gloveboxes and UHV shuttles will be developed.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

50.160,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at exploiting the upgraded correlative microscopy facility to strengthen competences through ad-hoc in-house research preparing for the fully upgraded RI service. The activity requests funding for 12 person months (50.160,00 €), distributed as follows:
–one researcher (CNR rank: level III) for 2 months,
–one researcher (CNR rank: level III) for 2 months,
–one researcher (CNR rank: level III) for 4 months,
–one technologist (CNR rank: level III) for 4 months

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.511,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-upgrade commissioning of CNR-SPIN for research on films and heterostructures

49 Activity short name

A7.10

50 Activity Start month and duration

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Activity Start month	18	Activity Duration	13

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

After completion of the upgrade, a full platform for the growth of epitaxial heterostructures from a physical vapour, for their in-situ and/or ex-situ characterization, as well as for the fabrication of device prototypes, will be available to users (installations 1-2-3).
The cluster of interconnected growth and characterization chamber will allow to produce new materials by design, especially in terms of atomically controlled epitaxial films, heterostructures and suspended membranes. In particular metal oxide perovskites will be grown by RHEED assisted PLD. Further functionalities will be added by coating in-situ with metal and/or organic materials, by applying epitaxial strain. Characterization with In situ XPS/UPS, SPA-LEED, AFM will be employed, jointly to XRD, for a quality assessment of crystal and surface properties.
Intranode and internode sample transfer will be guaranteed by gloveboxes and UHV shuttles- We plan to perform complex experiments in which growth and characterization stages will alternate. The formation of a mixed team able to routinely address growth, analysis of electronic spectra and theory will allow this node to offer really unique tools for studying the electronic properties of advanced functional materials.
The platform will also host device-fabrication-oriented experiments, exploiting the large growth area of our systems (4" for PLD), (installation 5) the possibility to add in-situ metal contacts and organic functional layers, as well as the available microfabrication facilities (optical lithography, direct laser writing, ion milling).

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

144.400,00 €

Cost description: –6 man months of a researcher (III livello). The hired resource will be an experimentalist mainly dedicated to the upskill and in-house research on the large sample area PLD chamber of the UHV growth and characterization cluster
–9 man months of a researcher (III livello). The hired resource will be an experimentalist mainly dedicated to the to the upskill and in-house research on the angle-resolved photoemission spectroscopy chamber or the UHV growth and characterization cluster
–9 PM of a researcher (III livello) with theorist profile. He/she will focus on the theoretical study of structural and electronic properties, energetics, and phase diagrams.
–6 PM of a laboratory technician. The hired resource will be mainly dedicated to maintaining and improving the samples transfer processes and all mechanical and vacuum aspects of the UHV growth/characterization cluster
–6 PM for a laboratory technician. The hired resource will be mainly dedicated to the optimization of control software, electronics, and data acquisition, including FAIR-compliant data management, of the UHV growth/characterization

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

10.108,00 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research at AREA for materials analysis across the full TRL scale

49 Activity short name

A7.11

50 Activity Start month and duration

Activity Start month	20	Activity Duration	11

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

Post-upgrade commissioning activity (WP4) of the open-access platform for industrial and academic users through in-house test experiments for strengthening competences:

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

experiments for strengthening competences:
The upskill through research programme builds on the available analytical competences, well embedded in the European landscape (NFFA-Europe, DREAM and further developments), fully integrated with Elettra, Fermi and CNR-IOM facilities also exploiting the long-standing experience in technology platforms. The AREA upgrades will enable in situ and in operando studies and 4DSTEM imaging of the dynamic properties of materials in reactive environments at sub-Angstrom resolution with chemical sensitivity and high energy resolution (below 300 meV). In-situ electrochemistry will enable research in e.g. fuel-cells, batteries, corrosion, hydrogen and green technologies for industrial applications.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

34.056,00 €

Cost description: 8 PM microscopist (Technologist III livello) for the development and pilot experiments on microscopy/spectroscopy/sample preparation

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

2.383,92 €

Cost description: Travel, dissemination

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research of Polifab-POLIMI on "wafer-scale" compatible samples

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

49 Activity short name

A7.12

50 Activity Start month and duration

Activity Start month	12	Activity Duration	19

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

Research with upgraded instruments (WP4) and combination with other methods/nodes to strengthen competences and for preparing for the fully upgraded RI services, available to NFFA-DI users. Post commissioning phase of in-house research enabled by the upgrade will be namely:
INSTALLATION 2-5: Cluster tool for combined deposition of heterostructures. Technologists T1 hired in the project will coordinate/support users groups of Polifab with specific expertise for the development of growth processes of representative materials to be included in the NFFA-DI materials portfolio: (a) Sputtering: piezoelectrics, ferroelectrics, chalcogenides, magnetic materials; (b) PLD: functional oxides, High Tc superconductors, TCO's; (c) CVD: 2D materials, graphene, MoS2; (d) ALD: conformal oxides, nitrides; (e) MBE on small samples: metals, chalcogenides
INSTALLATION 3: RF measurements. Implementation of protocols for FMR, all electric Spin-Wave excitation-detection, spin-pumping, integrated MW components analysis.
Time-resolved polarization microscope: Investigation of dynamics in magnetic systems (Spin Waves, domain wall motion, spin logic) and ferroelectrics.
Upskill activities for protocol developments for sample transfer – intranode and internode – via gloveboxes and UHV shuttles.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

69.750,00 €

Cost description: – 1 process specialist (technologist T1) expert in PVD/CVD growth, responsible for the cluster tool for combined growth. Development of growth processes for representative materials. (5 PM)
– 1 specialist (technologist T2) expert in MBE growth and electron spectroscopy. Set up of processes for MBE growth and in-situ fine analysis by XPS/ARPES. (4 PM)
– 1 research technologist (T3) in charge of the development of the time resolved polarization microscope and RF station, including the setup of measurements protocols for users. (9 PM).

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

7.320,00 €

Cost description: 4 publications open access

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

5.394,90 €

Cost description: substrates, pure materials, reagents, process gas, spare parts for the upskill phase; contribution to the upgrade (gas lines, antivibration platforms, e.m. field screening, etc) of spaces dedicated to new equipment; participation in conferences, travels to other nodes during upskill: 2000 € for 10 people (PI, RTDA, Technologist, 4 post-docs, 3 PhD)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Upskill and post-commissioning research of UNIMI for research on magnetic/plasmonic nanomaterials

49 Activity short name

A7.13

50 Activity Start month and duration

Activity Start month	6	Activity Duration	25

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

Research with upgraded instruments (WP4) and combination with other methods/nodes to strengthen competences for exploiting the full potential of upgraded/new instrumentation through ad-hoc in-house research preparing for the fully upgraded RI service, concerning Installations 1,2,3. The competence of NFFA-DI personnel will be enhanced through ad-hoc research programmes exploiting the upgraded instrumentation with focus on dual beam, PFIB nano-patterning and upgraded SEMPA-SFEMPA magnetic microscopies. Ad hoc large area nano-machining masks for thermal evaporation in UHV. High resolution SEM imaging at nanoscale of single

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Ad hoc large area nano-machining masks for thermal evaporation in UHV. High resolution SEM imaging at nanoscale of single nanostructure or large area arrays. Investigation of magnetic properties of patterned surfaces, ultra-thin films interfaced with non-magnetic or multi-iron or organic materials, prototype geometries for spin valves and spin filters of interest for spintronic technology co-developed or promoted in collaboration with other nodes. Optical excitation and spectroscopic analysis will complement the field-matter coupling processes investigation at the nanoscale. In particular, structural information will complement nanomagnetic phenomena driven by the optical field. Plasmonic structures will overcome the optical diffraction limits for down-scaling of optoelectronic devices. Studies on surface magneto-dynamics processes at nanoscale with the use of a pulsed source, extending the temporal resolution to the current spin-resolved spectral-microscopies. Node proposed activities will refine and be complemented by ultrafast spectroscopies and fine analysis at CNR and Electra toward a complete dynamic and in energy landscape characterization of phenomena.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

13.950,00 €

Cost description: 12 months at 30% FTE of one High-Qualification Technologist or Research Fellow for support to Upskill activities related to installations 1,2,3

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

976,50 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Exploratory methodological/instrumental developments at CNR-IOM for continuous upgrade of the RI

49 Activity short name

A7.14

50 Activity Start month and duration

Activity Start month	10	Activity Duration	21

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The upgrade of NFFA-DI will enhance the offer to users and, at the same time provide the technological basis for further development of exploratory methods and tools that require in-house, and RI collaborative research in order to realize a continuous-upgrade of the scientific offer during the 10-year operation period. IOM will develop a number of exploratory activities for ultimately controlling and tailoring functional materials and for upscaling novel materials and architectures to serve intermediate TRLs. Namely:
Controlling digital fractional monolayers of dopants (magnetic, metal or metalloid centers) during growth, building on semiconductor quantum well technology, to reach capcabilities and service for single layer control of artificial multiferroics and heterointerfaces with TMDs
Development of new methods and tools for the investigation at the atomic scale of short-lived (transient) species in surface kinetics by means of scanning tunneling microscopy. This will offer unique capabilities in the Italian RI scenario. As a perspective, the possibility of combining structural and chemical information will be explored.
Exploratory upgrade of Four Wave Mixing (FWM) techniques and apparatuses, with table-top and at FEL sources, to enable studies on skyrmionics and magnonics, and to manipulate antiferromagnetism and topology at the nanoscale. The combination of table-top and FEL FWM experiments, in different wave-vector regions, has the potential to establish a method for relating spin-wave dynamical relaxation and the dimension and topological order of of skyrmions, opening the way to engineering spintronic devices that exploit spin motion.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

100.320,00 €

Cost description: 2 researchers (RIC III livello) for one year

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

101.260,00 €

Cost description: 1) laser equipment
2) fast-electronics for STM/STS

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

2) fast-electronics for STM/STS

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

14.110,60 €

Cost description: consumables, cryogenics, missions

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at IMM-BO for continuous upgrade of the RI

49 Activity short name

A7.15

50 Activity Start month and duration

Activity Start month	7	Activity Duration	24

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The developed platform for MEMS and hybrid devices (including integration of 2D materials) will be used for explorative research on micro-nanofabrication and nanoscience. The focus is fabrication of customized MEMS for in-situ and in-operando characterization of

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

micro-nanofabrication and nanoscience. The focus is fabrication of customized MEMS for in-situ and in-operando characterization of nanomaterials, with a progressive increasing technological complexity. Some actions that will be considered are:
MEMS aperture holders for implementation of innovative characterization techniques based on quantum sorting of the electrons after interaction with the nanomaterials (e.g. spintronic properties);
MEMS test platforms for measurements of magnetic properties of nanomaterials, even at cryogenic temperatures with a complete control of the magnetization;
MEMS-based setup for the thermoelectric properties of nanomaterials measurement at the nanoscale (thermal conductivity, electrical resistivity, thermoelectric power) both in vacuum and in controlled atmosphere.
The MEMS devices will be operated in different instruments at different resolution (e.g. SEM, SPM, Optical Microscopies) and with complementary techniques (e.g. Raman, XPS, XRD, ..). The tests will be performed using the instrumentations available at the different nodes, and comparing the results obtained. The accomplishment of this activity will have the long-term objective of establishing a flexible technological platform comprising and combining all the technologies already developed, capable to develop on-demand customized MEMS devices directly based on the users' needs.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

20.900,00 €

Cost description: TD researcher for 5 months to work on fabrication of MEMS structure for in-situ characterization of nano-materials

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.463,00 €

Cost description: Travel

54.6 f. Training activities

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at IMM-CT for the continuous upgrade of the RI

49 Activity short name

A7.16

50 Activity Start month and duration

Activity Start month	7	Activity Duration	24

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The implementation of the upgrade and achievement of upskill activities will allow full integration of node in the NFFA-DI infrastructure and the development for a holistic approach to the integration of new/additional materials/structures in the prototype device manufacturing process. Thus, Artificial Intelligence (AI) techniques will be applied to the management of multiple information (namely: multiscale simulation approaches, material database, and dedicated characterization analyses). To this aim, the remarkable upgrade of the Electron Microscopy and 3D profiling labs will busts the perspective to access a 4D (space-time) high resolution characterization for the most comprehensive class of materials. As exploratory example of augmented virtual characterization, we will investigate the nanostructural kinetics upon annealing developing in-situ/in-silico measurements' protocols where the phenomenological approach is substituted by close feedback loops of => in situ TEM => elemental 3D distributions=> DFT => Machine Learning MD => for the analysis of the evolving atomic configurations. We plan to implement i) Productivity Enhancements environment for the 3D profiling tool, and (ii) dedicated numerical approaches which also consider the non-equilibrium effects induced in the samples by the measure.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

150.480,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at exploratory methodological development for continuous upgrade of the RI through in-house research toward an AI assisted management of multiple information. The activity requests funding for 36 person months, as it follows: one 24M (Researcher III Liv.) dedicated to the exploratory activity for the augmented TEM in-situ measurements, and 12M (Technicians III Liv.) for assisting the FAIRness of the data and publications generated by the in-house research.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

109.800,00 €

Cost description: Additional installation for the Productivity Enhancement of the 3D profiling tool includes a fully-integrated in situ heated carousel to reduce pumpdown times, increase specimen throughput and improve vacuum quality

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

18.219,60 €

Cost description: Consumables, travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at CNR-NANOTEC for continuous upgrade of the RI

49 Activity short name

A7.17

50 Activity Start month and duration

Activity Start month	24	Activity Duration	7

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

52 Activity description

The unique combination of available metal-oxide semiconductors, produced at CNR-NANOTEC by an existing Atomic Layer Deposition (ALD) system, with advanced characterization tools and nanofabrication capability can enable exploratory research at CNR-NANOTEC on the medium term time-scale towards:
i) Growth activities aimed at design and fabrication of novel hybrid nanosystems for nanophotonic applications. Integration of materials with optically resonant nanostructures and optical metamaterials will target the control and achievement of additional polarization-driven effects. The activity will focus on controlling and manipulating the incident, transmitted or emitted photons, adding novel functionalities (such as chiroptical effects, controlled directionality of radiation pattern, generation of optical harmonics, selective scattering, enhanced quantum efficiency even in the UV and deep-UV spectral range) and increasing the efficiency of optoelectronics devices and of light harvesting systems for photovoltaics or photocatalysis.
ii) Implementation of existing light- and electron-based correlative microscopy platform with mSEM, cross beam FIB/SEM and the serial block-face system to address frontier research on 3D imaging at extremely high spatial resolution (<10nm). We plan to implement a sample preparation workflow for imaging the labeled sections. The activity will involve soft matter (i.e. biological materials) and the more challenging hard materials for electronics, optoelectronics, nanophotonics and energy. By implementing applications enabled by artificial intelligence, we expect to process the large numbers of section images towards their full 3D reconstruction. The analysis tools must be highly automated and robust, and flexible enough to cope with different kinds of images. Ideally, any user can use the same interface and tools from his own desktop, or through an infrastructure node workstation.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

41.800,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at exploratory methodological development for continuous upgrade of the RI through in-house research for design and fabrication of novel hybrid nanosystems and for 3D imaging by high-throughput electron microscopy. The activity requests funding for 10 person months (41.800,00 €), distributed as follows:
–one researcher (CNR rank: level III) for 5 months,
–one researcher (CNR rank: level III) for 5 months.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.5 e. Indirect costs

2.926,00 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at CNR-SPIN for continuous upgrade of the RI

49 Activity short name

A7.18

50 Activity Start month and duration

Activity Start month	8	Activity Duration	23

51 OU in charge of the Activity

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

The theory activity will guide experimental users dealing with complex correlated materials, in the interpretation of their results 1) connected to the experimental synthesis (by providing theoretical structural properties, energetics, phase diagrams, …); 2) obtained from (spin-resolved) microscopies and spectroscopies (by providing theoretical electronic, magnetic, vibrational and transport properties). The theory activity, one-to-one linked to the corresponding experimental activity performed at NFFA nodes, by providing a microscopic understanding of the physics at play, is indispensable to allow the optimization of functional properties and the design of better-performing materials. In detail, the activity will be devoted to i) ab-initio simulations based on density functional theory (intrinsically based on the atomic-scale as for space-resolution and on the meV-scale as for energy-resolution) for functional quantum materials, where spin degrees of freedom are active; ii) bridging different methods (based on density functional theory, many-body techniques, effective Hamiltonians, etc) aimed at developing a multiscale modelling methodology specifically suited for "in-silico" spectroscopies of materials showing cooperative phenomena.
A multidisciplinary approach will be pursued, by pushing theorists to get engaged in hands-on experiments as well as in raw data analysis, and the experimentalist to learn exploiting theoretical and computational tools for the interpretation of their own data. In the long term, the outstanding experimental endowment and the routine collaboration between scientists expert of atomically controlled growth, of cutting-edge electronic spectroscopies and of different complementary theoretical approaches, should create in this node a unique expertise for addressing the future challenges of solid state science and technology.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

79.420,00 €

Cost description: –12 man months from one III level TD researcher with theoretical profile
–2 man months of a III level TD researcher contracts with experimental profile on photoemission measurements
–5 man months of a III level TD researcher contracts with experimental profile on film growth and characterization, dedicated mainly to the PLD chamber

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

36.600,00 €

Cost description: Hardware and software for connecting data analysis with theory and computation

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

8.121,40 €

Cost description: missions and consumables

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at POLIMI for continuous upgrade of the RI

49 Activity short name

A7.19

50 Activity Start month and duration

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Activity Start month	6	Activity Duration	25

51 OU in charge of the Activity

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

POLIMI will develop exploratory research activities, beyond the state-of-the-art of tools commercially available, including the development of new experimental techniques, as detailed below
1. Time-resolved polarization microscope
In WP4 a time-resolved polarization microscope (sub-micron resolution) suitable to image the micro-structure of materials structure of bare samples and devices (in the in-operando mode) will be developed to operate in the 1-10 GHz range. In the exploratory part of WP7 activities to move the frequency range in the sub-THz range will be carried out.
2. In-operando spin-resolved investigation of the electronic bandstructure
Within WP4, POLIMI plan to equip the novel cluster tool for wafer-scale growth with a photoemission chamber (XPS, ARPES). In WP7 Polifab, in cooperation with experts on the generation of XUV/soft-X short pulses from IFN) plan to upgrade the station with the capability to perform time-resolved photoemission experiments. Furthermore, specific tools for in-operando photoemission experiments upon application of external stimuli (electric fields, strain, etc.), in configurations mimicking the device operation, will be developed. A feasibility study for a peculiar 2D spin detector, based on spin-dependent transmission of ultrathin ferromagnetic membranes, will be carried out.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

23.250,00 €

Cost description: 6 MM of Technologist T2 for exploratory developments.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

25.010,00 €

Cost description: Vacuum components (vacuum chamber, pumps, valves, feedthrough,. etc.), electronic instrumentation for the exploratory development of a 2D Spin Polarimeter.

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.5 e. Indirect costs

3.378,20 €

Cost description: substrates, pure materials, reagents, process gas, spare parts for the upskill phase; contribution to the upgrade (gas lines, antivibration platforms, e.m. field screening, etc) of spaces dedicated to new equipment; participation in conferences, travels to other nodes during upskill: 2000 € for 10 people (PI, RTDA, Technologist, 4 post-docs, 3 PhD)

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Exploratory methodological/instrumental developments at UNIMI for continuous upgrade of the RI

49 Activity short name

A7.20

50 Activity Start month and duration

Activity Start month	7	Activity Duration	24

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

INSTALLATIONs 1-3
Exploratory research to develop an all-new experimental solution to local magnetometry at regime or sub-ps time scales. The perspective of having, for the first time, a local probe (atomic to nm resolution) capable of magnetic sensitivity at the relevant time scale for magnetic interactions and magnetization switching, is motivated by the need to address the fundamental features of magnetization dynamics at the nanoscale, and the limits of magnetic technology. CW or sub-ps laser pulses focused by in-situ (UHV) optics generate electron pulses from a tip in Field Emission or Tunnelling regimes. The foreseen outcome of this development, possibly coordinated with other nodes of NFFA-DI, will be an all-new users' facility to add competitiveness to the offer of NFFA-DI. Correlative UHV sub-micro Raman imaging with unprecedented performance in speed, sensitivity and resolution will explore molecular and bonding information, crystallinity or amorphization, stress and strain and orientation in newly syntetized smart material and nano magnetic based devices.
INSTALLATION 4
The scope of this activity is to add new theoretical methods to the NFFA Theory offer. This will allow users to benefit from advanced codes and methods, such as machine learning (ML)-based approaches, and interfaces for the remote (interactive) access to theory/simulations. The work will be done establishing a synergetic collaboration with the National Center for HPC and its facilities. Specifically, we plan to introduce the (still missing) computational tools suitable to describe the ab-initio electron-phonon couplings in the NFFA offer. This will allow users to predict Huang-Rhys factors, the vibronic effects on the optical properties, and the electronic friction

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP7 - Strengthening competence and leadership in research services through in-house research]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

NFFA offer. This will allow users to predict Huang-Rhys factors, the vibronic effects on the optical properties, and the electronic friction tensor. Moreover, the offer will be expanded to allow one to predict magnetic properties, including magnetic circular dichroism, magnons, and the Kondo effect. Finally, we will improve the interface with FAIR data repositories.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

116.250,00 €

Cost description: –12 months at 50% FTE of one High-Qualification Technologist or Research Fellow for the development of Exploratory Development activities related to installations 1,2,3
–24 months at 100% FTE of High-Qualification Technologist or Research Fellows for the development of Exploratory Development activities related to installation 4

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

8.137,50 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

33 Timing of the different work packages: See documents uploaded

34 WP inter-relation with other WPs: See documents uploaded

35 Costs Scheduling according with the Intermediate Objectives:

Bimester	Title	Costs	**Cumulative Costs**
3	Financing PhD positions	268.049,47	268.049,47
4	Start of training programme	8.292,50	276.341,97
7	Acceptance to RITRAIN school	48.150,00	324.491,97
10	First level training of data stewards	178.823,64	503.315,61
12	Second level training of data stewards: user support	31.652,10	534.967,71
13	Start of laboratory support by data stewards	131.257,65	666.225,36
15	User support by data stewards	31.153,80	697.379,16
15	Training of users and young researchers for the usage of the upgraded RI	31.153,80	728.532,96

36 WP title

Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European

37 WP number

WP8

38 Start month(relative to kick-off of the project) and **duration** (in month)

WP Start	1	WP Duration	30

39 OU(s) participating to the WP

OU Short Name	**OU Name**	**Applicant**
UO 1	CNR-IOM - Istituto Officina dei Materiali	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 2	CNR-IFN@MI - Istituto di Fotonica e	APPLICANT: CONSIGLIO NAZIONALE DELLE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

UO 2	CNR-IFN@MI - Istituto di Fotonica e Nanotecnologie Sede di Milano	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 3	CNR-IFN@TN - Istituto di Fotonica e Nanotecnologie Sede di Trento	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 4	CNR-IMM@BO - Istituto per la Microelettronica e i Microsistemi Sede di Bologna	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 5	CNR-IMM@CT - Istituto per la Microelettronica e i Microsistemi Sede di Catania	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 6	CNR-ISM - Istituto di Struttura della Materia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 7	CNR-Nanotec - Istituto di Nanotecnologia	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 8	CNR-SPIN - Istituto superconduttori, materiali innovativi e dispositivi Sede di Napoli	APPLICANT: CONSIGLIO NAZIONALE DELLE RICERCHE
UO 9	AREA - Area Science Park - Basovizza Campus	CO-APPLICANT: Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park
UO 10	Polifab, the micro and nanofabrication facility of Politecnico di Milano	CO-APPLICANT: Politecnico di Milano
UO 11	UNIMI - Dipartimento di Fisica	CO-APPLICANT: Università degli Studi di Milano

40 WP Leader

Riccardo Bertacco (POLIFAB)

41 Summary of the activities envisaged in the WP

The Training activity of NFFA-DI is designed aiming at the following results:
- to strengthen the facility competences to operate the new upgraded instrumentation, to operate the FAIR-data system and become compliant with EOSC, to enhance RI managerial skills at headquarters and node levels,
- to train users and young researchers or researchers from the private sector, with dedicated workshops, online webinars, and summer schools. Specific goal of NFFA-DI is to make young scientists fully aware of the advantages of using research infrastructures as a unique resource for their research and scientific carrier, specifically in nanoscience,
- to attract MSc and PhD students to engage in advanced nanoscience studies with bursaries involving more UOs, and complementing the nanoscience thesis projects with FAIR data management competences.
The efficient and long-term operation of NFFA-DI will critically depend on the staff competence building and on technical collaboration with European and international RIs.
Strengthening the competences for the upgraded RI to align the best practices among the participating nodes is assured by WP2 and WP5 at staff level, but may also reflect on young users needs and more general community building via training modules. These shall be benchmarked on international examples of nanoscience RIs (e.g. the "Nanoscale Science Research Centers" NSRCs from DOE in the US, large centers of the NFFA-Europe/NEP consortium, etc.). Specific activities for this scope are: 1) Training sessions involving users

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

and technical and managerial staff involving several or all nodes on specific infrastructure practices; 2) Participation of selected internal candidates to RITRAIN-Plus and similar master classes to train RI managers.
All nodes prone to hands-on access on experimental installations must support on-site training of young users for all user teams with accepted proposal, possibly grouping users that will access the facility in a given period and in any case prior to the scheduled user-access.
All Theory and Simulation nodes will provide users assistance in performing their simulations and/or training for the specific computational tools that have been developed or made available by the installation.
NFFA-DI will create a novel environment for RI users where internal training needs also shared by a critical mass of interested users and prospective users will prompt the organization of open webinars and schools on scientific, technical, managerial and RI-policy topics, also in collaboration with NFFA-Europe. Moreover, training schools will provide hands-on experience and education in dedicated nanoscience topics, including appropriate practices for FAIR data analytics. A synergy with the European initiatives of NEP may include co-organization of one school module after month 20, when a significant part of the upgrades will progressively go online. All teaching materials will become permanent resources for consultation on the NFFA-DI website. E-learning tools will be also developed upon demand by a critical mass of interested users/students at Master/PhD level. Strong synergy will be exploited with NFFA-Europe/NEP.
Offering a unique research environment for Doctoral research projects, NFFA-DI aims at enhancing the attractivity of PhD programmes on physics of condensed matter, chemistry and engineering of materials and interfaces at the nanoscale. This is accomplished by: i) PhD bursaries for a cycle of Doctoral Course that will involve performing research projects based on the exploitation of more than one node of the RI; ii) supporting competitive collaborative research projects of PhD candidates to stimulate collaboration and leadership; iii) facilitating the itineracy of researchers across NFFA-DI nodes; iv) facilitating the encounter of young students with NFFA-DI activities by offering support for training internships at MSc undergraduate or early-graduate level.
On the perspective of fostering engagement of young students, NFFA-DI will offer MSc Thesis projects to be performed at all nodes with emphasis on the FAIR-by-design implementation of the upgrade. These theses will represent a great opportunity for young people starting a perspective career in RIs to contribute to the digitalization of NFFA-DI and to gain competences in FAIR data technologies. The Thesis Projects will be open to Physics, Chemistry, Informatics, Engineering, Material Science and related Masters for working on periods of 6-8 months at the NFFA-DI nodes. Practicum and Sandwich courses at graduate level will also be made available for advanced training of young people with engagement perspective.
A PhD programme in connection with NFFA-DI will be designed as an asset for a perspective PhD course stably running along with the RI over a 10-years operation horizon, thus ensuring a permanent exchange of personnel and competences. A starting activity will be offering 5 PhD grants at Milano Academic nodes for research projects exploiting NFFA-DI, including extended permanence at no less than two non-co-located nodes of the RI: typically, one in a southern node and the other in a northern node, according to specific science project of the candidate. Researchers at the NFFA-DI nodes shall be co-tutors with an internal tutor of UNIMI or POLIMI. Such grants could cover most of the 3-year Doctoral school cycle, with full financial support to be assured for the possible remaining period beyond the NPPR on the basis of an ad-hoc agreement between the Academic Institution and tutor or co-tutor's institution.
The corresponding Actions are:
· Action a) Establishing a training network among all nodes for users, students and young researchers, finalized to competent usage of the upgraded RI to maximize the quality of science outcome.
· Action b) Establishing a FAIR-data training programme for staff, aiming at a qualified data-stewardship, and for users.
· Action c) Support for specific training of RI managers: 2 bursaries for RITRAIN-Plus (headquarters and nodes); support for participating to dedicated webinars; managerial staff exchange among headquarters and nodes.
· Action d) Webinars and Schools, contributions of the NEP training activities, specific online tools
· Action e) The development of an initial "Upskills and Exploration" PhD programme with 5 bursaries of the next cycle for research projects including residency at more than one node of NFFA-DI and further mobility at international RIs. Design of a new PhD Course on "Science and Technology at the Nano-Scale".
All UO will participate in this WP with an Activity that contributes to one or more of the above Actions.

42 WP inter-relation with other WWPP

WP8 interrelates with WP1 (training of managers), WP3 and WP7

43 Most relevant outcome:

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

The most relevant outcomes of WP8 are: i) the strengthening of competences of the RI staff involved in the facilities upgrade, who will then operate the new facilities and run the RI at the highest quality level; ii) the stable presence in all RI nodes of FAIR data experts both at the level of implementation, maintenance and constant upgrade of the FAIR-by-design technology, interoperability with the centralized headquarters, and stewardship with respect to the users; iii) creation of a new generation of users, formed through university MSc theses work and PhD programmes on nanoscience and FAIR data science and stewardship.
We plan to engage students in over 20 MSc theses (at least 1-2 per node) to be carried out within the 30 months of PNRR distributed into the nodes according to geographical balance criteria. This will yield a first result of having a sizeable amount of MSc candidates and young graduates with a FAIR-stewardship competence, for further academic paths or for the open job market.
At graduate level, the PhD programme in connection with NFFA-DI will be built as an asset for the perspective of over 10-year operation of the RI. At starting a total of 5 PhD grants will be offered at the University of Milano and Politecnico di Milano PhD Courses for research projects exploiting NFFA-DI instruments, and including extended permanence at no less than two non-co-located nodes of the RI.
The NFFA-DI WP8 outcome will indeed be empowering the vision of the EC for a closer connection of the ERA and EHEA. RIs offer a multifaceted research environment: interdisciplinary by necessity, data intensive, intrinsically open to an international community of researchers used to collaborative projects - with a definite objective on sharing and open as an attitude -, hosting the treasure of cutting-edge instrumentation and topmost competence. NFFA-DI will attract professional scientists with strong technical skills, robust knowledge, open entrepreneurial temper, thus producing a self-fertilizing environment especially favorable for the growth of a next generation of leading professionals in science and technology as well as in their management.
Similar profiles are timely and yet still rare for the digital and green transition of the Public-Sector according with EU and PNRR priorities (e.g. independent research regulatory control and surveillance Agencies with relevance for public health and environment protection) and in strategic sectors of Private Enterprise like Industrial R&D divisions, Start-up companies. The current offer from higher-education lacks specifically designed training tracks towards such careers, as well as specific ones for Data Stewards.
In order to set the stage for a robust PhD programme during the initial 10-year operation of NFFA-DI, the preparation of a new PhD Course on "Science and technology at the nanoscale" organized in association by Universities and Research Institutions according to Art.3 point 2 of DM 226 14/12/2021 and proposed to MUR within the term of PNRR, will be a firm objective of NFFA-DI.

44 List of WP deliverables that will be available according with the timing set by the Intermediate Objectives:

Title	Bimester	Deliverables
Financing PhD positions	3	D8.1 - Identification and approval by PhD schools of the NFFA-DI PhD profiles
Start of training programme	4	D8.2 - Terms of reference for the training programme
Acceptance to RITRAIN school	7	D8.3 - Enrollment of NFFA-DI people to the Retrain school
First level training of data stewards	10	D8.4 - First progress report on data steward training
Second level training of data	12	D8.5 - Second progress report on data steward training

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

training of data stewards: user support		
Start of laboratory support by data stewards	13	D8.6 - Third progress report on data steward training
User support by data stewards	15	D8.7 - Fourth progress report on data steward training
Training of users and young researchers for the usage of the upgraded RI	15	D8.8 - Report on training activities on the upgraded RI

45 Objective, quantitative, and measurable indicators relevant to the monitoring and ex-post assessment of the expected results:

Title	Bimester	Objective, quantitative, and measurable indicators
Financing PhD positions	3	Number of identified PhD profiles
Start of training programme	4	Number of planned training actions
Acceptance to RITRAIN school	7	Number of NFFA-DI people accepted to the Retrain school
First level training of data stewards	10	Number of data steward trainees
Second level training of data stewards: user support	12	Number of data steward trainees
Start of laboratory support by data stewards	13	Number of data steward trainees
User support by data stewards	15	Number of data steward trainees
Training of users and young researchers for the usage of the	15	Number of trainees

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

researchers for the usage of the upgraded RI		

46 WP Intermediate Objectives:

IO Title	*Financing PhD positions*		
IO Bimestre	*3*	IO Costs	*268.049,47*

IO Desciption

Financing (2-years) of PhD positions at Universities co-located with the Consortium nodes, selection of winners and attribution to NFFA-DI nodes for carrying out their research programme in nanoscience

IO Title	*Start of training programme*		
IO Bimestre	*4*	IO Costs	*8.292,50*

IO Desciption

Start of training programmes in all laboratories for young scientists including short exchange visits among the RI nodes to keep close contacts among all trainees and favour team building

IO Title	*Acceptance to RITRAIN school*		
IO Bimestre	*7*	IO Costs	*48.150,00*

IO Desciption

Application to the RETRAIN school of Research Infrastructure managers held by Univ. Milano Bicocca in connection with the EC-project RITRAIN-Plus. The school is addressed to future RI managers as well as to experienced practitioners of RI services. It can deliver a master certificate

IO Title	*First level training of data stewards*		
IO Bimestre	*10*	IO Costs	*178.823,64*

IO Desciption

First level training of data stewards: from developing DMPs at single laboratory level to application of the FAIR concept for in-house research.

IO Title	*Second level training of data stewards: user support*		
IO Bimestre	*12*	IO Costs	*31.652,10*

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

IO Bimestre	*12*	IO Costs	*31.652,10*

IO Desciption

Second level training of data stewards: FAIR-data services from EOSC and other relevant data infrastructures and possible development of user interfaces for guiding to these services.

IO Title	*Start of laboratory support by data stewards*

IO Bimestre	*13*	IO Costs	*131.257,65*

IO Desciption

Engagement of data stewards for implementing DMPs at all provider laboratory; user training for guiding to FAIR-data production and for exploiting FAIR-data services from EOSC and other relevant data infrastructures.

IO Title	*User support by data stewards*

IO Bimestre	*15*	IO Costs	*31.153,80*

IO Desciption

User assistance by data stewards for generating FAIR data sets from their research at the NFFA-DI facilities.

IO Title	*Training of users and young researchers for the usage of the upgraded RI*

IO Bimestre	*15*	IO Costs	*31.153,80*

IO Desciption

Training of users and young researchers for the usage of the new acquired instrumentation and for the maximum exploitation of its performances; training of users for the FAIR-by-design technology installed also on existing laboratory instruments.

47 WP budget description

Cost of fixed term personnel specifically hired for the project

Cost description:

-1.5 person-month of a fixed-term researcher at CNR-IFN@MI
-2 PM of 1 researcher at CNR-IFN@TN
-2 PM researcher at CNR-IMM@BO
-1 PM for 1 researcher and 1 PM for 1 technologist at CNR-NANOTEC
-2 + 2 PM from two experimentalist TD III livello, 2 PM theorist TD III livello
-4 MM (2 MM of technologists T1 and T3) for the set up and implementation of training programs at POLIFAB

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Scientific instrumentation and technological equipment, software licenses and patent

Cost description: N/A

Open Access, Transnational Access, FAIR principle implementation

Cost description: N/A

Civil infrastructures and related systems

Cost description: N/A

Indirect costs

Cost description:
-Participation to schools by PhD students at POLIFAB
-travel at CNR-IOM
-travel at CNR-IFN@MI
-travel and dissemination at CNR-IFN@TN
-travel at CNR-IMM@BO
-travel and consumables at CNR-IMM@CT
-travel at CNR-NANOTEC
-travel at CNR-ISM
-travel at CNR-SPIN
-travel at AREA
-travel at UNIMI

Training activities

Cost description:
-two boursaries for 1 year and a participation to RETRAInPlus at CNR-IOM
-two boursaries for 12 months each at CNR-IFN@TN
-1 internship post MSc to work on FAIR-data training program at CNR-IMM@BO
-2 CNR 24M boursaries (borsa di formazione) at CNR-IMM@CT
-1 bursary at CNR-ISM
-Three 14,5 K€/year post MSc bursary on FAIR data at CNR-SPIN
-4 boursaries of 1 year and 6 boursaries for master thesis at AREA
-RITRAIN-Plus master first two years of 3 PhD students (3rd year co-funded) at POLIFAB
-Management training course and 2 PhD bursuaries for 2 years (3rd year co-funded) at UNIMI

48 Activity title

Training at CNR-IOM

49 Activity short name

A8.1

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 1	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-IOM will participate in-kind to the Training Action a) - Training network among all nodes, with specific competences on Fine Analysis. As part of Training Action b), two internships for 1 year will be offered to train MSc students and graduates on FAIR principles and data/metadata handling under the general coordination provided by WP3, aiming at raising qualified data stewards. Participation of a young CNR-IOM researcher to the RITRAINPlus programme for training of RI managers (Training Action c) is also foreseen.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

3.038,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: travel

54.6 f. Training activities

43.400,00 €

Cost description: Two 1-year internships (borse di studio) for training MSc students and young graduates as qualified data stewards. Participation of a young CNR-IOM researcher to the RITRAINPlus programme for training of RI managers

48 Activity title

Training at CNR-IFN@MI

49 Activity short name

A8.2

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 2	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Action a): Experienced internationally-recognized researchers will participate in the training network among all nodes for users, students and young researcher (Action 8.1), offering advanced training on the following toipics:
- development of state-of-the-art ultrafast sources from the THz to the XUV
- ultrafast spectroscopy for the characterization of materials
- python for data analysis and instrument interfacing
Action d): In order to actively promote the training in fields relevant to NFFA-DI both within and outside the network, researchers participating in the infrastructure will organize a webinar series. Each webinar will be a public one-hour lecture directed to scientists and dedicated to a scientific topic relevant to NFFA-DI with a contribution from one researcher from the network and one international expert in the specific topic.
In particular CNR-IFN@MI will contribute to the series with the following webinars:
- attosecond transient absorption spectroscopy for the study of electron dynamics in materials
- ultrafast THz spectroscopy for the direct investigation of the transient complex dielectric function in semiconductors
- high-order harmonic spectroscopy in solids for the investigation of nonlinear properties in materials
Additional webinars on different topics delivered by experts from other nodes will be planned during the first bimester. The full set of webinars and e-learning tools will be developed and maintained up to date in close cooperation with NFFA-Europe (NEP). The online materials will provide a first acquaintance for the perspective users and the newly enrolled students, as well as specific detailed instructions on how to use the facility tools for the users.
CNR-IFN will contribute the organization of a yearly school, which will be structured along three sessions: 1) a facility showcase with

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

upgrade progress updates; 2) a scientific workshop; 3) a young scientist activity reporting event.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

6.270,00 €

Cost description: 1,5 person months of a researcher (III livello) in charge of the organization of webinars, training users and young researchers, for the usage of the upgraded RI to maximize quality of scientific outcome

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

438,90 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Training at CNR-INF@TN

49 Activity short name

A8.3

50 Activity Start month and duration

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 3	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Action a): CNR-IFN@TN plans to exchange technical and research personnel with the other nodes to align the operation methods on the training of researchers in the field of micro-nanofabrication
Action b): CNR-IFN@TN plans to: organize training on FAIR and FAIRification processes applied to nanotechnologies
Action c): Support for specific training of RI managers: host the RITRAIN-plus personnel for one week to make them acquainted with best practices for complying with Quality Management Systems and control of the production steps as required by specific sectors (e.g. space)
Action d): Support the network training activities with the preparation of a specific webinar on the combination of optical (stepper/ mask aligner) lithography with electron beam lithography and focussed ion beam milling for nanometric patterning.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: 2 person months of a researcher (III livello), training of other users and young researches on the new installations and the whole technoogical platform processes, including FAIR data management

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

2.573,20 €

Cost description: travel

54.6 f. Training activities

28.400,00 €

Cost description: two boursaries for 12 months each

48 Activity title

Training at CNR-IMM@BO

49 Activity short name

A8.4

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 4	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Action a): IMM-BO plans to: i) host users, students and young researchers hired by NFFA-DI for advanced training on micro/nano-fabrication techniques, synthesis and characterization of nano-materials, and device integration of 2D materials, with particular reference to multi-node processes within the NFFA-DI network; ii) exchange technical and research personnel with the other nodes to align the operation methods;

Action b): IMM-BO offers 1 internship (post MSc) for training on FAIR-by-design solutions in nano-fabrication technology and device integration of 2D materials, as well as on usage of metadata and NFFA-DI multi-node integration infrastructures.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: (action a) 1 month of TD researcher to participate to the network among all nodes for sharing of competences on the upgraded RI and (action b) 1 month of TD researcher to participate to the FAIR data training program

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

1.579,20 €

Cost description: travel

54.6 f. Training activities

14.200,00 €

Cost description: 1 internship post MSc to work on FAIR-data training program

48 Activity title

Training at CNR-IMM@CT

49 Activity short name

A8.5

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 5	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

52 Activity description

Action a) IMM-CT plans to: i) host users, students and young researchers hired by NFFA-DI for advanced training on full integrated facilities of the UO and in particular on the additive prototyping, X-Ray Scattering, 3D elemental profiling, dynamic transmission and multipurpose scanning electron microscopy, with particular reference to multi-node processes within the NFFA-DI network; ii) exchange technical and research personnel with the other nodes to align the operation methods
Action b): IMM-CT offers 3 two-years formation grants internship (post MSc) for training on the installations 1,3,5 respectively and for acquiring transversal skills on FAIR-by-design solutions in all the installations, as well as on usage of metadata and NFFA-DI multi-node integration infrastructures.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

5.930,99 €

Cost description: travel

54.6 f. Training activities

84.728,40 €

Cost description: 3 CNR boursaries of two years each

48 Activity title

Training at CNR-ISM

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

49 Activity short name

A8.6

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 6	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Action a): CNR-ISM plans to perform training activities with student, users and young researcher to fully exploit the potential of the upgraded facility and to facilitate the connections with the other nodes and installations. In this framework CNR-ISM shall offer a post MSc scholarship of one year.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

994,00 €

Cost description: travel

54.6 f. Training activities

14.200,00 €

Cost description: The activity aims at the training of one person with 1 post MSc scholarship to the knowledge and competent use of advanced spectroscopic methods, in particular transient absorption.

48 Activity title

Training at CNR-NANOTEC

49 Activity short name

A8.7

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 7	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

Action a): Training users and young researchers by means of researchers/technologists specifically hired for the project, which were previously trained on the planned upgrades: Molecular Beam Epitaxy for novel epitaxial grade metal-oxide semiconductors and Light- and Electron-based Advanced Correlative Microscopy. The activity is finalized to a competent usage of the upgrades to maximize quality of science outcomes. Exchanging technical and research personnel with the other nodes to align the operation methods;
Action b): Develop a FAIR-data training program for permanent staff of the node, aimed at qualified data stewardship.
In order to maximize the impacts of the proposed initiative, CNR-NANOTEC will implement ambitious dissemination measures. In particular, the project achievements will be promoted broadly, through the website of CNR-NANOTEC and NFFA-DI, public events, as well as via social media channels; dissemination activities will include publications and presentations at conferences.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

8.360,00 €

Cost description: The activity of the fixed term personnel, specifically hired for the project, aims at training users and young researchers, finalized to competent usage of the upgraded RI to maximize quality of science outcome. The training will be focused on MBE growth

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

finalized to competent usage of the upgraded RI to maximize quality of science outcome. The training will be focused on MBE growth and advanced correlative microscopy. Furthermore, the activity includes a FAIR-data training programme for staff aiming at qualified data stewardship. The activity requests funding for 2 person months, as follows: one researcher (CNR rank: level III) for 1 month, one technologist (CNR rank: level III) for 1 month.

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

585,20 €

Cost description: Travel

54.6 f. Training activities

0,00 €

Cost description: N/A

48 Activity title

Training at CNR-SPIN

49 Activity short name

A8.8

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

OU short name	UO 8	Participant	CONSIGLIO NAZIONALE DELLE RICERCHE

52 Activity description

CNR-SPIN will focus on: i) strengthening of scientific and technical competences of it's own staff; ii) endowing the node with FAIR data experts and iii) creating a new generation of users.
Action a): Establishing a FAIR-data training programme for staff aiming at qualified data stewardship, and for users or trainees. The training will be performed on the upgraded "MODA" laboratory, a UHV platform for nanomaterials growth and characterization made of several interconnected chambers. Our plan for FAIR-compliant data/metadata management is described in A3.10
Action b): Organization of Webinars and Schools, synergies with the NEP training activities, specific online tools.Participate and contribute to the three editions of the periodic school on Nanoscience
Among the beneficiaries of our training action, besides our own staff and the users, we plan to include MSc graduates. Three students will be offered a one-year internships on FAIR principles and data/metadata handling and will have access to all the training initiatives organized within the RI. Each student will have a researcher hired on the project as a mentor.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

25.080,00 €

Cost description: 2 + 2 months from two experimentalist TD III livello, 2 months theorist TD III livello

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

4.800,60 €

Cost description: travel

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54.6 f. Training activities

43.500,00 €

Cost description: 3 one-year post MSc internships on FAIR data management

48 Activity title

Training at AREA

49 Activity short name

A8.9

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 9	Participant	Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park

52 Activity description

Action a) the goal of the activity is FAIR-data training program for the NFFA-DI user community by forming a young and well coordinate group interested on FAIR data, data science and similar topic. Several fellowship will be promoted among recently graduated students interested in creating a career in the data science arena within research infrastructures.
The selected people after an initial training, in synergy with existing (ICDI /EOSC) competence frameworks and coordinate by the AREA science Park Data management will form the core team that can take care of creating and enhancing the awareness on scientific FAIR data management within the all NFFA-DI community. FAIR principles and methodologies will be continuously spread among community through a continuous training/learning innovative approach.
FAIR and OPEN Trainings program will be given as much as possible through a gamification educational path to maximize enjoyment and engagement by capturing the interest of learners and inspiring them to continue learning.
Weekly pills will cover best data management practices to apply to scientific data merging theory and practice, appointed personnel will be trained to become qualified data collector, data curator, data steward, data scientist, project director, and so on.
Completing the picture, several Data Management tool will be designed and implemented alongside with and for the benefit of all WP members: basic FAIR checklist, FAIR data self-assessment tool, FAIRification protocols for specific dataset, Data Management Plan editor, Metadata generator.
Other fellowships will be dedicated to undergraduate students interested in short term fellowship for internship and master thesis on such theme. There will several calls for them depending on the need and the activities that can be assigned to this class of students.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

7.000,00 €

Cost description: Travel costs

54.6 f. Training activities

100.000,00 €

Cost description: 4 fellowship of 12 month (18.250 €) for graduate students: total 73.000 € and 6 short term internship (4.500 €) for undergraduate students: total 27.000 €

48 Activity title

Training at POLIMI

49 Activity short name

A8.10

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

OU short name	UO 10	Participant	Politecnico di Milano

52 Activity description

Action a): POLIMI will coordinate NFFA-DI nodes to organize training sessions for young scientists along the whole project. The sessions will be spanning from short exchange visits among the RI nodes to keep close contacts among all trainees and make them develop as one team, with full awareness of the RI offer and possibilities, to workshop conventions where specific topics of relevance for the RI are discussed, or where novel tools offered to the users are showcased.
Action c): Participation of a staff member of Polifab to a RITRAIN-plus master course on management of research innrastructures
Action d): Three students will be enrolled at POLIMI in its PhD programme based at the Department of Physics and will spend extended periods (3 months minimum) in other research nodes. The research themes will be connected to POLIMI activities in WP7 as described below.
PhD1: Developed of wafer scale processes for growth of novel quantum materials by PLD, ALD, CVD. IMM and CNR-Nanotec for exchange.
PhD2: Methods and instrumentation for spin-resolved and in-operando photoemission, on the UHV system including a small MBE coupled to an electron-spectroscopies apparatus. Experimental runs at ELETTRA and FERMI beamlines, stages in CNR-SPIN nodes for modelling.
PhD3: Realization of a time-resolved polarization microscope and investigation of collective excitations in ferromagnets, antiferromagnets and ferroelectrics. Experiments at IFN-CNR and IOM-CNR beamlines
The PhD programmes will start simultaneously, within 6 months from the beginning of NFFA-DI. Owing to the support of the training network established by A8.1, the Candidates will be exchanging experience as being active part of a virtual class, although developing their research projects at the different nodes of NFFA-DI and being enrolled at different Academic institutions. The scheme will thus resemble and be developed essentially on the same model as the ITN/ETN networks of the Marie Skłodowska-Curie Actions of HEU.

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

15.500,00 €

Cost description: 4 MM (2 MM of technologists T1 and T3) for the set up and implementation of training programs

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

Cost description: N/A

54.5 e. Indirect costs

12.742,35 €

Cost description: travel expenses of PhD students

54.6 f. Training activities

166.533,52 €

Cost description: –151.533,52 €, corresponding to 48 MM for each of the three PhD students. The remaining 12 months, after the end of NFFA-DI at month 30, will be co-funded by POLIMI.
–15.000 € for participation in a RITRAIN-Plus master by a staff member of Polifab

48 Activity title

Training at UNIMI

49 Activity short name

A8.11

50 Activity Start month and duration

Activity Start month	1	Activity Duration	30

51 OU in charge of the Activity

OU short name	UO 11	Participant	Università degli Studi di Milano

52 Activity description

Action a): Participation of a young researcher by UNIMI to a RITRAIN-plus master course on management of research infrastructures.
Action b): Two students will be enrolled at UNIMI in its PhD programme on specific research topics in connection with WP7 activities at UNIMI or any of the other NFFA-DI nodes, including extended permanence at no less than two non-co-located nodes of the RI: typically, one in a southern node and the other in a northern node, according to specific science project of the candidate.
Topics at UNIMI are e.g.: nanomagnetic phenomena driven by optical filed and by plasmonic structure below the optical diffraction limit; surface magneto-dynamics processes at nanoscale and ultrafast spintronics; ab-initio computational tools towards electron-phonon coupling description; ab initio molecular dynamics with electronic friction, and other non-adiabatic effects at metallic surfaces. Building on the experience of the PhD School at UNIMI, a new PhD course will be designed on "Science and technology at the nanoscale", the course will be outlined with the perspective of being proposed to MUR as a PhD in associated form according to Art.3 point 2 of DM 226 14/12/2021 that will establish a long-term pursuit of NEP in Higher Education dedicated to the training of young people as Early Stage Researchers or prospective RI managers.

d) PROJECT WORK BREAKDOWN STRUCTURE - [WP8 - Training of a new generation of RI operators and of researchers for exploiting NFFA-DI and European]

(The information provided in this section will be evaluated with reference to criteria C1-C5)

54 Activity budget

54.1 a. Cost of fixed term personnel specifically hired for the project

0,00 €

Cost description: N/A

54.2 b. Scientific instrumentation and technological equipment, software licenses and patent

0,00 €

Cost description: N/A

54.3 c. Open Access, Transnational Access, FAIR principle implementation

0,00 €

Cost description: N/A

54.4 d. Civil infrastructures and related systems

0,00 €

Cost description: N/A

54.5 e. Indirect costs

7.978,60 €

Cost description: travel expenses

54.6 f. Training activities

113.980,00 €

Cost description: –98.980,00 € 2 PhD bursaries for 2 years (3rd year co-funded) –15.000,00 € participation in 1 RITRAIN-plus master

The Scientific Coordinator

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The legal representative for the applicant

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