Horizon Europe Programme

Standard Application Form (HE CSA)

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Project proposal – Technical description (Part B)

Proposal template Part B: technical description

Einstein Telescope Preparatory Phase (ET-PP)

List of participants

Participant No. *	**Participant organisation name**	**Country**
1 (Coordinator)	Institut de Física d'Altes Energies (IFAE)	Spain
2 (affiliated to 1)	Barcelona Supercomputing Center (BSC)	Spain
3 Partner	ISTITUTO NAZIONALE DI FISICA NUCLEARE (INFN)	Italy
4 Partner	UNIWERSYTET WARSZAWSKI (UW)	Poland
5 Partner	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	France
6 Partner	STICHTING NEDERLANDSE WETENSCHAPPELIJK ONDERZOEK INSTITUTEN (NIKHEF)	The Netherlands
7 Partner	UNIVERSITE CATHOLIQUE DE LOUVAIN (UCL)	Belgium
8 Partner	UNIVERSITEIT ANTWERPEN (ANTW)	Belgium
9 Partner	EUROPEAN GRAVITATIONAL OBSERVATORY (EGO)	Italy
10 Partner	DEUTSCHES ELEKTRONEN-SYNCHROTRON (DESY)	Germany
11 Partner	WIGNER FIZIKAI KUTATOKOZPONT (WIGNER)	Hungary
12 Partner	MONTANUNIVERSITAET LEOBEN (MUL)	Austria
13 Associated	UNIVERSITE DE GENEVE (UNIGE)	Switzerland
14 Partner	UNITED KINGDOM RESEARCH AND INNOVATION (UKRI)	UK

1. Excellence

The core scientific field of Einstein Telescope (ET) is gravitational wave (GW) physics. GWs are opening a new window on the cosmos that can revolutionise humanity's understanding of the universe up to cosmological distances and unlock unexplored territories of extreme physical conditions that no experiment on Earth can ever provide. ET has the ambitious mission to push the limits of our ability to detect GWs and learn more about the evolution of our Universe back to its earliest form right after the Big Bang. Based on well proven and experimentally tested concepts, ET will exploit cutting-edge technologies and push them to their physical limits. It combines the well-proven technologies from the current advanced LIGO and Virgo detectors with beyond-state-of-the-art systems planned for the next evolution stage of the advanced detectors, in an infrastructure designed to accommodate several technology upgrades over many decades. ET has been recently included in the ESFRI roadmap 2021.

The ET Scientific Collaboration is steadily growing and it is constituted by XXX institutions from YYY European countries. The collaboration already counts with a well-defined internal organization in several boards with the required technical and scientific competence. The ET political support has increased since 2020, when the ESFRI candidature was formally supported by five European countries. A first step towards an initial ET governance model was recently made in the form of a Project Directorate, an interim proto-Council including representatives from ZZZ funding agencies from ZZZ countries, and a Board of Scientific Representatives. For the purpose of this preparatory phase (ET-PP) application, the participation is concentrated in 13 institutions, acting as liaisons and coordinators at the national level.

1.1 Objectives

The main objective of this ET-PP proposal is to support crucial items in the preparatory phase of the experiment, including: the enlargement of the ET consortium, the legal framework, governance schemes, and financial regulations under which ET will be constructed and operated; the technical design and costing of the ET observatory; the selection of the site where ET will be deployed, detailing and cost-estimation of the required site infrastructure, and its socio-economic and environmental impacts; the schemes for technology transfer, procurement and industry involvement in the technical design and construction of ET; and the required linking with relevant science communities regarding the detailed definition of the science program, and the user services and data access model. We anticipate a EU budget request of 3.45M€ for a total duration of four years. This complements a very significant in-kind contribution from participants and third parties of about XXM€, for a total estimated cost of the ET-PP project of about XX M€.

The activities are organized in a set of ten well-defined work packages (WPs) with precise deliverables and milestones. Some of the work packages address explicitly aspects that were singled out during the ESFRI selection process. In the following, the definition and a brief description of the different work packages is provided. As detailed in Section 1.2, strong links between WPs are built.

WP1 - Management and Coordination - will be responsible for the global management and coordination of the WP activities, with the aim to guarantee an adequate use of the resources, and to facilitate a continuous and strong coordination across WPs and technical activities, by applying a transparent transfer-of-knowledge and information policy. In addition, WP1 will be responsible for the ET-PP administrative activities including regular reports and financial audits, and will contribute globally to increase the social awareness of the project. M. Martinez (IFAE) acts as IP and coordinator of the ET-PP proposal under the responsibility of the ET Project Directorate.

WP2 - ET Organization, Governance and Legal Aspects - has the mandate to put the foundations for establishing the internal organization model and the governance of the ET project, including the framework related to the definition of ET as a legal entity, and to facilitate the geographic enlargement of the ET consortium. WP2 will contribute to the political convergence across stakeholders on critical decisions affecting the main aspects of the research infrastructure like, for example, the final ET layout, site selection, total cost, etc. In addition, WP2 has the mandate to define the formal connections with other GW observatories and scientific communities. J. O'Byrne (STFC UKRI), F. Ferroni (INFN) and J. van den Brand (Nikhef) act as co-coordinators of WP2 in this proposal.

WP3 - Financial Architecture - has the mandate to investigate all aspects of the funding architecture required to ensure the construction, operation, and eventual decommissioning of the ET even with different alternatives in construction and legal settings; to identify risks (price, time, technological, legal, etc.); to define guidelines with a fair sharing of costs and scientific, industrial and socio-economic returns among all participating parties in the ET collaboration; and to set a strong financial model and a common tool for all financial data. In the framework of ET-PP, the main objective is to prepare the financial items of a signature-ready contract to commonly fund and build ET. Ch. Arina (U. Louvain), T. Berghöfer (DESY), A. Sequi (INFN) act as co-coordinators of WP3 in this proposal.

WP4 - Site Selection Preparation - is responsible for collecting and processing, from each potential site, all the required information necessary for site qualification. This includes site specific characteristics that might impact the ET scientific performance, socio-economic impacts, legal implications, and civil engineering costs. The information will be treated in a coherent and transparent manner, with the aim of facilitating a site selection process in a timescale consistent with ET anticipated schedule. M. Campinelli (INFN) and F. Linde (Nikhef) act as co-coordinators of WP4 in this proposal.

WP5 - Project Office and Engineering Department - has the mission to establish the ET project office and the corresponding engineering department. The role of this WP is to set-up a project management environment for the Einstein Telescope construction project. This environment will be supported by consultative and executive bodies equipped with means to monitor, control, coordinate and report on the technical design, the engineering, the technical specifications, the risks, the budget and the schedule. These activities are project-wide and make use of methodologies and tools which are the same across the whole of the Einstein Telescope construction project. R. Flaminio (CNRS), A. Freise (Nikhef), and R. Saban (INFN) act as co-coordinators of WP5 in this proposal.

WP6 - Technical Design - has the mandate to provide the ET-PP project management with a refined scientific case, the Technical Design Report (TDR) of the research infrastructure (RI) hosting the ET interferometers, and the TDR of the set of detectors (interferometers) and facilities (vacuum and cryogenic apparatuses and plants) composing the ET observatory. Furthermore WP6 has the duty to elaborate a data management plan (DMP) and a Data Access Policy in synergy with WP8 (see below) and WP2. The activities in WP6 take place inside the ET collaboration and will take full advantage of the existing technical and scientific boards inside the experiment. The chairs of the ET Steering Committee: H. Lück (Hanover) and M. Punturo (INFN) act, together with P. Chiggiato (CERN), as co-coordinators of WP6. P. Chiggiato coordinates the R&D and technical design of the ET pipe-arm vacuum system.

WP7 – Innovation and Industrial engagement - will be responsible for all the aspects related to Technology Transfer including the promotion of innovative technologies inside ET, the proper management of the intellectual property, and establishing the liaisons with industry to maximize the industrial returns. M. Morandin (INFN) and R. van der Meer (Nikhef) act as co-coordinators of WP7 in this proposal.

WP8 – Computing and Data Access - is devoted to realizing the model for computing and data access for ET, including: the definition of the workflow, the estimation of the required resources, the design of the online T0 data center, and the clarification of the policy for the storage and the access to the ET data on all relevant time scales, respecting the EU policies on open data. To a very large extent, the work relies on existing efforts in the ET collaboration, and also counts with the presence of experts from large computing centers with long experience on massive computing demanding challenges. S. Girona (BSC) and A. Stahl (Aachen) act as co-coordinators of WP8 in this proposal.

WP9 - Sustainable Development Strategy - focuses on those crucial aspects necessary for the design of a sustainable ET infrastructure, minimizing the landscape and environmental impacts. This includes, for example, strategies for low carbon footprint and low energy consumption of the whole experiment and a smart model for transportation. N. Arnaud (CNRS), S. Katsanevas (EGO) act as co-coordinators of WP9 and count with the presence of M. Marsella (INFN) for the coordination of the aspects related to ET civil infrastructures.

WP10 - Education, Outreach and Citizen Engagement - has the mandate to promote to the widest possible audience the game-changing scientific potential of ET for astronomy, cosmology and fundamental physics. It will coordinate across all member countries of our Consortium the creation and dissemination of educational and promotional materials that will bring the scientific vision of the ET project to all relevant stakeholders - including other scientists, journalists, politicians and policy makers, industry leaders, school and university students and the general public. M. Hendry (UKRI) and D. Rosinska (U. Warsaw) act as co-coordinators of WP10 in this proposal.

1.2 Coordination and/or support measures and methodology

In Figure 1, the global structure of the ET-PP project is shown and the main connections and interplays across WPs are presented. The WPs are naturally clustered into four main areas related to the ET organization, the instrument design, the instrument site and the sustainability and social related aspects, with WP1 orchestrating the global coordination. In the following some relevant aspects are discussed.

Organization, Governance, Legal Entity and Site Selection. ET-PP must ensure that the main decision making bodies, i.e. Ministries are provided with the relevant information in a transparent manner as much as possible. This includes at least a detailed science case document. This includes multi-messenger topics and will require discussions and possibly agreements with astronomy organizations such as ESA and ESO. The scientific and technical requirements for Einstein Telescope will be defined in the context of a future third-generation (3G) global network of observatories. As Einstein Telescope will be embedded in a global network, a common framework must be developed to tackle the computing issues, including low latency and alert distribution. Moreover, an international collaboration on R&D will be developed. This includes topics as mirrors, coating, quantum and cryogenic technologies, vibration isolation, vacuum technology, environmental monitoring and control, and civil infrastructure technologies (e.g. excavation). Here we strive towards detector architectures that include a level of design homogeneity in order to simplify the implementation, taking into account local conditions. At present LIGO, Virgo and KAGRA constitute a global 2G network of gravitational-wave observatories where various computational aspects have been integrated in an International Gravitational Wave Network (IGWN) framework. In this context a common engaged roadmap must be developed to go from the current generation 2G to 3G. Associated governance documents for the next phase must be developed together with involved funding agencies. Finally, the site-selection will be made at the level of Ministries, and again WP2, in close coordination with WP4 and WP1, will ensure that adequate information is provided in a transparent manner. This includes both geophysical information and cost studies for site infrastructure and detector architectures and identification of value engineering priorities and cost cap targets.

A primary objective of ET-PP is to prepare a legal entity for the Einstein Telescope Research Infrastructure (RI). The preferred implementation has to be determined and may be that of an Intergovernmental Organization (IGO) based upon a treaty-strength international Convention as exemplified by CERN or the recently formed SKA IGO. In this model, governments sign the fixed Convention in a durable and powerful commitment. like CERN and SKA. Alternatively, a European Research Infrastructure Consortium (ERIC) model can be considered in which each partner deposits with the European Commission a letter of commitment to the agreed work of the consortium, signed by an appropriate government official. Another option that will be considered is an International non-profit member company such as a Delaware LLC, German GmbH, Dutch Stichting, or a Belgian Association International sans but Lucrative [AISBL]. Governments can be members of the corporation and can make written company formation documents and contribution agreements that are legally binding and internationally recognized. These can have independent and appropriate procurement and employment systems and are fully responsible for all financial matters.

Note that all three governance models contain a strong central management. The final selection of which model to adopt must be made by the Ministries, project leaders and the funding agencies together. The path to the ultimate governance structure is similar no matter which of these three is chosen. An important objective is to expand the number of stakeholders participating in the Einstein Telescope project. We expect that during this process a Council will be established for the Einstein Telescope.

In the present Governance model under consideration, the Einstein Telescope Council is the highest authority of the Organization and has responsibility for all-important decisions. It controls ET's activities in scientific, technical and administrative matters. It approves programmes of activity, adopts the budgets and reviews expenditure. The Council is assisted by the Scientific Policy Committee and the Finance Committee. The Director-General, appointed by the Council, manages the ET Observatory. The Director-General is assisted by a directorate and runs the Laboratory through a structure of departments. ET is run by the Member States, each of which has two official delegates to the ET Council. One represents his or her government's administration; the other represents national scientific interests. The Scientific Policy Committee evaluates the scientific merit of activities proposed by physicists and makes recommendations on ET's scientific programme. Its members are scientists elected by their colleagues on the committee and appointed by Council on the basis of scientific eminence without reference to nationality. Some members are also elected from Non-Member States. The Finance Committee is composed of representatives from national administrations and deals with all issues relating to financial contributions by the Member States and to the Organization's budget and expenditure.

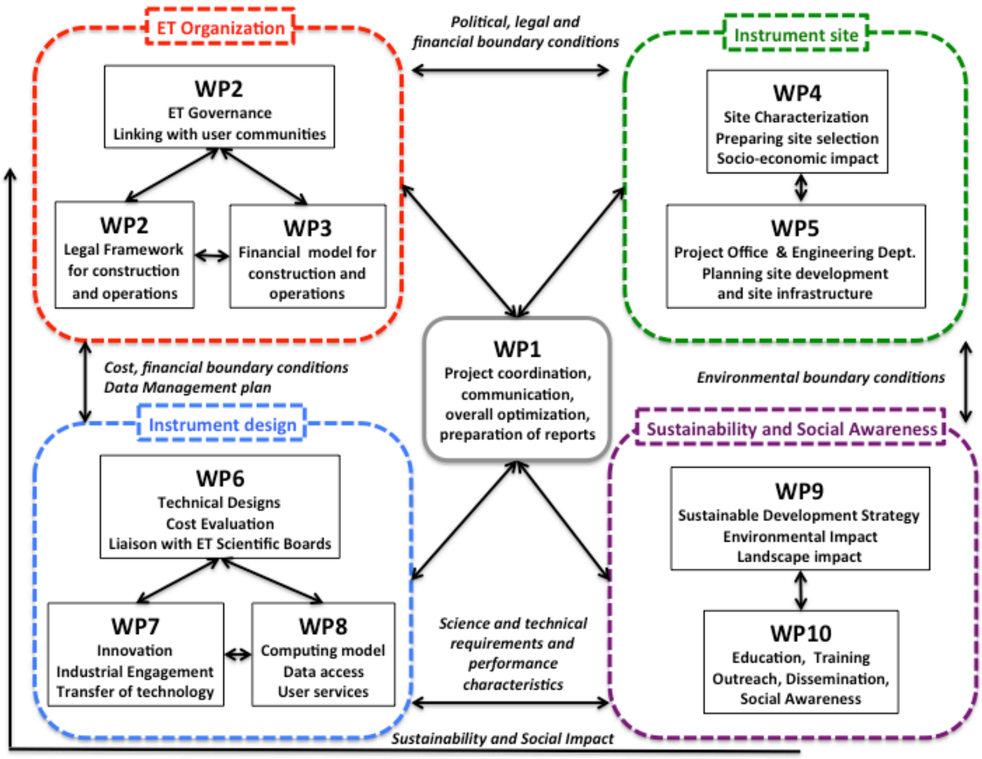

Figure 1: Project structure and interrelation of the different work packages, aiming to illustrate the most important relations between work packages.

Site Selection Preparation. A timely selection of the site, currently foreseen by 2024/2025, is a fundamental aspect of the ET-PP program. As already pointed out, the task of the WP4 is to collect –and wherever possible to quantify – all relevant site-specific aspects entering the Einstein Telescope project's site selection process. This for all sites that aspires to submit a bid book to host the Einstein Telescope infrastructure. Without being exhaustive, these aspects range from issues directly impacting the sensitivity/performance i.e. discovery potential of the Einstein Telescope Project like seismic noise, seismic activity and duty cycle, to aspects that impact the construction/operation costs such as rock stability and sub-surface hydrology to 'softer' aspects such socio-economic impact, accessibility and quality of life. In view of the anticipated prolonged operation of the Einstein Telescope Project, the site must also be safeguarded against the future installation of noise-generating facilities such as windmills, railroads, etc. in the vicinity. Apart from that each site must commit to the to be agreed upon schedule once selected i.e. possible delays in the start-up of notably the excavation works related to legal procedures, permitting, land acquisition, etc. must be taken care of beforehand.

Two items are at the core of the WP4 objective: how to arrive at robust and comparable cost and schedule estimates of the civil engineering (excavations) work in view of taking into account aspects such as the geology, the local population, nature conservation; and how to establish the impact of site characteristics on ET sensitivity and operation and, if needed, how to compensate it and at which level it would be possible to mitigate it. For many of the aspects the actual work will not be done within WP4 itself, but will be provided by the Einstein Telescope collaboration via WP6 (in particular the parameters affecting the Einstein Telescope Project's sensitivity) or will be outsourced to a professional organisation (e.g. socio-economic impact studies, quality of life assessment). Instead, within this WP4 the relevant aspects will be defined, collected, analysed and if needed quantified.

Financial Architecture. To develop the financial architecture for ET, it is important to establish commonly accepted and well-defined guidelines for the planning, monitoring and reviewing of costs, the provisioning of in-kind contribution and the financing and evaluation of R&D activities that will be run during this preparatory phase. It's also important to agree rules to measure and recognize effort and contribution provided by the partners through national and EU funded projects. These internal rules will be set and described in handbooks, one for the design and construction phase and one for the operating phase and, at the end, set in a signature-ready contract to fund and build ET. A financial module of the project management information system (PMIS) will be implemented to set up a living model for scheduling and budgeting. According to modern industry standards a "rolling wave" approach will be followed in funding and expenses management to progressively improve the financial planning. Cost risks in procurement will be identified and measures will be developed to mitigate these risks in close collaboration with the governance and project management working groups. Key indicators will be identified to monitor project execution. The financial plan will be developed, at different levels, according to the possible governance and legal status. Then, different scenarios will be elaborated to run sensibility analysis to cost and time variability and different procurement methodology. The results will help to set the right quantity of contingencies and "when and how" they can be used. As already mentioned, the ET Finance Committee will be established. WP3 in charge of the financial architecture, in close coordination with WP2, will be responsible for preparing, carrying out and following up biannual meetings during the ET preparatory phase. Annual progress reports will be shared with all involved funding agencies and ministries as well as the Physical Sciences and Engineering Strategic Working Group of ESFRI.

Project Office and Engineering Department. One of the main missions of ET-PP is the creation and consolidation of the ET Project Office and the corresponding Engineering Department. It is foreseen that a significant fraction of the requested funds (about 50%) are devoted to this mission. Holding to the primary constraints which are the scope, the schedule, and the budget, the role of the Project Office is to guarantee, that the as built RI -comprising infrastructure, technical systems and the interferometer itself- fully complies with the requirements, the parameters, the layout detailed in the Technical Design Report (TDR) without having undergone changes which were not endorsed by the stakeholders. While the requirements, the parameters, the layout of the interferometer are set by the collaboration in charge of the GW observatory, the infrastructure and technical systems associated with the interferometer are designed, procured, installed, commissioned, maintained and eventually dismantled by an Engineering Department yet to be created. The scope, the mandate and the composition of this unit will be defined within WP5. The architecture and location of the Project Office will be defined early during the ET-PP project to allow the start-up of the Project Office well before the completion of the project. The host(s) of the project office is expected to provide office space and the relevant infrastructure free of charge. The project office will be established for the preparatory phase; for the construction and operational phases, once the ET site selection process has been concluded, a different organization and location may be appropriate, with a proposal arising from the work in the preparatory phase.

The work to set-up the Project Office will be carried-out by personnel hired in the scope of ET-PP that will be supervised by engineers and scientists who have been involved in project management in their home institutions. The leaders of WP5 will constitute the Steering Board which will monitor and take part in the activities of the team until the end of the ET-PP project. It is also assumed that both the Head of the Project Office and the Head of the Engineering Department will be picked among the experienced staff in the community of GW observatories without receiving financial support from ET-PP.

Technical Design. One of the main objectives of the ET-PP is to provide a revisited/refined TDR of ET including both the infrastructure and the experiment together with updated cost estimates. As expected, this work will be developed to a large extent within the ET scientific collaboration, and will count with the assistance of experts on civil engineering, vacuum, cryogenics and infrastructure services in the ET Project Office. In particular, the vacuum system for ET's arms will be one of the most challenging ever built for research facilities. An intimate relation with experts from the CERN vacuum department has been established. CERN will coordinate the TDR on the baseline solution for the vacuum system for ET's arms. This includes detailed information on the proposed technologies, planning and tunnel integration, and budget. In parallel CERN will coordinate the activity on value engineering to find the best compromise between cost and performance. For that purpose, material selection, manufacturing techniques and pumping technologies will be investigated in close collaboration with the European industry and the collaborating institutes.

WP6 serves as a bridge to the ET scientific collaboration, already well organised in specific boards (see Figure 2), with the required technical and scientific competences and precise mandates. The Observational Science Board (OSB), currently composed by more than 200 scientists, and led by three co-chairs with specific skills in Fundamental Physics, Multi-Messenger Astronomy and Data Analysis, will deliver a refined ET science case, taking into account the latest update in the observatory design. The Instrument Science Board (ISB), currently composed of a few hundred scientists and engineers, will take care of the development of the TDR of the interferometers composing the ET detectors. The TDR of the RI and the design of the vacuum system will be realised under the management of the project directorate and the Project Office in WP5, in close collaboration with the ISB. Technological collaboration with major laboratories in Europe and in the world, highly skilled on the specific technological aspects will be pursued. The coherence between the WP6 activities and the ET scientific collaboration actions are guaranteed by the chairs of WP6 and of the ET steering committee. Given the existing resources in the ET collaboration, the WP6 activities will be done without receiving support from this ET-PP action.

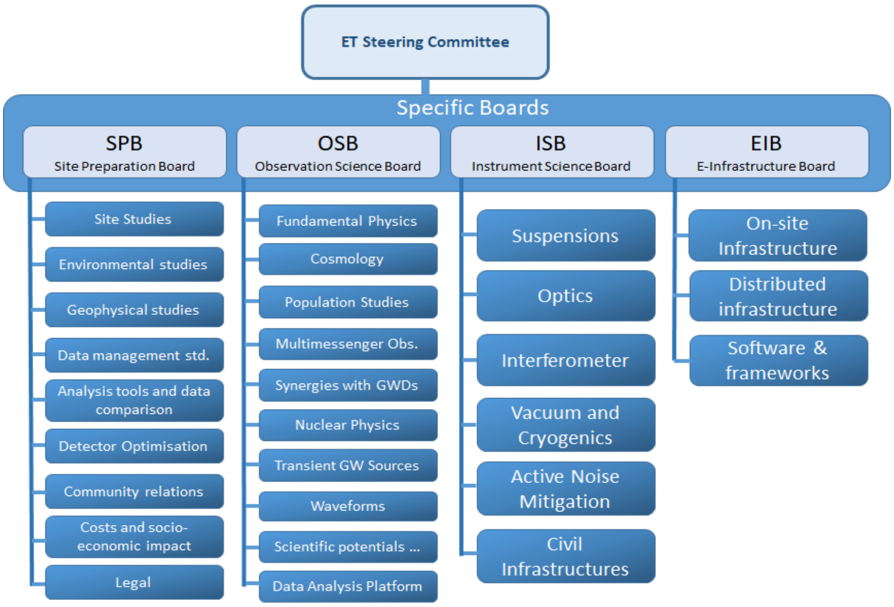

Figure 2: Current organization of the ET Collaboration.

Computing model and data access. The development of a valid computing and data access model is an objective of ET-PP. It requires close cooperation with ISB, OSB and EIB boards of ET to define the workflow from the instrument to the publication. A geographically distributed model of resources is foreseen as the only way to match the computing needs of the experiment over its lifetime. A powerful T0 on-site computing center will receive the data taken by the experiment. The model will define the services provided by the center, and the delimitation against services realized with distributed computing. The development of the model is intimately linked to a proper estimate of the computing resources (computing power and data storage), the personnel, and the operational cost required for all aspects of ET computing, where the potential for mitigation must be addressed. Similarly, the ET computing solutions must include those aspects related to the sustainability and energy efficiency of the model. Moreover, ET-PP will develop a policy on the storage of the data and the access to the data, following all the EU open data standards. As pointed out, this requires the close coordination of WP8 with WP6 and WP2, where the latter addresses the required coordination with other GW observatories.

Innovation and Industrial engagement. Establishing the proper contacts with industry for R&D and in preparation for the future massive industrial production during the ET construction phase is a pillar of the ET-PP program. Goods and services needed to build the ET facility are demanding in terms of technical, engineering, managerial or manufacturing capabilities. It can be expected therefore that the number of companies that can satisfy the requirements imposed in the tendering procedures might be in some cases limited. In order to guarantee a sufficient level of competition and industrial capability, measures are needed to attract the interest of a sufficient number of companies and, in some extreme cases, where suppliers with sufficient capabilities may not exist, engage companies in the R&D phases to prepare them for subsequent effective involvement in the production phase. ET-PP will define the appropriate objectives that ET could establish to support and enhance the development of innovative technologies and the incorporation of new ventures in the implementation of the ET project. At the same time, a mapping of the engagement initiatives already in place in partner countries, both for ET and other RIs will be made along with the validation of the maturity of the technologies and industry capabilities needed in the construction and operations phase. This might translate into the need for a new engagement plan for national and international activities. Those activities will be driven by WP7 in close cooperation with the Project Office. The proper balance of industrial returns to the countries that constitute the ET consortium will be at the root of the success of the ET project. During ET-PP, and in coordination with WP3, models for a balanced industrial return in tendering procedures used in other RI will be studied, with the aim to arrive at a satisfactory solution. Finally, ET-PP will bring the opportunity to determine the approach ET will follow for the management of the Technology Transfer processes and, specifically, the management of the Intellectual property.

Sustainability. As already mentioned, one crucial aspect of the ET-PP is to develop the strategy for the realization of a sustainable ET infrastructure. During the next few years, an accurate evaluation of the ET carbon footprint during both its construction and initial operation stages will take place. All power consumptions of the infrastructure will be taken into account (instruments, service plants, computing facilities) as well as those linked to the transportations (commuting, supplies, travels) by analysing all the scientific scenarios envisioned. The study will be based on simulations and projections using literature standards, plus some critical revision of the existing studies for the current ground-based gravitational-wave detectors: the two LIGO instruments (USA), Virgo at EGO (Italy) and KAGRA (Japan, underground). Surveys made by large research infrastructures like CERN and SKA will be used as well, both for their methodology and as inspiration for our actions for ET. A responsible energy consumption policy will be reinforced by increasing the efficiency of all devices, reducing the ET global need for energy thanks to an optimised design of the most energy-consuming areas, and by recovering as much emitted energy as possible (e.g. heat from cooling systems) to reuse it. Moreover, a responsible production for the consumed energy will be promoted, whether it be produced on site (e.g. by arrays of solar panels) or provided by external suppliers. Such optimization will be done separately for the three main elements of the on-site infrastructure –underground constructions, surface buildings and the local computing center – that all have different requirements to fulfil and challenges to meet. A joint work of WP9 with WP6 and WP8 is foreseen.

Landscape and environmental impact. The ET-PP plan includes specific actions on how to optimize the surface transportation network and design an underground transportation system for personnel and materials, by identifying the paths, the types of users, the vehicles needed, and also by considering the highest safety standards; on the planning and management issues related to the definition of critical areas (safety and environmental) and to the necessary investigations to obtain the associated risk assessments; on the impact of different scenarios for the design of the underground structures (tunnels, shafts and caverns) to minimize interference with external surface infrastructure networks, urban and natural areas; on the development of layout concepts for the foreseen surface infrastructures taking into account technical requirements, environmental constraints and connection with existing infrastructure and service plants; on the development of integrated processes for environmental assessment evaluation in agreement with local regulations; on the study of the impact on biodiversity and on the hydrologic cycle; and, finally, on a global approach for non-hazardous and hazardous waste management and recycling both during the construction and operation phases.

Inspired by relevant CERN actions, ET-PP will study the organization to manage environmental issues. As part of its Environmental Protection Strategy, ET may launch an ET Environmental Protection Steering Board to identify and prioritize environmental areas to be addressed and to propose programs of action, and an ET Energy Management Panel to monitor the ET energy consumption and identify measures to improve efficiency and promote energy re-use. These actions will be developed in the framework of WP2 and the environmental protection regulations of the ET hosting and member states.

Social awareness. The ET project relies on a significant investment of public funds from the different countries forming the ET consortium. Therefore, the awareness and recognition of the project value by the society is of utmost importance. Moreover, the ET project has the duty to return the investment to society also in the form of outreach, education and training opportunities for the general public and the next generations of scientists. In the ET-PP structure, WP10 is formed by a large community with huge experience on outreach and communication activities in the framework of LIGO/Virgo gravitational wave experiments. WP10, in close collaboration with WP1, will establish procedures for coordination of outreach and communications across national networks and WPs. It will create, disseminate and curate high-quality promotional materials on ET science and technology, and design educational resources on ET science and technology, aligned with national STEM curricula. In particular, this involves the design, development and maintenance of a dedicated ET website and social media platforms, as well as the design and production of a range of professional-quality videos and interactive resources on ET science and technology. In addition, ET-PP will develop a sustainable mentorship and training programme for early career researchers, including a training plan for design and delivery of future summer schools.

2. Impact

2.1 Project's pathways towards impact

The clear WP structure and the strong links built across WPs (see Figure 1) are key aspects of ET-PP that pave the path towards reaching the goals and the required impact. The appointed co-coordinators of the different WPs were carefully selected and are a distinguished set of prominent and internationally recognized experts on the field with great experience on managing Big Science projects. In many cases, the WP co-coordinators bring first-hand experience from international laboratories like EGO, CERN or DESY, among others.

The ET-PP requested funds **(3.45M€)** are strategically placed to maximize their impact. However, the ET-PP success relies on the strong commitment from the different institutions participating in the proposal, putting forward very significant in-kind contributions in the form of dedicated personnel and cash. The personnel contracts funded by ET-PP EU funds will have a duration of three years and will count with co-funding from the host institutions, committed to extend the contracts to match the duration of the ET-PP project. As described in Section 3.2, the ET-PP participants have clear commitments to current GW experiments and already provided strong support to ET.

As already mentioned, a main objective of ET-PP is to establish the governance of the ET project as a legal entity and to facilitate the formation of a strong Project Directorate structure, leading to a solid technical design and cost estimates (for the infrastructure, detectors and computing), and a timely site selection, presumably resulting into a geographic and financial enlargement of the ET consortium. Figure 3 presents, in the framework of the Project Directorate, details on the positions ET-PP will promote. As anticipated, emphasis will be put in the definition of a strong Project Office and Engineering Department. They will principally be staffed by personnel hired by the participants, as in-kind contributions and/or from support requested in this application. A total of **1.7M€** from ET-PP are allocated to this purpose, in order to facilitate the hiring of up to seven highly qualified young engineers with the required competences. This includes the following positions:

- *Technical Coordinator:* with the primary mission of technical management that focuses on the definition, the configuration, the schedule, the budget, the safety, the logistics, the installation, and the interferences on the worksites.
- *Systems Engineer:* that focuses on how to design, integrate, interface and manage a complex system like Einstein Telescope over its life cycles and will take a leading role in a methodical, multidisciplinary approach for the design, the interfaces, the constraints, the costing, the realization, the technical management, the commissioning, the operation, and final dismantling of the facility.
- *Parameters, Layout and Risk Manager:* in charge who interfaces with the ET collaboration to collect, process and store the parameters and the requirements to elaborate the layout and the configuration which will be translated into the baseline design of the interferometer. She/he manages change requests, handles non-conformities and is in charge of risk management.
- *Software Engineer:* with quality control competences and experience of a project management environment who will participate to the selection and the procurement, and will take the lead in the installation, the configuration and the commissioning of the project management software suite which will be used for configuration management, project breakdown structures, work break down structures, risk matrices, document workflows, planning, earned value management, etc.
- *Civil Engineer:* expertise internal to the ET project that, in collaboration with national institutes and the ET collaboration, translates user requirements into specifications and interfaces with the companies which will carry out the civil engineering works. She/he will be in charge of the reception of the civil engineering works also resolving non conformities.
- *Integration and Technical Infrastructures Engineer:* with expertise in technical infrastructure systems (ventilation, cooling, electricity distribution, logistics, handling and transport) who will focus on the integration of the technical infrastructures, the detectors and the detector subsystems in the civil engineering works. He/she will interface with the civil engineer to propagate the requirements and the constraints.
- *Vacuum Engineer:* expertise internal to the ET project that, in collaboration with national institutes, CERN and the ET collaboration, translates user requirements into specifications and interfaces with the companies which will be contracted to manufacture, install, commission, and eventually operate and maintain the vacuum systems.

The engineers will be strategically placed in those host centers such that they are surrounded by experienced staff engineers providing the required supervision. ET-PP will help to address important sustainability and environmental aspects affecting the ET design by hiring an expert of those matters and/or contracting expert consulting services, for which **0.3M€** are allocated. In addition, ET-PP will be instrumental in resolving financial and legal aspects, in establishing the relation with industry, and in validating the cost and the socio-economic impact of the new infrastructure. For this purpose, ET-PP will support the creation of the Financial Manager and Industrial Liaison positions with a total of about **0.4M€,** and will allocate **0.35M€** for the preparation of legal documents and professional consulting expenses.

For the success of the ET project, a close cooperation of the Project Office under the leadership of the Project Directorate with the ET Collaboration is necessary. This is particularly relevant for the ET vacuum system, which constitutes a significant fraction of the total cost of the RI and will be directly managed by the Project Office. The cost of the vacuum system would be about 500 M€ if the same technology as for Virgo were to be used. Therefore, robust development is required to find the best compromise between cost and performance; for that purpose, material selection, manufacturing techniques and pumping technologies will be investigated in close collaboration with the European industry and the collaborating institutes. Given the importance of the ET vacuum system and the cost, its design will be outsourced to professionals from the CERN vacuum department providing the corresponding TDR. The anticipated CERN service costs (about 1M€ in three years) will be covered by own funds from the participants.

The design of a valid and scalable computing and data access model for ET, due by the end of the ET-PP period, is put in the hands of experts on distributed computing from different European centers and experts on high-performance computing from supercomputing centers within PRACE, with experience on data management and CPU/GPU-intensive computation tasks for GW physics. They play a central role in the current GW experiments and have long experience on WLCG computing for the LHC at CERN. Despite the fact ET counts with a strong community related to computing aspects, it is somehow dispersed in many projects. ET-PP will play an important role in focusing existing efforts and reaching the objectives by promoting the creation of a fully committed computing engineer position acting as coordinator. For this purpose, a total amount of **0.25M€** is allocated.

As pointed out, ET-PP includes a WP devoted to increasing the social awareness of the project and returning the society investment in the form of education and training programs. A strong community of experts on outreach and communication is already in place in the framework of the LIGO/Virgo experiments and ET will profit from it. Nethertheless, the production of high-quality contents for media communication, including the maintenance of a website requires professional support. For this purpose ET-PP plans to devote **0.16M€** to these activities.

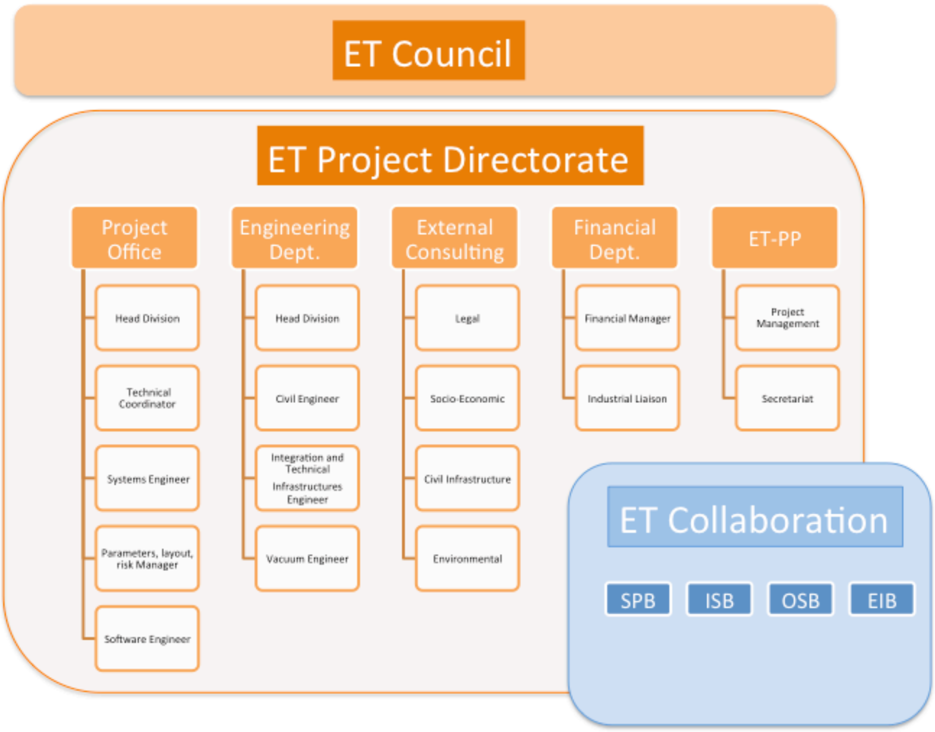

Figure 2. Positions promoted by the ET-PP actions directly related to the Project Directorate. The activities directly related to the ET Collaboration in ET-PP are funnelled via WP6.

Finally, proper management of the ET-PP project, to maintain strong links and a fluid transfer of information across WPs over the duration of the project, and to prepare reports to the EC and the corresponding financial audits, requires a reinforced E-PP administration and secretariat at the coordinating institution. For this purpose, a total of **0.29M€** is allocated.

2.2 Measures to maximise impact - Dissemination, exploitation and communication

The plan for dissemination, exploitation and communication activities in ET-PP includes different aspects.

A proper communication and dissemination of information across WPs and with representatives from the different funding agencies is mandatory for the success of the ET-PP project. As already mentioned, a clear and well-defined structure of WPs has been established, where the intimate relation with the existing ET internal organization has been preserved, while bringing new key players with the necessary skills. During the execution of ET-PP, regular meetings will be organized by each of the WPs co-coordinators, complemented by monthly WP-coordinators meetings chaired by the ET-PP coordinator.

Similarly, a close and continuous interaction with the recently formalized ET proto-Council of Ministerial Representatives is anticipated for all the aspects related to governance, financial architecture, legal framework and site selection. Following high standards in other large research infrastructures, governing boards meetings will be formalized and a solid system of documentation and reporting will be established to guarantee a transparent access to all the relevant information by all the interested parties. ET-PP will result in the preparation of legal form and governance model documents based on consensus requirements, the financial items of a signature-ready contract to commonly fund and build ET, and a business plan will be set up for the operation phase.

The geographical enlargement of the ET consortium will be a priority in ET-PP for which the ET Project Directorate will proactively maintain conversations with new European countries expressing interest in joining ET. As pointed out, ET is framed within IGWN in order to define a worldwide common roadmap for 3G experiments. During ET-PP the international coordination with the USA, Asia and Oceania will be reinforced via bilateral and multilateral dedicated workshops.

One of the ET-PP missions is the delivery of updated TDRs for the infrastructure and the experiment. This requires a significant R&D effort in aspects related to mirrors, coating, quantum and cryogenic technologies, vibration isolation, vacuum technology, environmental monitoring and control, and civil infrastructure technologies. Detailed studies that will result in a number of scientific and technical publications and in some cases they might translate into patents.

A major milestone of ET-PP is the selection of the ET location by 2024/2025. This will be the result of a complex process, involving several factors, that should be carefully and adiabatically driven during ET-PP and that requires transparency and an exquisite communication among parties. In addition to promoting a fluid and transparent communication with funding agencies, measures will be put in place to pave the path towards a site selection process that preserves the political convergence, including comprehensive internal and external reviews, the organization of town meetings, workshops at different stages of the selection process, as well as topical workshops for different technical inputs relevant for the decision, where the harmonization and proper scrutiny of the information provided by the sites will be guaranteed. As a result, a number of technical documents will be delivered including all the information relevant from each site like, for example, legal procedures, permitting and land acquisitions i.e. the steps to be taken prior to starting excavations; updated socio-economic impact studies; reports on accessibility, quality of life etc; a complete quantification of all the aspects impacting the Einstein Telescope performance for each site; 3D geology, hydrology, etc. model with detailed localisation of the Einstein Telescope infrastructure; and a robust and complete cost and schedule estimates of the excavations.

As pointed out, an early involvement of industry is fundamental. In order to attract the interest of industry, the existing liaisons with the industrial capabilities in each of the countries will be fully exploited and industrial sessions will be organized. A clear and consistent view of the project finances and costs, and a fair share policy in the industrial returns in each country contributing to the construction and operation costs of ET, will be needed to raise the necessary construction funds and to maintain a strong commitment of the different funding agencies over time. A functional Financial Board during ET-PP providing information to the participants of the ET consortium in a comprehensive, transparent and consistent manner will be instrumental to achieve those goals. This includes a report on industry engagement plan execution, a model for pursuing in ET a balanced industrial return, and a report on TT and Intellectual property management in ET.

An intense campaign of outreach and communication in social media, of utmost importance to create the necessary atmosphere for raising the interest of the society on the project and its recognition at local, national and international levels, will be performed. As pointed out, the ET community counts with an experienced network of outreach officials in the different countries. ET-PP will facilitate that the activities are carried out in a centralized and coordinated manner. Actions will include the design, development and maintenance of a dedicated ET Consortium website and social media platforms, and the commissioning and production of high-quality outreach materials. Such materials will be used on the ET Consortium website and social media, in professional outreach and political engagement, at science centres, science festivals and exhibitions and within formal education and citizen science programmes. The goal of these materials will be to create an established, professional brand for the Einstein Telescope, emphasising its game-changing scientific potential for astronomy, cosmology and fundamental physics. Materials will span all aspects of ET Consortium instrument and observational science and technology, including multi-messenger and multi-band gravitational-wave astronomy synergies, and all materials will be translated into the languages of all ET Consortium partner institutions. In addition to the science and technology content, materials will also showcase ET as a conduit for STEM careers - emphasising the importance of diversity and promoting under-represented groups - and as a driver for industrial innovation. Moreover, the materials will emphasise the pan-European nature of the ET Consortium as an international community of scientists, engineers and other professionals and a unifying project that strengthens pathways for cultural exchange amongst EU countries and their people.

Finally, ET-PP will develop a strategy for delivering a comprehensive, sustainable mentorship and training programme for early-career researchers (ECRs) across the ET Consortium. The structure of the programme will combine delivery of formal workshops and training sessions with establishing an annual ECR "excellence awards" scheme and an informal mentoring and support network that pairs ECRs with established ET Consortium researchers. The main goal of the programme will be to establish a pipeline for identifying and supporting the development of future ET Consortium leaders (on the mid-2030s timescale of Einstein Telescope operations) from amongst the current ECR cohort.

2.3 Summary

KEY ELEMENT OF THE IMPACT SECTION

SPECIFIC NEEDS	D & E & C MEASURES	EXPECTED RESULTS
What are the specific needs that triggered this project? 1. The enlargement of the ET consortium, and the definition of the legal framework, governance schemes, and financial regulations under which ET will be constructed and operated. 2. The revisited technical design and costing of the ET observatory. 3. The timely selection of the site where ET will be deployed, detailing and cost-estimation of the required site infrastructure, and its socio-economic and environmental impacts. 4. To determine the schemes for technology transfer, procurement and industry involvement in the technical design and construction of ET. 5. The required linking with relevant science communities regarding the detailed definition of the science program, and to determine the user services and the computing and data access model.	What dissemination, exploitation and communication measures will you apply to the results? *Dissemination.* 1. Scientific and Technical publications on the ET science case, the infrastructure and the experiment. 2. Documents internal to ET Council describing the governance and financial model. 3. Legal documents establishing ET as legal entity. 4. Documents internal to ET Council describing the site selection process. 5. Scientific Workshops and Meetings with Industrial partners *Exploitation.* 1. Patenting R&D results. 2. Transfer of Technology to Industry for ET construction. *Communication.* 1. Outreach and news on social media to explain the ET project. 2. Presentations at science centres, science festivals and exhibitions of ET science targeted to the general public.	What do you expect to generate by the end of the project? 1. ET established as a legal entity. 2. Complete financial plan and financial scenario analysis. 3. Complete characterization of sites including socio-economic impact and environmental studies, and a robust and complete cost and schedule estimates of the excavations. 4. Site selection 5. Operational Project Office and Engineering Department. 6. Updated Technical Design Reports for the infrastructure and the experiment. 7. Data Management Plan and data access policy. 8. Reports on industry engagement plan execution and on Technology Transfer and Intellectual property management in ET. 9. A model for pursuing in ET a balanced industrial return. 10. Definition of the computing and data model of ET. 11. A sustainable mentorship and training programme for early career researchers. 12. An increased social awareness of the ET project.

TARGET GROUPS	OUTCOMES	IMPACTS
Who will use or further up-take the results of the project? Who will benefit from the results of the project? 1. The funding agencies supporting ET who are receiving the necessary documentation. 2. The ET Collaboration as a whole, becoming a legal entity with a functional governing model and a well-structured project office and engineering department in place. 3. The scientific community interested in the ET mission, including GW observatories and other experiments planning to exploit a multi-messenger approach using ET data. 4. The industry in the participating countries engaged in the R&D and the construction of ET. 5. The general public targeted with dedicated outreach and educational activities related to GW physics and the understanding of the cosmos.	*What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?* 1. Increasing interest and recognition in society on the ET project. 2. The enlargement of the ET Consortium with the required funding for ET construction and operations. 3. A timely selection process preserving the political convergence, followed by the start of the construction phase.	*What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?* 1. The start of a new era in the exploration of the universe using gravitational waves. 2. Significant industrial and technological returns to society during R&D and construction phase. 3. The participation of ET on global sustainable goals becoming an interdisciplinary and technological hub open to a variety of collaborations with geoscientists, electromagnetic and data science expert and contributing to the studies on natural hazards and climate changes.

3. Quality and efficiency of the implementation

3.1 Work plan and resources

Figures 4 and 5 present Gantt diagrams with the project planning details, including milestones. As discussed in Section 3.2, the ET consortium, strategically complemented with this ET-PP action, has the necessary resources and the competences to carry out the objectives in due time.

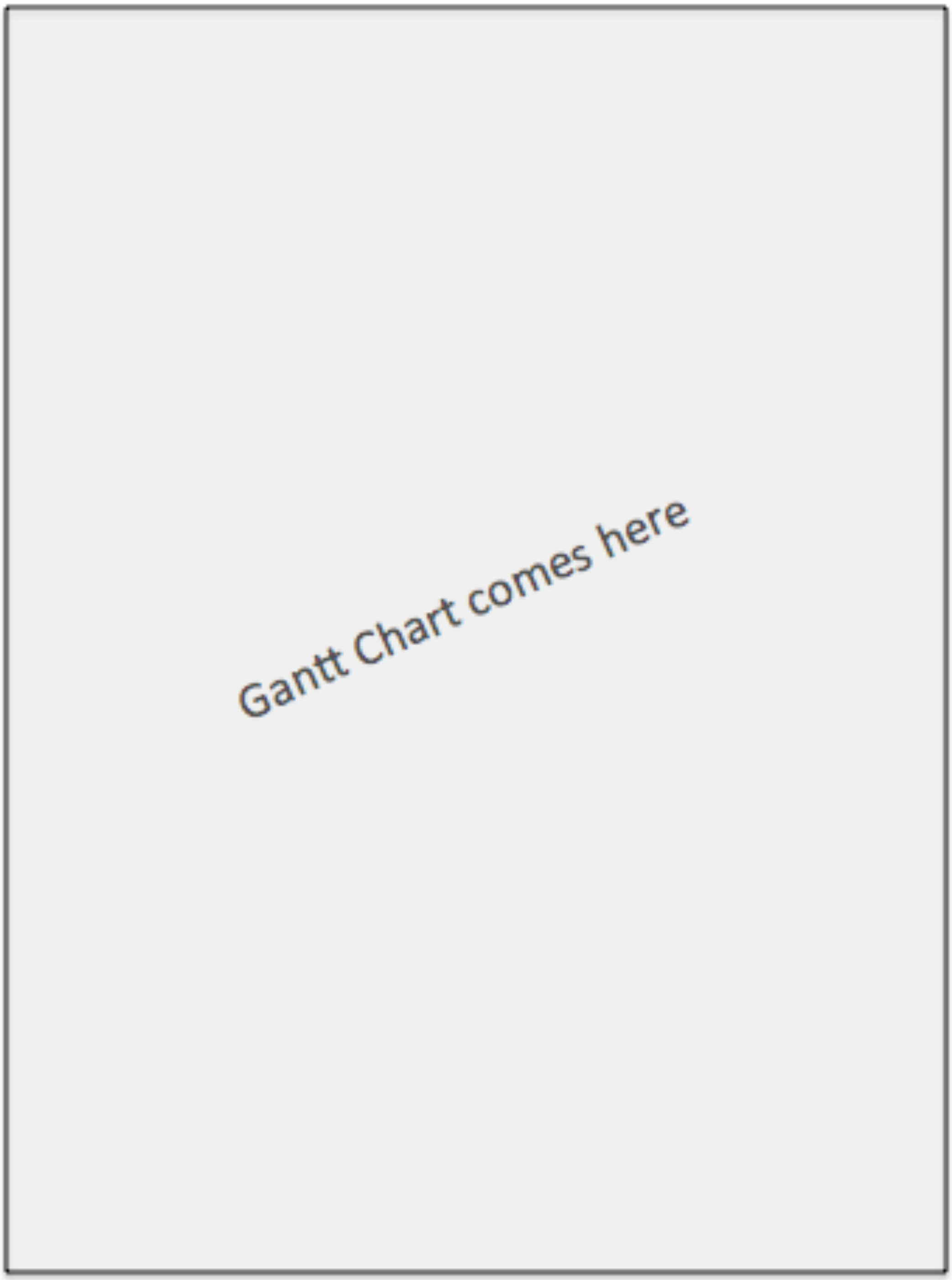

Figure 4: Gantt chart

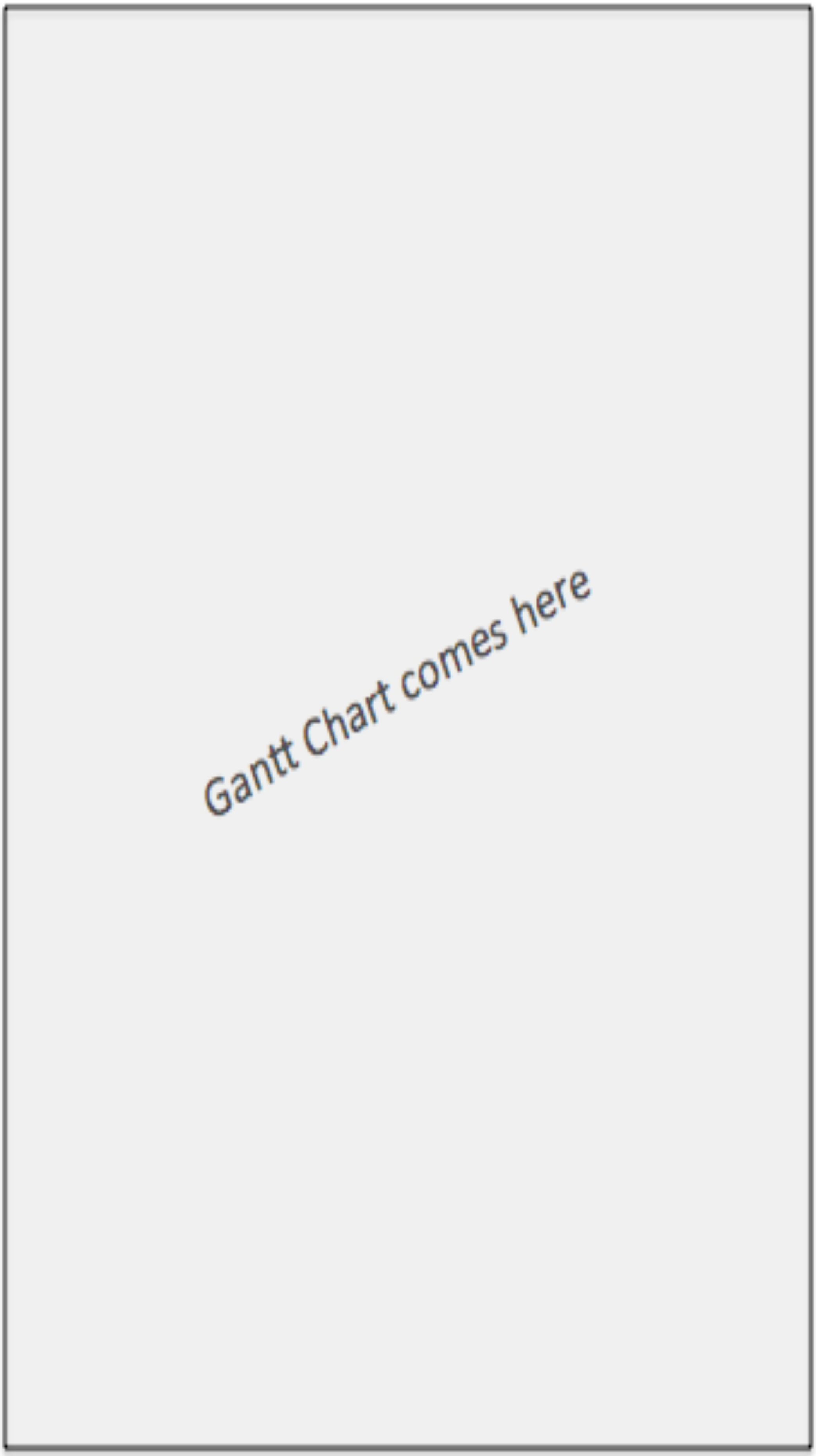

Figure 5: Gantt chart

3.2 Capacity of participants and consortium as a whole

The ET-PP proposal is supported by the full ET Scientific Collaboration, which is directly represented in the WP structure of the project. Here, The pan-european interest in ET is represented by 13 main participants from 12 countries, including major funding agencies and worldwide recognized leading research institutions in the field of GWs in Europe. The list of partners includes:

The Centre National de la Recherche Scientifique (National Centre for Scientific Research): a government-funded research organization, under the administrative authority of France's Ministry of Research. CNRS's annual budget represents a quarter of French public spending on civilian research. As the largest fundamental research organization in Europe, CNRS carries out research in all fields of knowledge, through its seven Institutes and three national Institutes. Among them, **IN2P3** (Institut National de Physique Nucléaire et de Physique des Particules) coordinates French research and development activities in the fields of nuclear, particle and astroparticle physics on behalf of the CNRS and universities. IN2P3 is responsible for running several major national facilities including particle accelerators and also supports international research facilities (e.g., CERN, EGO, EGI). In the domain of gravitational wave detection, the EGO consortium managed by CNRS, INFN, and Nikhef who recently joined, has been constructing and operating since 2000 the Virgo interferometer located in Italy. The core of the French teams involved in this EU proposal corresponds to the scientists who contributed to the construction of Virgo, AdVirgo, AdVirgo+, to the first gravitational waves detections and to the genesis of the Einstein Telescope project. Two essential IN2P3 structures essential for this program are: LMA in Lyon as a unique technological French platform dedicated to provide large and very low loss mirrors for frontier optical experiments, and CC-IN2P3 which provides resources and services to experiments supported by IN2P3. A copy of all Virgo data is stored at CCIN2P3. CNRS participates in the AHEAD2020 research infrastructure integration activity aiming to develop multi-messenger astronomy scenarios with gravitational waves, neutrinos and high energy gamma ray detection. CNRS is also coordinating the ESCAPE H2020-INFRAEOSC project which aims to address the Open Science challenges shared by ESFRI facilities as well as other pan-European research infrastructures in astronomy and high energy physics. The laboratories participating in this European project are: APC – IN2P3 : AstroParticule et Cosmologie, Paris; ARTEMIS : Astrophysique Relativiste, Théories, Expériences, Métrologie, Instrumentation, Signaux, Nice; CC-IN2P3 : Centre de Calcul de l'IN2P3, Lyon; IJCLab – IN2P3 : Laboratoire Irène Joliot-Curie, Orsay; IPHC – IN2P3 : Institut Pluridisciplinaire Hubert Curien, Strasbourg; IP2I – IN2P3 : Institut de Physique des 2 Infinis de Lyon; LAPP – IN2P3 : Laboratoire d'Annecy de Physique des Particules; LKB : Laboratoire Kastler Brossel, Paris; and LPCC – IN2P3 : Laboratoire de Physique Corpusculaire de Caen.

Deutsches Elektronen-Synchrotron (DESY) is a world known large national research centre performing physics and astrophysics related research at two locations, Hamburg and Zeuthen near Berlin, and belongs to the Helmholtz Association of German research centres. DESY has a long tradition in planning, constructing and running large scale research infrastructure with expertise in many technological fields required to build ET. In astrophysics DESY is following a multi-messenger approach including gravitational waves physics.

The Institut de Física d'Altes Energies (IFAE) in Barcelona conducts research, both theoretical and experimental, on the frontier of fundamental physics: high-energy physics (ATLAS, T2K/HyperK), astrophysics (MAGIC, CTA), cosmology (DES, DESI, PAU, LSST), and GWs (Virgo, ET) and also in various areas of applied physics, such as medical imaging and quantum computing. IFAE contributes to the hardware upgrades of Virgo and participates actively in ET and the ET-pathfinder developments. In 2003, IFAE and CIEMAT founded the Port dInformació Científica (PIC) in Barcelona, one of 13 LHC Tier-1 data centers in the world. PIC contributes significantly to LIGO/Virgo distributed computing efforts. In this proposal IFAE represents the Spanish ET consortium including also contributions from the Barcelona Supercomputing Center (BSC), specialised in high performance computing (HPC) with Marenostrum, one of the most powerful supercomputers in Europe, where ET became an strategic line, and CDTI, the Spanish public business entity under the Ministry of Science and Innovation and the ILO for the most relevant research infrastructures in the ESFRI domain of Physical Sciences and Engineering in which Spain is involved (CERN, ESO, ESRF, ESS, European XFEL, F4E, ILL and SKA). Other Spanish Institutions involved in GW physics with LIGO/Virgo, signatories of the ET MoU, and contributing to ET-PP phase via contributions made in the framework of the ET working groups include: the Institute of Cosmos Sciences of the University of Barcelona (ICCUB), the Universitat de les Illes Balears (UIB), and the Universitat de València (UV).

INFN - Istituto Nazionale di Fisica Nucleare. The Italian support to the ET project is realised through a multiple-action scheme. The Italian Ministry for the University and the Research (MUR) supports directly the Sardinian candidature to host the ET observatory since 2018 with a special grant of 17M€, provided to INFN in three annual tranches. This support is addressed both to the candidature of the site and to the development of new technology. The site candidature is also supported by the regional government of Sardinia through a grant of 3.5M€. Furthermore a special support of about 4M€ for the development of the cryogenic technologies for ET has been provided by MUR to the "La Sapienza" University in Rome, allowing the realisation of the Amaldi research centre. Finally, four competitive grants have been attributed to ET related projects by the MUR within the PRIN programme (Progetti di Rilevanza Nazionale) in the last three years for a total of more than 2.5M€. These projects are addressed to the site characterisation, to the development of technologies for ET and to the improvement of the science case of ET with special focus on the multi-messenger astronomy.

Nikhef – National Institute for Subatomic Physics. Within The Netherlands, gravitational-waves research and in particular the Einstein Telescope (ET) project is strongly supported. The Dutch Royal Academy lists ET as one of its 13 'must have' facilities; the National Science Agenda includes ET as a 'game changer'; and ET is part of both the 2016 and 2021 editions of the National Roadmap for Large-Scale Research Facilities. Recently, the Dutch Ministry of Education, Culture and Science submitted an application to secure the anticipated Dutch contributions towards the realization of ET in the Euregio Meuse-Rhin (EMR). Together with Italy, The Netherlands are the coordinators (Nikhef and INFN) of the ET-ESFRI project. More concretely, often in collaboration with Belgian and German partners, various subsidies have been granted in the past years. For example, a 14,5 M€ capital investment subsidy to realize the ETpathfinder laser interferometer R&D laboratory in Maastricht focused on key ET technology innovations such as the use of cryogenically cooled silicon mirrors. Furthermore a 15 M€ subsidy (E-TEST) for instrumentation development and geological characterizations of the EMR site. And a number of national and regional subsidies (ET2SME, ETT-OpZuid, etc.) totaling more than 5 M€ to stimulate industrial collaboration on ET-related technologies. These subsidies typically are supported by national ministries, provinces and Interreg. Within The Netherlands, gravitational-waves research receives substantial funding from the Dutch Research Council and Nikhef. As a result the group has tripled in size over the past five years and includes – besides gravitational-wave scientists– experts in for example cryogenics, computing, controls, geology and seismology.

The Polish Virgo Consortium and the Polish ET Consortium. The principal members of these groups are University of Warsaw (UW), Nicolaus Copernicus Astronomical Center Polish Academy of Science (NCAC), Institute of Mathematics Polish Academy of Science (IMPAN) as well as National Center for Nuclear Research (NCBJ), University of Bialystok, and Cyfronet. The hardware development included parts of vacuum systems for Virgo, electronics for Virgo, and development of and installation of the seismic Newtonian noise system, and infra-sound monitoring of the site. Additionally the group has been active in long term seismic characterizations of several ET candidate sites for the last 8 years.

The University of Geneva, through the departments of Astronomy (represented here by Profs. Fragkos and Meynet) and Particle Physics (represented here by Profs. Schramm and Sanchez Nieto), has strong competencies in the development of computing, data processing & analysis, and data archiving & public access infrastructures, through the involvement in multiple space- and ground- based observatories, and large particle-physics experiments, such as the INTEGRAL, GAIA, CHEOPS, EUCLID, and ATHENA astronomical satellites, the ATLAS experiment, and the CTA observatory. Notable are also the activities of the Department of Theoretical Physics (represented here by Profs. Maggiore and Riotto) in the Einstein Telescope collaboration, with leadership roles in the steering committee and the Observing Science Board. Furthermore, relevant competencies exist at the University of Zurich (represented here by Prof. Jetzer) and the Federal Institute for Technology in Zurich (represented here by Prof. Adrian Biland), both of which play an important role in the LISA mission. Finally, the University of Geneva maintains close ties with the Swiss National Supercomputing Center (CSCS) and the Swiss Data Science Center (SDSC), which possess valuable expertise related to this project. People mentioned by name here, commit to playing an advisory role in the tasks performed by the team of the University of Geneva.

The University of Louvain (UCLouvain) UCLouvain physics research is carried out at the Research Institute in Mathematics and Physics and more particularly at the Cosmology, Particle Physics and Phenomenology (CP3) center. Presently the CP3 center counts 10 academic staff members, 7 permanent research scientists and about 50 postdoctoral researchers and PhD students. Physicists at the CP3 center are active in a number of international experimental Collaborations, and in particular in the gravitational wave physics experiment VIRGO at the European Gravitational Observatory EGO. The UCLouvain gravitational wave group is involved in two EU FEDER INTERREG projects, "Einstein Telescope EMR Site & Technology (ETEST)" and "ETPathfinder", assigned to a consortium of German, Dutch and Belgian universities for the development of technologies for the Einstein Telescope.

UKRI- The UK has a long history of pioneering the technology and data analysis techniques essential for gravitational wave astrophysics and on the overall understanding of planning and operation of large-scale international infrastructures. This includes: the design, development and implementation of sophisticated ultra-low noise suspensions and interferometric techniques in the UK-German GEO600 GW interferometer; financial and intellectual partnership in the 'Advanced LIGO' observatories located in the US; working in close collaboration with colleagues in the Virgo collaboration; leading work packages of the initial design studies for the Einstein Telescope and holding significant positions on the executive committee, oversight committee, and working groups of the LIGO Scientific collaboration.

ANTWERPEN, U. LEOBEN, WIGNER, EGO (descriptions to be added when available)

Tables for section 3.1

Table 3.1a: List of work packages

Work package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
1	Management & Coordination	**1**	**IFAE**	**64,8**	**1**	**48**
2	Organization, Governance and Legal Aspects				**1**	**48**
3	Financial Architecture				**1**	**48**
4	Site Selection Preparation				**1**	**36**
5	Project Office & Engineering Dpt.				**1**	**48**
6	Technical Design				**1**	**48**
7	Innovation and Industrial Engagement				**1**	**48**
8	Computing and Data Access				**1**	**48**
9	Sustainable Development Strategy				**1**	**48**
10	Education, Outreach and Citizen Engagement				**1**	**48**
				Total person-months		

Table 3.1b: Work package description

Work package number	**1**	**Lead beneficiary**			**IFAE**		
Work package title	Management & Coordination						
Participant number	1						
Short name of participant	**IFAE**						
Person months per participant:	**64,8**						
Start month	**1**		**End month**	**48**			

Objectives

Global coordination of the ET-PP activities across the different WPs. Reports to EC.

Description of work
Management and Coordination - will be responsible for the global management and coordination of the WP activities. WP1 will be responsible for the ET-PP administrative activities including regular reports to EC and financial audits, and will contribute globally to increase the social awareness of the project.

Deliverables
D1.1 First Report to EC (M18); D1.2 Second Report to EC (M36); D1.3 Final Report to EC (M48)

Work package number	**2**	**Lead beneficiary**					
Work package title	Organization, Governance and Legal Aspects						
Participant number	3	6	14				
Short name of participant	**INFN**	**Nikhef**	**UKRI**				
Person months per participant:	**10**	**10**	**10**				
Start month	**1**			**End month**	**48**		

Objectives
This work package focuses on issues related to organization, governance and legal aspects. The activity tries to reconcile international, national and regional political and financial priorities.

Description of work
The main goal of this work package is to provide all necessary input for the political processes related to site selection, legal entity and governance. The main deliverables include the preparation of the required legal forms and these include the governance model documents. Here the main principle will be that structure follows function and this requires close cooperation between scientific, technical, legal and financial experts in order to allow a stable and fruitful long term operation of the facility. The activity includes the development of options on scientific and user related legal form requirements, development of options on scientific and user related governance model requirements. The preparation of legal form and governance model documents based on consensus requirements. Moreover the activity will align as temporal funding profiles in Europe and perform financial engineering for the construction phase. Finally a business plan will be set up for the operation phase.

Deliverables
D2.1 Kick-off meeting WP2 (M1); D2.2 Report providing options for legal entity (M12); D2.3 Minutes of meetings with EC and involved ministries (M12); D2.4 Legal documents and statutes (M24) ; D2.5 Legal entity statutes (M36); D2.6 Legal entity established (M48)

Work package number	**3**	**Lead beneficiary**					
Work package title	Financial Architecture						
Participant number	**10**	**3**	**7**				
Short name of participant	**DESY**	**INFN**	**UCL**				
Person months per participant:	**72**	**10**	**10**				

Start month	**1**	**End month**	**48**

Objectives

To prepare the financial items of a signature-ready contract to commonly fund and build ET.

Description of work

Investigate all aspects of the funding architecture required to ensure the construction, operation, and eventual decommissioning of the ET even with different alternatives in construction and legal settings; to identify risks (price, time, technological, legal, etc.); to define guidelines with a fair sharing of costs and scientific, industrial and socio-economic returns among all participating parties in the ET collaboration; and to set a strong financial model and a common tool for all financial data.

Deliverables

D3.1 Handbook for design and construction phase (M36); D3.2 Handbook for design and construction phase (M42); D3.3 Financial plan and Scenario analysis (M48)

Work package number	**4**	**Lead beneficiary**					
Work package title	Site Selection Preparation						
Participant number	**3**	**6**	**4**				
Short name of participant	**INFN**	**Nikhef**	**UW**				
Person months per participant:	**10**	**10**	**10**				
Start month	**1**			**End month**	**48**		

Objectives

Facilitate the site selection process by collecting –and wherever possible quantifying – all relevant site-specific aspects entering the Einstein Telescope Project's site selection process. This will be done for all sites that aspire to submit a bid book to host the Einstein Telescope infrastructure.

Description of work

Collect and treat in a transparent manner the information from the sites and provide comprehensive documentation to facilitate the site selection process. Relevant aspects for site characterization range from issues directly impacting the sensitivity/performance i.e. discovery potential of the Einstein Telescope Project like seismic noise, seismic activity and duty cycle, to aspects that impact the construction/operation costs such as rock stability and sub-surface hydrology to 'softer' aspects such socio-economic impact, accessibility and quality of life. For many of the aspects the actual work will not be done within the WP4 itself, but will be provided by the Einstein Telescope collaboration and/or will be outsourced to a professional organisation.

Deliverables

D4.1 Scan of legal procedures, permitting and land acquisitions i.e. the steps to be taken prior to starting excavations.
D4.2 Updated socio-economic impact studies. Scan of accessibility, quality of life etc.
D4.3 Complete quantification of all the aspects impacting the Einstein Telescope performance for each site.
D4.4 3D geology, hydrology, etc. model with detailed localisation of the Einstein Telescope infrastructure.
D4.5 Robust and complete cost and schedule estimates of the excavations. Including, if necessary: instrumentation for Newtonian Noise cancellation; costs of debris removal; costs of land acquisition, permitting, etc.

Work package number	5	Lead beneficiary				
Work package title	Project Office & Engineering Dept.					
Participant number	5	3	6	1	8		
Short name of participant	CNRS	INFN	Nikhef	IFAE	ANTW		
Person months per participant:	60	160	160	24	10		
Start month	1			End month	48		

Objectives
To set-up a project management environment for the Einstein Telescope construction project.

Description of work
Establish the ET project office and the corresponding engineering department. The role of this WP is to set-up a project management environment for the Einstein Telescope construction project. This environment will be supported by consultative and executive bodies equipped with means to monitor, control, coordinate and report on the technical design, the engineering, the technical specifications, the risks, the budget and the schedule.

Deliverables
D5.1 A document which defines the structure and the mandate of the Project Office. (M25) D5.2 A document describing the functionalities required from the tools in support of the project management activity used across all the project units. (M25) D5.3 A document containing the structure and the mandate of the Engineering Department. (M25) D5.4 The Engineering Department as a functional unit complete with key figures operational, mission statement and budget. (M28) D5.5 The operational Project Office as a functional unit complete with manpower, mission and budget. (M28)

Work package number	6	Lead beneficiary					
Work package title	Technical Design						
Participant number	13	8	3	6	10	5	1
Short name of participant	UniGE	ANTW	INFN	Nikhef	DESY	CNRS	IFAE
Person months per participant:	XX	XX	XX	XX	XX	XX	240
Start month	1			End month	48		

Objectives
Delivering of the technical design both of the research infrastructure and of the hosted detectors of the Einstein Telescope. Delivering the science case in a global context. Delivering, in collaboration with WP2 and WP8, the Data Management Plan and the Data Access Policy for ET.

Description of work
This WP will act as a bridge between ET-PP and the ET collaboration. In fact, the ET collaboration is already well organised in specific boards targeting the objectives of this WP6. The activities indicated in this work package are carried out by a larger community (currently more than 400 scientists) that is only rudimentarily represented by the person-months indicated in the WP6 table. There are many more institutions and universities (more than 80 in

December 2021) involved in this activity than indicated in the current WP6 table; as it is impossible to list them all, we provide a link to a public list here: https://apps.et-gw.eu/tds/ql/?c=16183 . The overall structure of the ET collaboration producing the deliverables is presented in Figure 2. Finally, as indicated by the deliverables, WP6 will provide the Technical Design Report both for the research infrastructure and for the detectors, as developed by the collaboration. Furthermore, the Data Management Plan and the Data Access policy will be defined together with WP2 and WP8.

Deliverables

D6.1 Refined Science Case. Describe the science targets of ET in the updated global scenario (M18); D6.2 Vacuum pipe Design. Vacuum pipe is one of the most expensive components of the ET facility and it needs a specific design process (M24); D6.3 Preliminary RI TDR. The ET civil infrastructures will be realised in an iterative process and a preliminary design is expected in M24; D6.4 Preliminary DET TDR. In parallel to the civil infrastructure design, the hosted detectors need to be designed in an iterative process (M24); D6.5 RI TDR. Final TDR of the civil infrastructures (M40); D6.6 DMP and Data Access Policy. The policy for accessing data in ET will be defined in synergy with WP2 and WP8 (M48).

Work package number	**7**	**Lead beneficiary**				
Work package title	**Industry contact and transfer of technology**					
Participant number	**6**	**3**	**1**			
Short name of participant	**Nikhef**	**INFN**	**IFAE**			
Person months per participant:	**14**	**24**	**12 + 16 (CDTI)**			
Start month	**1**		**End month**	**46**		

Objectives

The objective of this WP is to address all connections between ET and industry. These are: Contact with industry to do R&D for innovation (new technologies and products) and place orders. This is divided into making sure we know the appropriate companies, that they can produce what we need, that they are interested in our innovation and possible spin-off and that they will generate financial return to the participating countries. In-kind contributions of 8 person-months from the Spanish CDTI third party, relevant for task 2, are listed under IFAE.

Description of work

Task 1. Promotion of innovative technologies
SWOT Analysis of promotion strategies on experiences and best practices in similar Big Science projects. [MS in M8]
Define appropriate objectives that ET could establish to support and enhance the development of innovative technologies and incorporation of new ventures in the implementation of the ET project. Develop plan of action to be executed in C&O phase of ET. [D in M12]
Task 2. Liaison with industry
Risk analysis on maturity of technologies and industry capabilities needed in the C&O phase.
Mapping of engagement initiatives already in place in partner countries, both for ET and other RIs. Address gaps from Risk analysis and extend activities into an Engagement plan for national and international activities. [MS in M10].
Execute this plan and report on activities at the end of the project [D in M42].
Study the options for a balanced industrial return in tendering procedures from other RI [MS in M15].
Create a model and strategy for pursuing in ET a balanced industrial return [D in M33].
Task 3. Technology transfer (Intellectual property)
Define the principles that have to shape the ET approach to the management of the Technology Transfer processes and, specifically, the management of the Intellectual property [D in M44].

Deliverables

D7.1 Innovation Plan (M12); D7.2 Report on industry engagement plan execution (M42); D7.3 Model for pursuing in ET a balanced industrial return (M33); D7.4 Report on TT and Intellectual property management in ET (M44)

Work package number	8	Lead beneficiary:			
Work package title	Computing and Data Access				
Participant number	2	10	5	13	3	1
Short name of participant	BSC	DESY	CNRS	UNIGE	INFN	IFAE
Person months per participant:	57,6	6 (RWTH)	5	18	3	10
Start month	1		End month		48	

Objectives

Definition of the computing and data model of the Einstein Telescope, including the definition of the workflow, estimate of the resources. Data Access – technical guidelines and principles for implementing the data access policies defined in WP6 and WP2.

Description of work

Task 8.1: “T0 data center” / coordinator Inst. A: Conceptual design of the center in close collaboration with the instrument science board. Definition of the services provided by the center, delimitation against services realized with distributed computing.

Task 8.2: “Computing and Data Model” / coordinator Inst. B: Development of the computing and data model in close cooperation with the instrument science board and observational science board of ET. Definition of the workflow from the instrument to the publication.

Task 8.3: “Resources” / coordinator Inst. C: Estimate of the computing resources (computing power and data storage), the personnel, and the operational cost required for all aspects of ET computing. The potential for mitigation must be addressed.

Task 8.4: “Data Access Implementation” / coordinator Inst. C: guidelines for the data policy compliance, relevant to the data storage, access, process and distribution, on all relevant time scales, respecting the EU policies on open data.

The coordinators of the WP and the tasks will be assisted by a computing engineer financed through the EU budget. The ET collaboration will support the work with the expertise of a number of specialists from INFN (including CNAF), CNRS (including CCIN2P3), IFAE (including PIC) and others adding up to approx. 5 FTE (not included in table 3.1b). Of special importance is the contribution of the group from the University of Geneva coordinating task 8.2 and supporting it with their own personnel and applying for a Swiss funded position.

Deliverables

D8.1 Computing and Data Requirements (M18): Documentation of the inputs on the computing and data requirements received during the process; D8.2: Computing and Data Model (M42): Final version of 8.1; D8.3: Data Access Implementation Guidelines (M48): A document describing how to implement the policy for the storage and the access to the ET data, according to the data model.

Work package number	9	Lead beneficiary				
Work package title	Sustainable Development Strategy					
Participant number	9	3	5	12			
Short name of participant	EGO	INFN	CNRS	MUL			
Person months per participant:	48	39,2	12	10			
Start month	1			End month	48		

Objectives

1. Study and minimize the carbon footprint of Einstein Telescope, including computing and travel.

2. Evaluate and minimize the landscape and environmental impact. 3. Evaluate the contributions of the infrastructure to the UN sustainable goals.

Description of work
Task 9.1 ET Carbon footprint assessment and mitigation (CNRS, EGO, INFN) 9.1.1 ET carbon budget. 9.1.2 ET Energy consumption optimization. Task 9.2 Landscape, environmental and societal impact (INFN, EGO, CNRS, Austria) 9.2.1: Assessing and minimizing the ET impact on its environment. 9.2.2 Environmental management approach. 9.2.3 Analyse and define an overall strategy for the reclamation, reuse and recycling of the excavated materials.

Deliverables
D9.1 ET Sustainable Development Implementation Strategy (M12); D9.2 ET Environmental impact assessment and mitigation strategy (M24); D9.3 ET CO2 footprint ET assessment and mitigation strategy (M36).

Work package number	10	**Lead beneficiary**				
Work package title						
Participant number	**4**	**14**	**9**	**12**	**1**	**3**
Short name of participant	**UW**	**UKRI**	**EGO**	**WIGNER**	**IFAE**	**INFN**
Person months per participant:	**37**	**20**	**15**	**15**	**10**	**5**
Start month	**1**			**End month**	**48**	

Objectives
1. Establish procedures for coordination of outreach/communications across national networks and WPs. 2. Create, disseminate and curate high-quality promotional materials on ET science and technology. 3. Design educational resources on ET science and technology, aligned with national STEM curricula. 4. Develop a sustainable mentorship and training programme for early career researchers. ET collaboration will support the work with existing efforts from institutions involved in similar LIGO/Virgo activities and not listed here for a total of about 1 FTE.

Description of work

Deliverables

Table 3.1c: List of Deliverables

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (in months)

D1.1	Report to EC	WP1	IFAE	R	PU	M18
D1.2	Report to EC	WP1	IFAE	R	PU	M36
D1.3	Report to EC	WP1	IFAE	R	PU	M48
D2.1	Kick-off meeting	WP2		R	PU	M1
D2.2	Report providing options for legal entity	WP2		R	PU	M12
D2.3	Minutes of meetings with EC and involved ministries	WP2		R	PU	M12
D2.4	Legal documents and statutes	WP2		R	PU	M24
D2.5	Legal entity statutes	WP2		R	PU	M36
D2.6	Legal entity established	WP2		R	PU	M48
D3.1	Handbook for design and construction phase	WP3		R	PU	M36
D3.2	Handbook for operating phase	WP3		R	PU	M42
D3.3	Financial plan and Scenario analysis	WP3		R, O	PU	M48
D4.1	Document detailing the site-specific characteristics that impact Einstein Telescope sensitivity and its duty cycle.	WP4		R	PU	M3
D4.2	Common methodology to estimate impact of site characteristics on ET sensitivity and operation and, if required, a scheme to compensate it.	WP4		R	PU	M10
D4.3	Scan of legal procedures, permitting and land acquisitions i.e. the steps to be taken prior to starting excavations.	WP4		R	PU	M10
D4.4	Updated socio-economic impact studies	WP4		R	PU	M15
D4.5	Complete quantification of all the aspects impacting the Einstein Telescope performance.	WP4		R	PU	M22
D4.6	3D geology, hydrology, etc. model with detailed localisation of the Einstein Telescope infrastructure.	WP4		R	PU	M27
D4.7	Robust and complete cost and schedule estimates of the excavations. Including, if necessary: instrumentation for Newtonian Noise cancellation; costs of debris removal; costs of land acquisition, permitting, etc.	WP4		R	PU	M36
D5.1	Structure and mandate of the Project Office	WP5		R	PU	
D5.2	Functionalities required from the tools in support of the project management	WP5		R	PU	
D5.3	Structure and mandate of the Engineering Department	WP5		R	PU	
D5.4	Funcional Engineering Department	WP5		R	PU	
D5.5	Funcional Project Office	WP5		R	PU	

D6.1	Refined Science Case	WP6	UNIGE	R	PU	M18
D6.2	Vacuum pipe Design	WP6	UANTWERPEN	R	PU	M24
D6.3	Preliminary RI TDR	WP6	INFN	R	PU	M24
D6.4	Preliminary DET TDR	WP6	NIKHEF	R	PU	M24
D6.5	RI TDR	WP6	INFN	R	PU	M40
D6.6	DMP and Data Access Policy	WP6	DESY	R	PU	M48
D7.1	Innovation plan	WP7	IFAE	R	PU	M12
D7.2	Report on industry engagement plan execution	WP7	Nikhef	R	PU	M42
D7.3	Model for pursuing in ET a balanced industrial return	WP7	INFN	R	PU	M33
D7.4	Report on TT and Intellectual property management in ET	WP7	INFN	R	PU	M44
D8.1	Computing and Data Requirements	WP8	BSC	R	PU	M18
D8.2	Computing and Data Model	WP8	BSC	R	PU	M42
D8.3	Data Access Implementation Guidelines	WP8	BSC	R	PU	M48
D9.1	ET Sustainable Development Implementation Strategy	WP9	CNRS	R	PU	12
D9.2	ET Environmental impact assessment and mitigation strategy	WP9	INFN	R	PU	24
D9.3	ET CO2 footprint ET assessment and mitigation strategy	WP9	EGO	R	PU	36
D10.1						
D10.2						
D10.3						
D10.4						

Table 3.1d: List of milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
M1.1	Kick-off of ET-PP coordination	WP1	M1	Workshop
M1.2	ET-PP first year internal review		M12	Workshop
M1.4	ET-PP middle term internal review		M24	Workshop
M1.4	ET-PP final internal review		M42	Workshop
M3.1	Constitution / first meeting of the resource board	WP3	M33	Workshop
M4.1				
M4.2				
M5.1	The recruitment of the Project Office team is completed.	WP5	M15	Report
M5.2	All three documents (WP5-D1, D2 and D3) are published.	WP5	M25	Report
M5.3	The Engineering Department as a functional unit complete	WP5	M27	Report
M5.4	The Project Office as a functional unit complete	WP5	M27	Report
M6.1	ET Collaboration in place	WP6	M12	ET Symposium
M7.1	Analysis of promotion strategies	WP7	M8	Report

	accomplished			
M7.2	Engagement plan produced	WP7	M10	Report
M7.3	Analysis of balanced industrial return strategies accomplished		M15	Report
M8.1	Workflows Requirements collection and constraints: computing and data	WP8	M12	Workshop (+D8.1)
M8.2	Computing Infrastructures availability for ET workflows, characteristics	WP8, WP9	M24	Workshop (+ D8.1)
M8.3	On site infrastructure, computing and data model	WP8, WP6	M36	Workshop (+D8.2)
M8.4	Low latency and offline workflows and computing model	WP8, WP6	M40	Workshop (+D8.2)
M8.5	Data management, access, policy and implementation	WP8, WP6, WP2	M46	Workshop (+D8.3)
M9.1	Preliminary sustainability plan	WP9	M12	Report
M9.2	Final sustainability plan	WP9	M48	Report
M10.1				
M10.2				

Table 3.1e: Critical risks for implementation

Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)	Work package(s) involved	Proposed risk-mitigation measures
R5.1 Delay in completing hiring process for new full-time engineering positions (low, medium)	WP5	Assign existing part-time personal from partner institutes to assist in the start-up phase.
R5.2 Difficulties to find personnel in the participant institutions for the leadership and the collaborator positions required for the Project Office and the Engineering Department (low, medium)	WP5	Provide temporary support from the collaboration and invite experts from external institutes.
R6.1 Delays in producing the RI TDR (i) Medium (ii) High	WP6,WP5	Involve external engineering companies in order to speed-up the process
R6.2 Delays in producing the Detector TDR (i) Medium (ii) Medium	WP6,WP5	Define a staged installation strategy and prioritise design of first stage
R7.1 Limited interest on the part of industry in the preparatory phase of the ET (likelihood medium, severity medium)	WP7	Monitor industry implication and enforce industry engagement plan if needed.
R7.2 Low level of industrial capabilities identified in certain areas of the project (likelihood medium, severity medium)	WP7	Implement measures in industry engagement plan to involve industry in R&D projects with key institutes
R8.1 Difficulties to find full time personnel adequately in time, with the skills needed for the project (i) Medium (ii) Medium	WP8	Dedicate part of the time of more than one person of the Collaboration to cover the needs, and complement with personnel in-kind contribution.
R8.2 Scientists are not able to provide sufficiently detailed information to elaborate the computing and	WP8	The computing and data model will be generic and realistic to satisfy the given requirements.

data model (i) Low (ii) (Medium-Low)		
R8.3 The pandemic delays the organization and limit the participation to workshops planned to receive input and feedback from the stakeholders (i) Low (ii) Medium	WP8	Online planned workshops and webinars, adjust timing, offline surveys...
R9.1 Delays in technical designs (i) Medium (ii) Medium	WP9	Adoption of a reference scenario
R9.2 Evolution of the national energy policies (i) Low (ii) Low	WP9	Consultation with national institution

Table 3.1f: Summary of staff effort

	WP1	WP2	WP3	WP4	WP5	Total Person-Months per Participant
1 IFAE, 2 BSC	64,8	0	0	0	24	**88,8**
3 INFN	0	10	10	10	160	**190**
4 UW	0	0	0	10	0	**10**
5 CNRS	0	0	0	0	60	**60**
6 NIKHEF	0	10	0	10	160	**180**
7 UL	0	0	10	0	0	**10**
8 ANTWERPEN	0	0	0	0	10	**10**
9 EGO	0	0	0	0	0	**0**
10 DESY	0	0	72	0	0	**72**
11 WIGNER	0	0	0	0	0	**0**
12 UM	0	0	0	0	0	**0**
13 UniGEN	0	0	0	0	0	**0**
14 UKRI	0	10	0	0	0	**10**
Total Person Months	**64,8**	**30**	**92**	**30**	**414**	

	WP6*	WP7	WP8	WP9	WP10	Total Person-Months per Participant
1 IFAE, 2 BSC	240	28	10 + 57,6	0	10	**288 +57,6**
3 INFN	?	24	3	39,2	5	
4 UW	?	0	0	0	37	
5 CNRS	?	0	5	12	0	
6 NIKHEF	?	14	0	0	0	
7 UL	?	0	0	0	0	
8 ANTWERPEN	?	0	0	0	0	
9 EGO	?	0	0	48	15	
10 DESY	?	0	6	0	0	
11 WIGNER	?	0	0	?	15	
12 UM	0	0	0	10	0	**10**
13 UniGEN	?	0	18	0	0	
14 UKRI	0	0	0	0	20	**20**
Total Person Months		**66**	**99,6**	**109,2 ?**	**102**	

*** The person-months numbers are only indicative since WP6 involves the whole ET collaboration.**

Table 3.1g: 'Subcontracting costs' items

Participant Number/Short Name		
	Cost (€)	**Description of tasks and justification**
Subcontracting		

Table 3.1h: 'Purchase costs' items (travel and subsistence, equipment and other goods, works and services)

Participant Number/Short Name		
	Cost (€)	**Justification**
Travel and subsistence		

Equipment		
Other goods, works and services		
Remaining purchase costs (<15% of pers. Costs)		
Total		

Table 3.1i: ‘Other costs categories’ items (e.g. internally invoiced goods and services)

Participant Number/Short Name		
	Cost (€)	**Justification**
Internally invoiced goods and services		
…		

Table 3.1j: ‘In-kind contributions’ provided by third parties

Participant Number/Short Name			
Third party name	**Category**	**Cost (€)**	**Justification**
RWTH	Seconded personnel	6 months	Achim Stahl, co-coordination of WP8
UNIGE	Seconded personnel	6 months	Anastasios Fragkos, coordination of task 8.2
UNIGE	Seconded personnel	48 months	N.N., computing engineer for task 8.2. Contribution requested from SNSC.
CDTI	Seconded personnel	8 months	J. Echavarri, contributing to WP7 task 2.