SEVENTH FRAMEWORK PROGRAMME
RESEARCH INFRASTRUCTURES
Construction of new infrastructures – preparatory phase

Combination of Collaborative Project and
Coordination and Support Action

ILC-HiGrade

International Linear Collider and
High Gradient Superconducting RF-Cavities

www.ilc-higrade.eu

Grant agreement number 206711

Annex I – "Description of Work"

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PART A

A1 Budget breakdown and project summary

A 1.1 Project summary

There is worldwide consensus that the e^+e^- International Linear Collider (ILC) is the next major project in High Energy Physics following the imminent commissioning of the LHC; it is a high priority in the European Strategy for Particle Physics agreed by CERN Council. The ILC will constitute the precision tool for the Terascale, the scale of electroweak symmetry breaking. The ILC complements the potential of the LHC, which will initially chart this unknown territory.

The ILC-HiGrade project brings together the key players in Europe to engage towards the realisation of the ILC. They constitute a large fraction of the European element of the Global Design Effort (GDE) that has recently led to the publication of the Reference Design Report (RDR). The report forms the basis for the Engineering Design Phase of the ILC, which the GDE will complete by mid-2010 when the proposal for the ILC will be presented to the global stakeholders, i.e. governments and funding agencies to seek approval. The technically driven schedule envisages construction beginning in 2012. Project approval and start of construction is thus a two-stage process.

Starting in 2008, the ILC-HiGrade Consortium will address important elements in this 2-stage process with siting of the facility as one major ingredient. Currently there are site proposals in Japan, US and in Europe. Their benefits will be evaluated and the international framework in which the project will be realised will be developed. ILC-HiGrade encompasses the European side in this global endeavour. The participating laboratories and universities contribute their long-standing experience in conceiving large-scale experiments and the organisation of large collaborations to a process that establishes the global framework for an organisation that will support start of construction matching the technical timelines.

The linacs of the ILC constitute a major cost-driver. Their design and their cost depend on the achievable accelerating gradient for the ILC. The global gradient development programme will establish a realistic operational gradient for the ILC by employing proven preparation techniques, with European laboratories leading the effort. In the course of ILC-HiGrade, the partners will prepare at least 24 fully dressed cavities, which will initially serve as a technical reference for the decision on the choice of gradient and eventually as the industrialisation of the high-gradient process.

The timelines of this 4-year project are well aligned with those of the Global Design Effort, aimed at establishing the technical basis for proposing the ILC by mid-2010. There is a world-wide consensus that at this time the design and physics capabilities of the ILC will be evaluated in the environment following the first physics and operational results from LHC in order to chart the path towards approval of the ILC in 2010 and construction beginning at the earliest by 2012.

From a European perspective, all crucial elements necessary to produce this outcome, both technical and political are reinforced and explicitly supported in the ILC-HiGrade project.

A 1.2 List of beneficiaries

Table 1 – List of beneficiaries

Beneficiary number	Beneficiary name	Beneficiary short name	Country
1 (Coordinator)	Stiftung Deutsches Elektronen-Synchrotron	DESY	Germany
2	Commissariat à l'Energie Atomique	CEA	France
3	European Organization for Nuclear Research	CERN	Switzerland
4	Centre National de la Recherche Scientifique	CNRS	France
5	Istituto Nazionale di Fisica Nucleare	INFN	Italy
6	The Chancellor, Masters and Scholars of the University of Oxford	UOXF.DL	UK

The list of beneficiaries in Table 1 encompasses those institutes that have a long standing engagement in the developments of the e^+e^-–linear collider through their participation in the TESLA project or assume a special role in representing and forging European consensus for the projects of particle physics. CERN as the European laboratory for particle physics and the University of Oxford as the coordinating centre for the European Global Design Effort are represented.

A 1.3 Overall budget breakdown

Table 2 Breakdown of the budget for each beneficiary and activity

Partici-pant number in this project	Participant short name	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EC contri-bution
		RTD (A)	Coordi-nation (B)	Support (C)	Manage-ment (D)	Other (E)	TOTAL A+B+C+D+E		
1	DESY	3424000.00	448000.00	448000.00	450000.00	0.00	4770000.00	0.00	2484424.00
2	CEA	501598.00	0.00	0.00	2000.00	0.00	503598.00	0.00	294199.00
3	CERN	0.00	240000.00	360000.00	2000.00	0.00	602000.00	0.00	349750.00
4	CNRS	1399987.20	224000.00	112000.00	2000.00	0.00	1737987.20	0.00	811306.00
5	INFN	1048000.00	112000.00	112000.00	2000.00	0.00	1274000.00	0.00	652900.00
6	UOXF.DL	0.00	658524.80	244536.00	2000.00	0.00	905060.80	0.00	407358.00
Total		6373585.20	1682524.80	1276536.00	460000.00	0.00	9792646.00	0.00	4999937.00

PART B

B1 Concept and objectives, progress beyond state of the art, S/T methodology and work plan

We are about to enter a new era of discovery in particle physics. The Large Hadron Collider (LHC) at CERN will start physics operation in 2008 and is expected to make major discoveries that will have a profound impact on our understanding of the universe in which we live. Specifically, the Standard Model of particle physics has major omissions, such as the lack of a quantum theory of gravity, inconsistencies and missing elements, which the LHC is expected to explore. However, the history of particle physics shows that the major discoveries that have shaped our understanding of the physics of the basic constituents of the universe have been shared between hadron machines, similar to LHC, and electron-positron annihilation machines; specifically, the precision studies that have had such a profound effect in shaping and testing our current theories have been predominantly carried out at electron-positron annihilation machines such as the proposed International Linear Collider (ILC). The importance of such a machine was recognised in the European Strategy for Particle Physics promulgated last year by the CERN Council, in which it was characterised as “fundamental to complement the results of the LHC” and “a unique scientific opportunity”. The decision of ESFRI to incorporate the CERN Council Strategy into its Road Map thus underlines the importance of the ILC in the future landscape of European research infrastructures.

The ILC is a 500 GeV centre-of-mass-energy linear electron-positron collider, so constructed to avoid the very large energy losses caused by synchrotron radiation in circular colliders of this energy. Although a linear collider is essential to reach this collision energy, it has drawbacks. In particular, the beams can only interact once and are then dumped, in contrast to the situation at a circular collider such as LHC, where the beams will interact many millions of times per second over periods of hours. This means that in order to achieve the required luminosity, a measure of the probability that electrons and positrons will annihilate, to deliver the physics goals of the ILC, the size and divergence of the beams must be reduced to an unprecedented level, orders of magnitude smaller than achieved in linear colliders to date. The ILC is based on superconducting radio-frequency accelerating structures, as pioneered by the TESLA Technology Collaboration predominantly based in Europe. This technology has been very successfully developed over the past few years within Europe, substantially through both the European XFEL proposal and the European Framework VI programmes CARE and EUROTeV. If the ILC is to be affordable, it is essential to maximise the accelerating gradient in the cavities, since it is directly proportional to the length of the collider required to achieve a specified energy. This improvement in gradient constitutes the main difference with respect to the cavities of the XFEL. Although many cavities with the appropriate gradient have now been produced in laboratories worldwide, the spread in the maximum gradient is still much too wide; and the cavities must be produced in industrial conditions. The achievement of this industrial reproducibility is the major technical goal of this project and is central to the production of the final engineering design of the ILC.

The ILC will probe the innermost structure of matter with unprecedented precision and will offer European scientists unique facilities to pursue their science. Only one linear collider of this energy range will be constructed in the world. Each of the main regions in particle physics has aspirations to play host to the machine. The organisation to allow site development and selection must be specified in the next few years; government involvement in the governance of the project will grow in the period leading up to the time of project submission, currently planned for 2010. The main purpose of this document is to describe the technical and organisational work necessary before submission for approval.

B 1.1 Concept and project objective(s)

There are two main objectives of the preparatory phase: firstly, to ensure that the crucial R&D has been carried out to allow the project to be constructed within the internationally agreed cost envelope; secondly, to establish all necessary structures and technical capabilities to ensure that the ILC can be brought to governments for submission for approval in 2010 and that the site choice has been technically prepared.

There is no doubt that the major technical challenge of the ILC in the preparatory phase is to ensure that the superconducting accelerating structures, currently produced in laboratory conditions in excess of the ILC specification, can be industrially produced with the required reproducibility and field gradient. This requires substantial R&D both in laboratories and in an industrial environment and close collaboration between ILC scientists and engineers and industrial companies. In particular, the production of final prototypes of the accelerating modules plays a key role in this and is a major objective of the preparatory phase. The achievement of this will require the provision and construction of new test facilities in Europe beyond those for the XFEL to match those under construction in the US and in Asia. While there are many other technical developments and R&D necessary to ensure that the ILC can be successfully built, the successful establishment of the necessary parameters for the superconducting accelerating structures is a *conditio sine qua non* for the success of the project. This work builds on immense European expertise in this technology, nurtured by support through the CARE and EUROTeV programmes.

The second main goal of the preparatory phase is the development of appropriate organisational infrastructure and governance structures to supervise the preparation of the ILC project for submission to stake-holding governments for approval. The ILC is a global project with a well developed international management structure. The Global Design Effort (GDE) under GDE Director, Barry Barish, supervises the worldwide effort aimed at producing an engineering design. The GDE Executive Committee, chaired by the GDE Director, includes three Regional GDE Directors, one of whom is the Regional GDE Director for Europe. Further information on the GDE and its structures can be found in Section B2. Although the GDE has a sophisticated and functional management, much remains to be done as the project moves into a new phase now that the reference design phase is complete. The structures to develop include the GDE Project Management Team, further work on the development of a European site and a variety of questions on governance, legal issues etc. These goals can be achieved by the engagement of the appropriate individuals to devote substantial fractions of their time to this end. The European Regional GDE Director will direct the overall strategy of the ILC-HiGrade project and interact with the other Regional GDE Directors and the GDE Director in developing the best structures for the project. The European member of the GDE Project Management Team also plays a major role in this, as well as steering the technical development of the work packages. The Representative of the Coordinator of the ILC-HiGrade project (Coordinator) will be fully devoted to this task and will be assisted by accelerator physicists from the two major European centres, DESY and CERN. Civil engineering effort is also required to develop further the European site proposal. Legal advice on the appropriate way in which to frame the structures for the final governance of the ILC will also be very important. A final vital element necessary for the success of the project is to fund attendance at and organisation of the necessary international meetings where the progress of the project can be reviewed and to facilitate outreach to governments and the general public by, amongst other things, the provision of appropriate documentation and descriptive material in major European languages.

Specifically ILC-HiGrade will address the following objectives in its work packages:

- WP1: Management of the Consortium
- WP2: Integration and optimisation of the European contribution within the global GDE organisation as the ILC project moves through the GDE Engineering Design Phase
- WP3: Ensure that the characteristics and importance of the ILC, and its place within the world of science and research, is widely disseminated to the peoples of the European Union, and their governments
- WP4: Investigate features and develop possible schemes of governance for the ILC, exploiting expertise of CERN (LHC) and DESY (HERA) in international projects
- WP5: Prepare and investigate possible European sites for ILC construction
- WP6: Investigate and monitor the production process that yields high-gradient cavities with high yield. Establish the process in industry
- WP7: Optimization of the coupler conditioning at reduced cost
- WP8: Demonstrate suitability of tuner design in tests. Establish a cost-effective tuner production

The overall success of the project will be measured in

- the establishment of governance structures for Europe that are adequate and match the equivalent efforts in other regions;
- the choice of a realistic accelerating gradient with an overall assessment of cost.

B 1.2 Progress beyond the state of the art

The progress beyond the state of the art for cavity production is evidently the establishment of high gradients in the superconducting accelerating structures. Currently the state of the art for SCRF gradients is roughly 25 MV/m for series production, which constitutes the current technological baseline at high yield. Higher gradients have been achieved in several cases for single cavities whilst simultaneously maintaining a high Q-value. The physical limit for the gradient is above 40 MV/m. It is also understood that the recipe for producing high-gradient cavities is well advanced. In fact the purpose of this work is to establish that the current recipe, or a slight variant of the process, guarantees the production of cavities with high gradient with high reproducibility. A statistically significant number of cavities is required for this purpose. – It should be added that even higher gradients are being investigated, particularly in Japan, by varying the shape of the cavities. While that programme is certainly interesting it is not yet sufficiently close to mass production that it can form the basis of the ILC linac at this time.

The plans for advancing the governance structures and the political process for the ILC go well beyond the currently existing international structures. CERN is the European laboratory for particle physics operating under international conditions. The ITER project has developed an international approach for a global science project. To date the Global Design Effort has successfully provided a Reference Design Report for the ILC. The coming years will provide the engineering details to enable a technical decision for the ILC over the time span of this project. The political process to establish the proper governance structures will be directly addressed in the global context and the contribution of ILC-HiGrade will be vital. The exploration of the various sites and the decision process towards selection of a host site is key.

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy and general description

The overall strategy for ILC-HiGrade is well imbedded in the international process for the ILC as pursued by the Global Design Effort. Within this effort, ILC-HiGrade will assume a key role in testing and treating routinely produced cavities to establish that the nominal operating gradient of 31.5 MV/m is realistic. With the longstanding experience from the TESLA Technology Collaboration, Europe is in a key position to actually carry this development forward. There is a technical risk in achieving the goal. Should it happen that the nominal gradient cannot be established it will be very important to understand what the maximum gradient actually will be. A lower gradient will entail a longer linac at somewhat higher cost. A typical assessment for this risk shows that the overall project cost increases by 7% when the average gradient is dropped from the nominal value to 28 MV/m. It is hence evident that the results of this work will have a high impact.

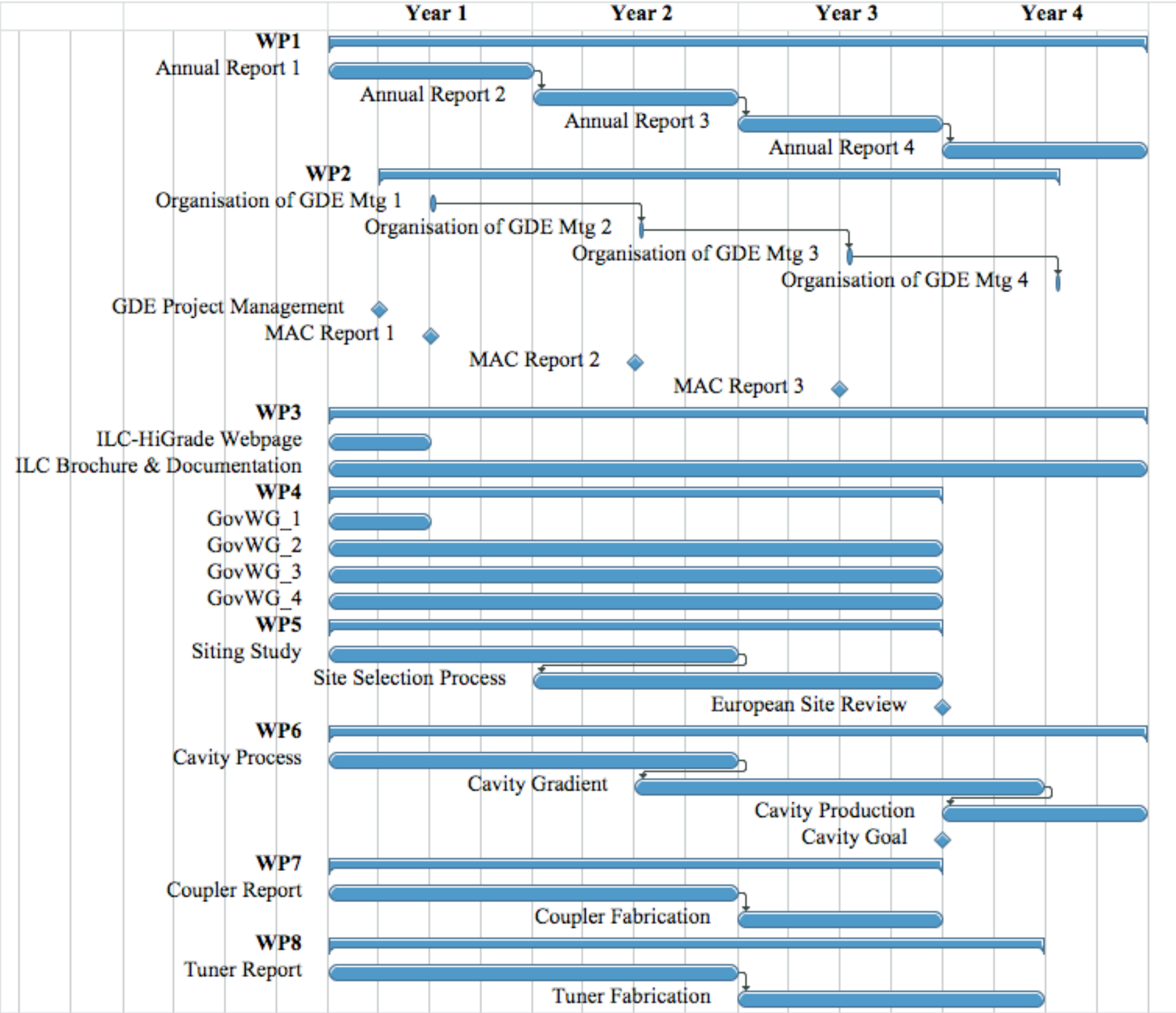
The progress for the approval process of the ILC is harder to predict. For a project of the size of the ILC it is evident that the final decision is a political one. In many aspects the process is comparable to the decision process for ITER. ILC-HiGrade contributes decisively towards enabling a decision for the ILC once the engineering design is complete. It brings the key player in Europe together and ties in the political level.

B 1.3.2 Timing of work packages and their components

An overview of the activities for the individual work packages is shown as a Gantt chart in Figure 1. The deliverables and the milestones are displayed. The various abbreviations for deliverables and milestones are explained in subsequent chapters.

Several goals of this project are targeted towards contributing directly to the GDE Engineering Design Phase. The corresponding E&D report will be issued in the second half of 2010. The European GDE Project Management activities and the establishment of the governance structures are timed accordingly. The technical work packages WP6-WP8 will deliver results for the cavity gradient decision while the programme itself continues into a fourth year. Details are given in chapters B 1.3.5.

Figure 1 The temporal development for the various work packages



B 1.3.3 Work package list / overview

The list of work packages is given in Table 3. ILC-HiGrade will maintain close links with the overall implementation and developments in the other regions. An indication of the activities in Asia and in the Americas is given in section B 1.3.8.

Table 3 – List of Preparatory Phase Work Packages

Work Package No	**Work package title**	**Type of activity**	**Lead beneficiary**	**Person months**	**Start month**	**End month**
WP1	Management	MGT	1	48	1	48
WP2	Coordination of European GDE Activity	COORD	6	74	1	48
WP3	Dissemination and Outreach	COORD	6	88	1	48
WP4	Governance	SUPP	6	87	1	48
WP5	ILC Siting in Europe	SUPP	1	42	1	48
WP6	Cavities	RTD	1	148	1	48
WP7	Couplers	RTD	4	54	1	48
WP8	Tuners	RTD	5	30	1	48
	Total			571		

B 1.3.4 Deliverables list

The list of deliverables is summarised in Table 4. More details concerning the actual method of verification are given in section B 1.3.5 for each work package. All reports are non-confidential and available to the public.

Table 4 – List of Deliverables

Del. no	Deliverable name	WP no.	Lead beneficiary	Estimated indicative person months	Nature[1]	Dissemination level[2]	Delivery date (proj. month)
1.1	Annual Report 1	WP1	1	12	R	PU	12
1.2	Annual Report 2	WP1	1	12	R	PU	24
1.3	Annual Report 3	WP1	1	12	R	PU	36
1.4	Annual Report 4	WP1	1	12	R	PU	48
2.1	Organisation of GDE Mtg 1	WP2	6	20	R	PU	6
2.2	Organisation of GDE Mtg 2	WP2	6	20	R	PU	18
2.3	Organisation of GDE Mtg 3	WP2	6	17	R	PU	30
2.4	Organisation of GDE Mtg 4	WP2	6	17	R	PU	42
3.1	ILC-HiGrade Webpage	WP3	6	7	R	PU	6
3.2	ILC Brochure & Documentation	WP3	6	81	R	PU	48
4.1	GovWG_1	WP4	6	18	R	PU	6
4.2	GovWG_2	WP4	6	51	R	PU	36
4.3	GovWG_3	WP4	6	12	R	PU	36
4.4	GovWG_4	WP4	6	6	R	PU	36
5.1	Siting Study	WP5	3	30	R	PU	24
5.2	Site Selection Process	WP5	3	12	R	PU	24
6.1	Cavity Process	WP6	1	82	R	PU	24
6.2	Cavity Gradient	WP6	1	8	R	PU	42
6.3	Cavity Production	WP6	1	58	R	PU	48
7.1	Coupler Report	WP7	4	48	R	PU	24
7.2	Coupler Fabrication	WP7	4	6	R	PU	36
8.1	Tuner Report	WP8	5	10	R	PU	24
8.2	Tuner Fabrication	WP8	5	20	R	PU	42
			TOTAL	571			

[1] R=Report, P=Prototype, D=Demonstrator, O=Other

[2] PU=Public, PP=Restricted to other programme participants (including Commission Services), RE=Restricted to a group specified by the consortium (including Commission Services), CO=Confidential, only for members of the consortium (including Commission Services)

B 1.3.5 Work package description

This chapter contains a description of the individual work packages that are subject to an European Commission contribution.

B 1.3.5.1 Management of the Consortium

Work package number	WP1	**Start date or starting event:**				1
Work package title	Management					
Activity type	MGT					
Participant id	1					
Person-months per beneficiary	48					

Objectives Management of the Consortium

Description of work

The Coordinator will provide the Annual Reports on the activities of the Consortium and take care of the compilation of the financial statements. The Coordinator will establish the Consortium Agreement between all partners and obtain the signatures of all participants to the Contract at the beginning of the project.

The Coordinator establishes proper communication inside the Consortium. To this end he will use the (internal, access-restricted, if necessary) web-pages of the project. The Coordinator reports to the bodies of the Consortium, in particular to the Governing Board, the representation of the participants.

The Coordinator maintains direct contact with the European Regional GDE Director and consequently the GDE itself to assure compliance of the work performed in the Consortium with the developments for the ILC as a whole.

The Coordinator is responsible for overall outside representation of the project.

Deliverables

1.1	Annual Report 1	12
1.2	Annual Report 2	24
1.3	Annual Report 3	36
1.4	Annual Report 4	48

B 1.3.5.2 Coordination of European Contribution to GDE

Work package number	WP2		**Start date or starting event:**		1	
Work package title	Coordination of European GDE Activity					
Activity type	COORD					
Participant id	1	3	6			
Person-months per beneficiary	24	18	32			

Objectives Integration and optimisation of European contribution within global GDE organisation

Description of work

The role of the European Regional GDE Director consists in steering and representing the European work within the wider ILC effort. He will be assisted by a personal assistant, by two coordinators of outreach (see WP3) and by his two deputies based in the two major European particle physics laboratories. The European Regional GDE Director will arrange meetings of the various bodies of the GDE organisation within Europe; in particular once per year he will arrange a plenary meeting in Europe open to all working on the ILC both in the GDE and in the design of the experiments for the ILC. The European GDE will liaise closely with the Coordinator to ensure coherence between the activities pursued in the Consortium and those pursued outside within the context of the ILC.

Milestones

1	GDE Project Management	Project management for the ILC in place. The structure will reflect how the goals of the GDE Engineering Design Phase can be reached.	3
2	MAC Report 1	Report from Machine Advisory Committee on progress of Engineering Design Report (EDR)	6
4	MAC Report 2	Report from Machine Advisory Committee on progress of EDR	18
6	MAC Report 3	Report from Machine Advisory Committee on completion of EDR	30

Deliverables

2.1	Organisation of GDE Mtg 1	Plenary Meeting of GDE in Europe including report	6
2.2	Organisation of GDE Mtg 2	Plenary Meeting of GDE in Europe including report	18
2.3	Organisation of GDE Mtg 3	Plenary Meeting of GDE in Europe including report	30
2.4	Organisation of GDE Mtg 4	Plenary Meeting of GDE in Europe including report	42

B 1.3.5.3 WP3 – Outreach

Work package number	WP3	**Start date or starting event:**		1		
Work package title	Dissemination and Outreach					
Activity type	COORD					
Participant id	1	4	5	6			
Person-months per beneficiary	24	24	12	28			

Objectives Ensure that the characteristics and importance of the ILC, and its place within the world of science and research, is widely disseminated to the peoples of the European Union, and their governments.

Description of work

The science results from the ILC are likely to change our paradigm of particle physics and therefore our understanding of the evolution of the Universe. While it is relatively straightforward for the general public to understand the information from telescopes, that coming from the ILC will be more difficult to digest. It is essential that there is a broad base of support for the ILC at the level of the general public that will translate into strong support from governments. The GDE has a very active outreach activity but to complement this it is essential that specific materials tailored for and in the main languages of the member states of the EU are produced. There is much work already done in this area, including a weekly web-based ILC newsletter and several brochures and booklets on aspects of the ILC. So far these materials exist in English and partially in Japanese. The current European Outreach Subgroup chaired by the European Regional GDE Director will use and adapt some of this material as well as developing new material and techniques to further a general appreciation of the importance of ILC science.

The material will be issued at regular intervals during the project duration. An overview will be compiled at the end of the Project.

Deliverables

3.1	ILC-HiGrade Webpage	Design and Installation of an ILC-HiGrade web-page for outreach and internal communication	6
3.2	ILC Brochures & Documentation	Report on material issued describing the ILC in several EU languages	48

B 1.3.5.4 Governance

Work package number	WP4	**Start date or starting event:**	1			
Work package title	Governance					
Activity type	SUPP					
Participant id	1	3	4	5	6	
Person-months per beneficiary	24	15	6	12	30	

Objectives Investigate features and develop possible schemes of governance for the ILC, exploiting expertise of CERN (LHC) and DESY (HERA) in international projects

Description of work

The ILC will be a large international organisation, sharing many features of other organisations such as CERN and ITER but having some unique characteristics. Europe has a wealth of experience in these issues that needs to be brought to bear on the problem of ensuring proper supervision and oversight for a project fully international from the outset. The best mechanism by which governments can take over this oversight from the current structures and the optimal timescales for this to happen will be investigated and discussed with governments and funding authorities both via the Funding Agency for Large Colliders (FALC) and when appropriate bilaterally with individual countries. A Working Group on Governance will be set up to pursue these goals, which will need to organise meetings and make a variety of fact-finding visits. This part of the project will benefit from the presence in the collaboration of senior figures in both laboratory management and the European Regional GDE Director. Other senior people with highly applicable experience will be co-opted onto the various organs to be set up in this work package.

Milestones

5	Development of new Governance Structures	Interim progress on new governance structures	18
7	Governance Structures	New governance structures	30

Deliverables

4.1	GovWG_1	Report on full management model and implementation in engineering studies	6
4.2	GovWG_2	Engineering Design report for ILC construction including the information relevant for ILC approval by stake holding governments	36
4.3	GovWG_3	Recommendations for action from Governance Working Group	36
4.4	GovWG_4	Proposal for new oversight and governance structures evolving to full government involvement	48

B 1.3.5.5 Siting Studies in Europe

Work package number	WP5	**Start date or starting event:**		1		
Work package title	ILC Siting in Europe					
Activity type	SUPP					
Participant id	1	3	4			
Person-months per beneficiary	24	12	6			

Objectives Prepare and investigate possible European sites for ILC construction.

Description of work

A site 100-150m underground near CERN has been considered as a possible deep site in Europe. This is the only European site currently discussed in the Reference Design Report of the ILC. The advantage is that the tunnels of the ILC could be placed in rock with little extra reinforcement. The geological advantages of the site are considerable – ground motion is typically 1-2 orders of magnitude smaller than in near-surface areas. A ”quiet” site considerably eases the problem of stabilising the final focus to the level required to bring beams of a few nanometres into collision.

A site near CERN poses other advantages: CERN is the world's leading laboratory for particle physics. International treaties have been established and international collaboration is practiced without undue restrictions. There is no other HEP laboratory that is so well prepared in this context.

In the context of the TESLA project, DESY had developed a proposal for a site of the linear collider near Hamburg. Those plans were based on a site 10-15m below the surface and extending some 35km to the northwest of DESY. Since the presentation of the proposal in 2001, the design for the ILC has considerably advanced, so that in order to adapt those plans for the current ILC design considerable engineering effort is required. The exploration of a near-surface site considerably eases the access for the civil engineering. It also makes it possible to place several of the support installations for power and cooling outside the tunnel. As a consequence the space requirements in the linac tunnels vary considerably and the ILC might have a single tunnel that is not accessible while the machine is running.

The Joint Institute of Nuclear Research (JINR) in Dubna has proposed a site near their institute, south of the Volga river. That proposal comprises a machine close to the surface but constructed using tunnel-boring machines. Sufficient power from the Russian national grid is available. The project will assess the potential of such a site and conclude on the benefits and risks.

An entirely different approach has often been mentioned: a green-field site with few restrictions from buildings will yield cost advantages for construction. Such savings have to be balanced with the additional costs of supporting an entirely new infrastructure at the site. We will explore this possibility, paying particular attention to possible sites in those regions of the EU that qualify for structural development funding.

This work package will be steered by a Working Group that will also investigate the availability of technical facilities and working conditions. The Group will need to involve governments and funding agencies closely with this work. The lessons to be learned from the process of choosing the ITER site will need to be studied, digested and applied to the

ILC situation.

Milestones			
3	European Site Preparation	European site preparation – interim review on special properties and demands for European site	24

Deliverables			
5.1	Siting Study	Intermediate report on the further development of the CERN and DESY sites for the ILC including the Dubna site assessment	24
5.2	Site Selection Process	Report on suggested mechanisms for site evaluation and selection including timescales and milestones. Report will address green-field sites and the possibility of structural funding	36

Figure 2 – Schematic description of the site selection process

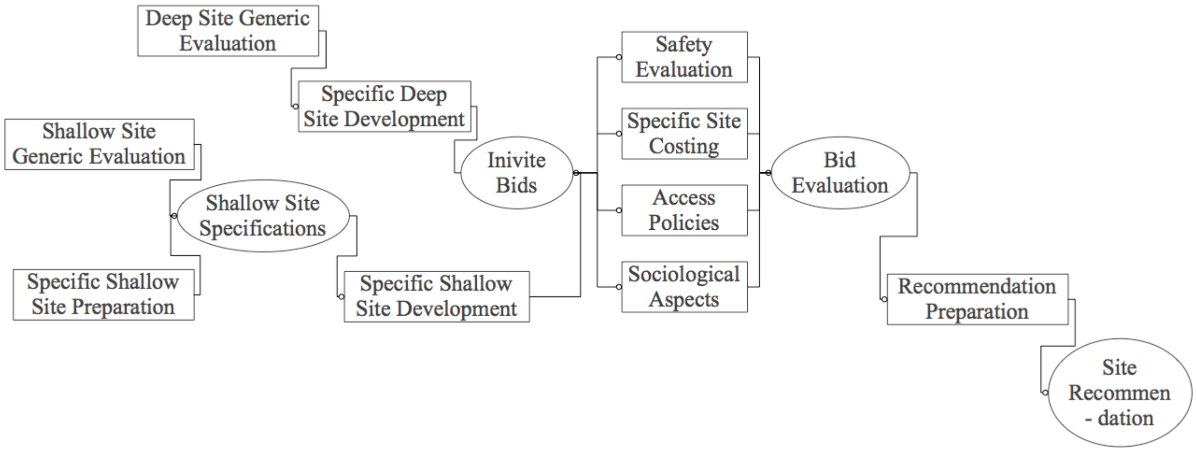


Figure 2 displays a schematic representation of the site selection process.

B 1.3.5.6 High gradient cavities

Work package number	WP6		**Start date or starting event:**		1		
Work package title	Cavities						
Activity type	RTD						
Participant id	1	2					
Person-months per beneficiary	120	28					

Objectives Investigate and monitor the production process that yields high-gradient cavities with high yield. Establish the process in industry

Description of work

Within the context of the X-ray Free Electron Laser (XFEL) at DESY some 800 superconducting cavities will be fabricated in industry while the testing of the cavities will be done in the laboratory. These cavities are required to support an accelerating field of 23.6 MV/m in the accelerator.

The ILC cavities have to support fields of 31.5 MV/m. Such gradients have been demonstrated on a number of individual cavities. However, the process to mass-produce the 16000 cavities for the ILC with high yield is not yet well understood. It would be too expensive and time-consuming to construct a test facility from scratch that would allow such a targeted gradient development programme. This goal will be achieved by using the facilities of the XFEL for testing and advancing the process control for the ILC.

We plan to acquire at least 24 cavities from industry where special attention will be given to the quality control. A well-focused R&D programme on single-cell cavities within the ILC is under way and the optimised procedures are expected to be available by the end of 2008. The material for these cavities will be either the standard (fine-grain) Niobium that is currently used routinely or the so-called large-grain material. Large-grain Niobium has the advantage of a smaller number of grain boundaries, which are potential sources of gradient-limiting field emission. Such material may also yield a cost advantage. Such cavities will be delivered from industry and have typically undergone an electro-polishing step removing a 150 µm layer from the surface.

In the laboratory the cavities will be subject to dedicated investigation using the current state-of-the-art process control. The qualification process will be fully automatic to guarantee comparable standards for all cavities. The cavities themselves will undergo several steps of surface treatment (short electro-polishing, ultra-pure water high-pressure rinse, etc.). The process will be systematically monitored until the high gradient has been both achieved and understood.

The advances in understanding the process will be implemented in the facilities at DESY and be followed by a low-power test for the cavities.

The experience gained will be made available to industry to improve the quality of delivered cavities. At the same time the original cavities will be fed back into the stream of cavities used for the XFEL for long-term operation and in support of their high-gradient programme at a beam energy of 24 GeV. This programme would select a new batch of cavities to confirm and improve on the production process. A considerable number of cavities has to be processed to gain confidence that the process control is sufficiently established to guarantee good yield.

Milestones			
9	Cavity Goal	Cavities have been produced and process under control	36

Deliverables			
6.1	Cavity Process	Report on cavity processing	24
6.2	Cavity Gradient	At least 24 cavities at high gradient	42
6.3	Cavity Production	Report on cavity industrialisation	48

B 1.3.5.7 RF couplers

Work package number	WP7	**Start date or starting event:**		1			
Work package title	Couplers						
Activity type	RTD						
Participant id	4						
Person-months per beneficiary	54						

Objectives Optimization of the coupler conditioning at reduced cost

Description of work

RF couplers are needed to feed the high-power RF into the vacuum chamber of the cavities. CNRS has acquired a vast amount of experience in producing couplers that satisfy the needs of 1.3 GHz cavities. One of the critical steps in the process is the RF-conditioning of the couplers, which requires great care. Only recently, this conditioning time has been reduced by a factor of six over the period initially required.

The couplers will be purchased in industry under tight quality control for the production process. The couplers will be prepared for installation and undergo the required heat treatment and a carefully balanced sequence of RF tests.

Deliverables

7.1	Coupler Report	Report on coupler processing	24
7.2	Coupler Fabrication	Couplers fabricated	36

B 1.3.5.8 Cavity tuners

Work package number	WP8	**Start date or starting event:**				1
Work package title	Tuners					
Activity type	RTD					
Participant id	5					
Person-months per beneficiary	30					

Objectives Demonstrate suitability of tuner design in tests. Establish a cost-effective tuner production of 24 tuners.

Description of work

Long-term frequency drifts of the cavities e.g. due to changes in helium pressure have to be compensated by a slowly operating mechanical system. Such tuners have been developed in Milan. Under RF load cavities undergo mechanical deformation due to the Lorentz force such that the frequency of the cavity is detuned during the RF pulse. Given the high Q-value of superconducting RF cavities, the efficiency of the acceleration is immediately affected. It is hence mandatory to counteract the Lorentz force with a fast piezoelectric tuner. The integration of the fast actuators is being pursued and needs to be validated at the gradient levels of the ILC. One of the biggest challenges is to operate and control the tuner in the vacuum at temperatures of 2°K and to maintain a cost-effective design.

A sufficient number of tuners to support power tests of cavities in a cryostat will be procured.

Deliverables

8.2	Tuner Report	Report on tuner fabrication	24
8.3	Tuner Fabrication	Tuners fabricated	42

B 1.3.6 Efforts for the full duration of the project

The staff effort is detailed in Table 5 for the individual work packages and in Table 6 according to activity. The lead institute in Table 5 is highlighted.

Table 5 Summary of staff effort in person months per work package and beneficiary

Workpackage/ Beneficiary	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total person months
DESY	**48**	24	24	24	**24**	**120**			264
CEA						28			28
CERN		18		15	12				45
CNRS			24	6	6		**54**		90
INFN			12	12				**30**	54
UOXF.DL		**32**	**28**	**30**					90
Total	**48**	**74**	**88**	**87**	**42**	**148**	**54**	**30**	**571**

Table 6 Staff effort in person months split up according to activity type

Activity Type	DESY	CEA	CERN	CNRS	INFN	UOXF.DL	TOTAL ACTIVITIES
RTD							
WP6	120	28					148
WP7				54			54
WP8					30		30
Total 'research'	120	28		54	30		232
Consortium Management activities							
WP1	48						48
Total 'management'	48						48
Coordination activities							
WP2	24		18			32	74
WP3	24			24	12	28	88
Total 'coordination'	48		18	24	12	60	162
Support activities							
WP4	24		15	6	12	30	87
WP5	24		12	6			42
Total 'support'	48		27	12	12	30	129
TOTAL	264	28	45	90	54	90	571

B 1.3.7 List of milestones and planning of reviews

Table 7 – Description of milestones

Milestone no.	Milestone name	Brief description
1	GDE Project Management	GDE Project Management Team in place and operating. The GDE has nominated GDE Project Managers who are in the process of setting up the overall management structures. The structures will be presented in October 2007 and evidence of their operational effect will be given in March 2008.
2	MAC Report 1	ICFA has nominated a Machine Advisory Committee (MAC) for the ILC. They have accompanied the initial RDR phase. A similar external review body is being set up for the GDE Engineering Design Phase. The MAC will assess the progress of the ILC including the political dimension.
3	European Site Preparation	A report will be produced that describes the features of the European sites where a deep and shallow site will be explored. The current version of the ILC Reference Design Report deals exclusively with shallow sites. The original TESLA site at DESY is near surface.
4	MAC Report 2	See above for the role of the MAC
5	Development of new Governance Structures	A development report will be produced that describes the evolving governance structure for the ILC. It will include the description of the interaction between the three regions.
6	MAC Report 3	See above for the role of the MAC
7	Governance Structures	The plan for governance structures should be fully developed and preparations to facilitate the decision process on siting and financing methodology should be made.
8	European Site Review	A report on European candidate sites will be available. This will serve as input for the politicians to decide on the ILC site.
9	Cavity Goal	All cavities will be available and tested for the performance. Their gradient will be measured and summarised in a report. The performance figure will contribute to the decision on the accelerating gradient for the ILC and will hence impact the cost.

Table 8 List of milestones

List and schedule of milestones					
Milestone no.	**Milestone name**	**WPs no's.**	**Lead beneficiary**	**Delivery date from Annex I**	**Comments**
1	GDE Project Management	WP2	6	3	GDE Project Management Team in place and operating
2	MAC Report 1	WP2	6	6	Report in writing
3	European Site Prpearation	WP5	1	12	Report in writing
4	MAC Report 2	WP2	6	18	Report in writing
5	Development of new Governance Structures	WP4	6	18	Report in writing
6	MAC Report 3	WP2	6	30	Report in writing
7	Governance Structures	WP4	6	30	Structures in place
8	European Site Review	WP5	1	36	Report in writing

B 1.3.8 Parallel Activities

The Work packages of ILC-HiGrade have to be seen in the wider context of activities for the ILC both in Europe and in the other regions. Some of the activities are described below to indicate the interrelation of the various projects across global regions.

- *Other European work on superconducting RF*
  European laboratories and universities pioneered the application of high-gradient superconducting cavities to accelerators and still have a lead in this technology. Much activity is continuing in this area which is not directly a part of this project but which is synergetic to it. Some of this work, for example on the development of higher-gradient single cells, is carried out for the ILC alone; other work is carried out with and directly relevant to the XFEL project.

- *Siting studies in the Americas*
  The EPP2010 panel report, chaired by a former President of Princeton University and comprising a blue-ribbon group of US industrialists, scientists and academics concluded that "The capacity of the LHC and the ILC to explore the Terascale directly offers the promise of deep insights into such matters as the Higgs boson, supersymmetry, dark matter candidates and hidden spatial and quantum dimensions"; "An aggressive approach to the realization of the ILC is the central element in a new strategic plan for the US program in particle physics"; "The United States should launch a major program of R&D, design and industrialization and management and financing studies of the ILC accelerators and detectors."; and "Hosting the ILC will inspire students, attract talented scientists from throughout the world, create a suite of high technology jobs and strengthen national leadership in science & technology."
  The US Department of Energy (DoE) and National Science Foundation (NSF) are

currently supporting the aspirations of the US particle physics community to host the ILC with a sustained programme of increased R&D in accelerator physics in general, but specifically in preparing a proposal to host the ILC at the Fermi National Accelerator Laboratory, in Batavia, Illinois, in the suburbs of Chicago. This effort is looking at the geological and environmental impact of the proposal as well as the legal and administrative requirements of a "deep" site passing under a large number of domestic and industrial properties outside the substantial DoE-owned Fermilab site proper. The study is also investigating the implications of establishing a true international laboratory with free and open access to all scientists capable of benefiting from its use. In the current climate of enhanced security and visa regime, this is a non-trivial problem.

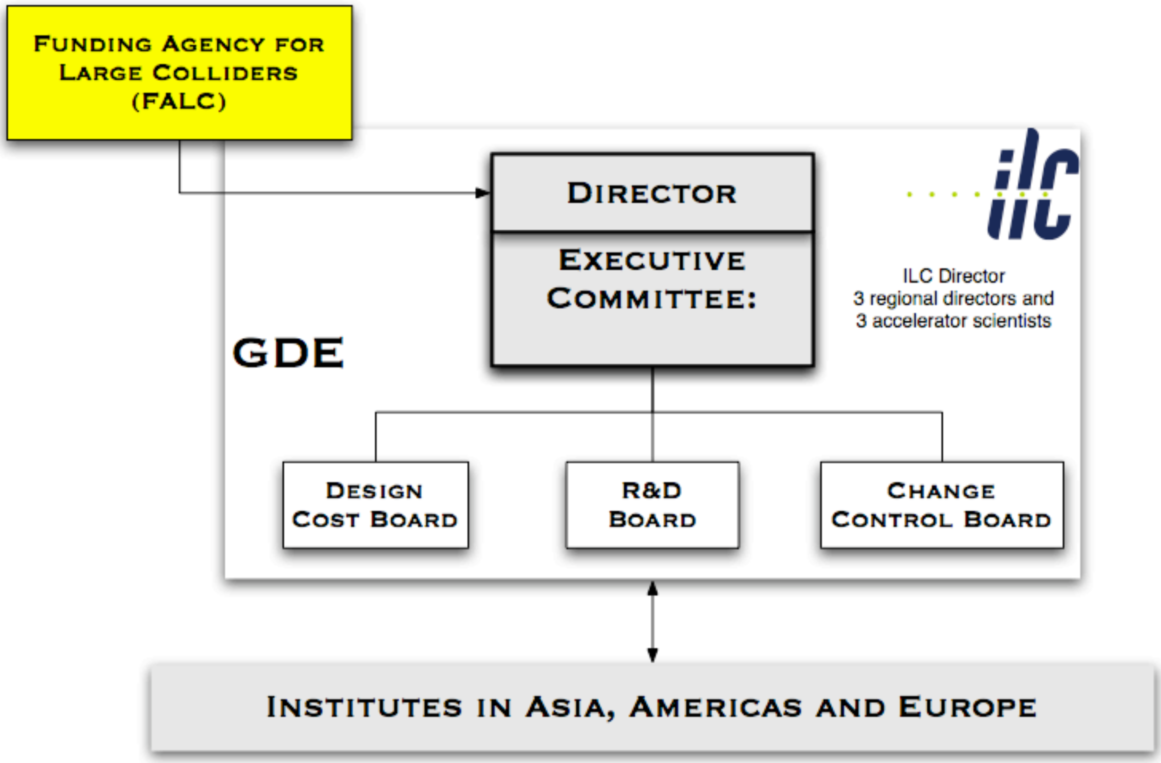
- *Siting studies in Asia*
  The current site proposed by the Asian region is a hybrid, featuring several of the features of likely sites in Japan. These sites are generally in granite geology, promising great stability against seismic events and in general characterized by substantial overburden of rock caused by mountain ranges. As a result, the site is "deep" and characterized by the use of quasi-horizontal access shafts rather than the vertical shafts that access the ILC tunnels in the Americas and European proposed sites.
  The Asian region[3] is characterized by a number of countries rapidly increasing their involvement in experimental high-energy particle physics, such as China, India and Vietnam, as well as countries with a long-established programme and tradition of working at the energy frontier, such as Japan and South Korea. There is thus a great deal of activity in these countries in deciding the level of their involvement and the effort they wish to devote to the ILC, together with an eventual decision as to whether they wish to make a concrete bid to host the machine.
- *Development of industrial capacity in the US capable of producing a substantial fraction of the total required accelerating and related structures for the ILC*
  In contrast to Europe, there is a very small capacity in US industry in the general area of superconducting RF technology. Even in Europe there is insufficient capacity to produce the whole ILC superconducting cavities on the required timescale, but in any case it is essential that the three major regions should all have a major share in the industrial production of these advanced high-tech systems. The intention is to involve suitable US companies in the prototyping of cavities and modules in the context of the development of major test facilities, in particular at the Fermi National Accelerator Laboratory near Chicago. By transfer of technological experience from the research labs to the industrial companies it is intended to develop a pool of vendors that can guarantee competitive tenders for the production of the final modules. The experience from European industry will be essential in this endeavour, although obvious concerns about commercial confidentiality mean that the interaction will occur through the research laboratories and scientists. An organisation for US industrial companies interested in ILC technology and applications has been set up and is growing both in membership and activity,
- *Development of industrial capacity in Asia capable of producing a substantial fraction of the total required accelerating and related structures for the ILC*
  The situation in Asia, specifically in Japan, is somewhere between that of Europe and the Americas. Japanese industry has organised a very strong, active and highly developed association for those interested in ILC technology. There is in addition an influential committee of members of the Japanese Diet interested in the ILC project and its industrial, scientific and educational implications. South Korea has both an active R&D programme in the construction and development of superconducting cavities and substantial industrial

[3] Note that Russia is classified as in the European region in the ILC.

involvement and interest. There is great interest in the industrial imperatives of ILC in both India and China, building initially on the models that allowed these countries to make very important and useful contributions to the construction of the Large Hadron Collider at CERN. Other countries in the Asian region are interested in aspects of ILC industrialisation that we expect to grow and become more concrete as the project progresses.

- *Development of technical systems, instrumentation & diagnostics, software for ILC operation*
  The ILC will be the most complex and advanced accelerator ever built; in order to commission and operate it, a very large number of instruments, techniques and systems need to be developed. These are in addition to the major open technical questions on superconducting acceleration that are considered to be the most crucial ones and that are therefore considered separately in the work packages outlined above. The scope of this work is much too large and complex to be described even briefly in this document. It comprises the use of non-invasive, non-destructive techniques to characterise the beam throughout the accelerator for example “laser-wires”, using back-scattered photons from lasers shining onto the beam, which gain substantial fractions of the beam energy in the process. The physics goals of the ILC require high luminosity, which in turn implies an extraordinary reduction in the size and divergence of both the electron and positron beams. To achieve this in a sophisticated system of damping rings is the subject of substantial research and development. Some of the issues relating to safety, such as the design of beam dumps, are intimately related to the siting of the project and will need to be estimated for each candidate site until a choice of site can be made. There are a variety of other issues that are undergoing R&D in preparation for the submission of the project for approval, currently planned for 2010. This work is going on all around the world and is overseen by the GDE Executive Committee through the GDE Research & Development Board.

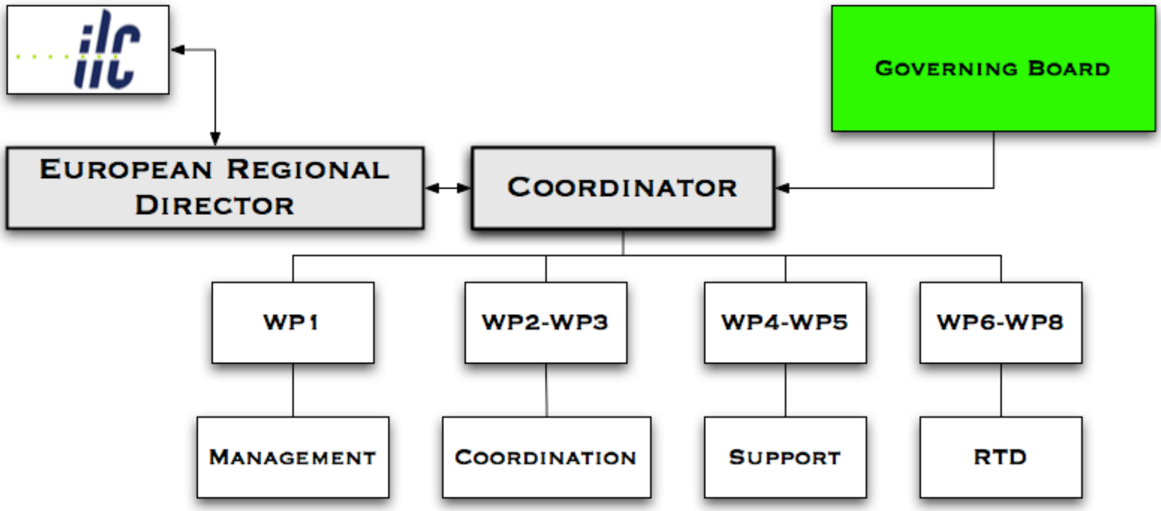
B2 Implementation



The effort to design the International Linear Collider is organized through an international organization known as the Global Design Effort (GDE). This was organized by and reports to the International Committee for Future Accelerators (ICFA), which is the highest-level international supervisory body for particle physics. The International Union of Pure and Applied Physics (IUPAP) founded ICFA and receives its reports. Whereas in the current phase, which is just ending, the members of the GDE are relatively few (~ 40 FTE), it coordinates the effort of a much larger team throughout the world. The project integrates effort from a very large number of laboratories and universities throughout the world to form a coherent project organisation. This is achieved under the supervision of the GDE Executive Committee (GDE-EC). This consists of the GDE Director who has the overall responsibility for the project and who chairs the GDE-EC, and six other members. Three of these are Regional GDE Directors, one for each of the three main regions collaborating in the project, Asia, Americas and Europe; the remaining three are eminent accelerator physicists. The GDE-EC meets weekly by teleconference and monthly face to face and supervises all parts of the project, including various boards that it has setup to supervise particular activities, such as R&D, costing, preparation of the reference design etc. All laboratories, universities and individual engineers and researchers participate in the project through area and technical systems groups whose leaders are appointed by the GDE Director. All resources are provided through laboratories and universities and are supervised and coordinated at a regional level by the Regional GDE Directors. The GDE-EC has recently appointed a GDE Project Management Team and is setting up the structures necessary for the next phase of the ILC-project, covered in this project, the GDE Engineering Design Phase, which is planned to begin in the autumn of this year.

The GDE and its Director report to funding agencies through an organization called Funding Agencies for Large Colliders (FALC), which contains representatives from the funding authorities and governments of the major countries contributing to the project, together with regional organizations, such as CERN, who represent their smaller member countries. This body, and its subsidiary bodies such as the FALC resources group, meets regularly several times a year and receives reports from the GDE Director on progress on the project and requests for the provision of small amounts of central resource. The Chair of FALC is a member of this project and will work on the issues of governance etc. that are central to it.

B 2.1 Management structure and procedures



The management structure of the Consortium itself will incorporate the usual structure that has proven successful in earlier consortia.

The Coordinator is the single point of contact between the European Commission and the Consortium. The Coordinator is responsible for all the administrative obligations of the Consortium. He will oversee the introduction of a Consortium agreement prior to commencement of the project. He will ensure that all participants duly sign the Contract. He will also collect all the financial information at the usual intervals and report to the Commission.

The Coordinator also executes the decisions of the Governing Board, the governing body of the Consortium. The Governing Board rules on all overarching questions affecting the Consortium and receives the annual activity report by the Coordinator.

The Coordinator is also responsible for the installation of proper means of dissemination of the achievements of the Consortium.

A Scientific Assistant will support the Coordinator in the execution of his tasks.

In a completely international and inter-regional project such as the ILC, it is essential that, in addition to the normal management structures of a FP7 project, close attention be paid to excellent communication between the regions. The involvement of both the European Regional GDE Director and the Coordinator ensures this. The European Regional GDE Director sits on all the major governance organs of the GDE and will sit on future ones as they are developed; the Coordinator is Deputy Chair of the Research & Development Board of the GDE, which will play a crucial role in coordinating the R&D, particularly with respect to the superconducting cavities, in the GDE Engineering Design Phase. These aspects and considerations of the wider GDE Project Management as it develops will thus be automatically fed into the management of ILC-HiGrade.

B 2.2 Beneficiaries

DESY is the leading German laboratory for accelerator physics. DESY has an outstanding expertise in the development and operation of particle accelerators and takes a leading role in the developments of the ILC technologies. DESY coordinates the ILC-related FP6 projects EUROTeV and EUDET and participates in CARE. In addition, DESY participates in other European Commission funded projects through its activities for FLASH and the XFEL.

CEA has an outstanding tradition in the developments for particle accelerators and holds significant expertise in R&D of superconducting devices.

CERN is the European Laboratory for High Energy Physics and has an outstanding expertise in the development and operation of particle accelerators.

CNRS is the leading French organisation for high energy and accelerator physics research.

INFN is the leading Italian organisation for high energy and accelerator physics research. The INFN section of Milan has longstanding expertise in the development of high-gradient Superconducting RF.

The **University of Oxford** (UOXF.DL) has a long tradition in research in High Energy Physics and participates in experiments at all major accelerator laboratories.

B 2.3 Consortium as a whole

As a global project, the ILC has many participants from outside European Commission. Some, for example the United States, Russia and Japan, have very large particle physics communities and a long tradition of activity at the forefront of particle physics. Others, for example India and China, have a long tradition but at a relatively low level of resources; this now seems to be growing rapidly. Thus the commitment of the countries to the ILC varies too, with very large communities from the US and Japan down to relatively small ones from countries such as Vietnam. Nevertheless, all countries bring relevant and necessary expertise and resources to the project and are able to contribute in a coherent way through the GDE organization and the Regional GDE Directors. Thus the benefits to the European Community of this participation are real, tangible and absolutely essential to the success of a project that by its very nature is international; indeed, the ILC is probably unique among large scientific projects in having being truly international from its outset.

The Global Design Effort organizes the contributions to the project from all across the world. The level of control over resources exercised by the GDE varies from country to country: in some countries there is a rather direct input into the allocation of resources for the projects; in others that control is very indirect and rather proceeds by influence and advice. As we move into the Engineering Design Phase there is a growing trend towards more direct control of resources, but differences of scientific culture will mean that it will not be possible to impose an homogeneous system with full management control until after ILC approval. One of the most important tasks of the GDE in the period covered by ILC-HiGrade is precisely to ensure that this task proceeds in the optimum way. The funding agencies are linked into the project at many different levels: they provide the funding for the current R&D and engineering and so directly interact with individual laboratory and university groups; they are also members of FALC, the Funding Agencies for Large Colliders, which holds regular meetings at which it receives reports from the GDE. FALC also has subgroups that work closely with the GDE to ensure that resources are used to the best advantage.

Inside Europe, the high priority of the ILC on the European Strategy for Particle Physics shows that the governmental funding authorities of the CERN member states recognise the importance of the ILC for the future of particle physics. As we move towards project approval, FALC and the GDE will deepen their interactions with an aim to funding authorities eventually directly supervising the GDE Project Management.

Each member of the ILC collaboration brings specialized expertise that must be properly integrated into the project as a whole. This is carried out by the GDE organization. The global nature of the project means that the ILC can take advantage of the best expertise and prices in industry throughout the world as well as ensuring that the best technical expertise is available to work on a given part of the project. As an example, the significant expertise in superconducting RF acceleration built up by European industry is a clear contribution to the project from Europe. Similar specialist expertise exists in the other regions so that the entire project benefits from this complementarity. The organisation of the GDE Engineering Design Phase will take these synergies and complementarities into account in allocating work packages. The participants in the project are linked by decades of collaboration either in particle physics and accelerator construction in general or R&D into techniques relevant to the ILC in particular. The particle physics community has a long tradition of worldwide collaboration and strength in working towards common goals that form the central core of the Global Design Effort to build the ILC.

The large number of components required for the ILC necessitates close involvement of industry and the production of all aspects of an RF module is no exception. The cavities will be ordered in industry who to date have learnt the production from the studies on individual cavities. Similarly the couplers and tuners will be obtained from industry, which either has been or will be trained to fulfil the requirements.

New partners in the GDE are always welcome and are joining the project continuously, both nationally and as individual laboratories and universities, and will be integrated by the GDE Project Management Team. With regard to ILC-HiGrade, we have ensured that the main centres of expertise in Europe in superconducting acceleration and in questions of governance, siting etc. are full members. The participation of CERN allows an easy and convenient mechanism for new actors to become engaged in this project and we will certainly facilitate this in conjunction with the European Commission.

B 2.4 Resources to be committed

An overview of the resource usage is shown in Table 9. The indirect costs have been calculated on the basis of the activity using the accounting model that is in effect in the respective institution. Some of the major expenses are detailed below:

MGT – WP1: The management of the Consortium is carried out by DESY. The bulk of the cost arises from the effort to administer the Consortium: provide the deliverables to the European Commission and establish the communication links both internally and externally. The Coordinator will use the web-page of ILC-HiGrade for internal communication while the Outreach work package emphasises the external communication. The Coordinator will also arrange for the Annual Meetings of the Consortium and carries the responsibility for the timely submission of the yearly Annual Reports. The participants are being reimbursed for the audit certificate for which an amount has been set aside for each participant.

COORD – WP2-WP3: The two coordination work packages of ILC-HiGrade involve solely manpower and the support of the integration of the European action into the global endeavour of the ILC. The requested support will thus be used to support the participation of senior physicists and managers in the preparation of the ILC to voice the European position and strengthen the European contribution. The activity will involve some travel cost which has not been separated out. The coordination part also includes the outreach part where in all countries an outreach person will be (partly) funded through the ILC-HiGrade activity. The goal is to raise both public and political awareness for the ILC project.

SUPP – WP4-WP5: The support activities in ILC-HiGrade are aiming at developing the necessary plan for governance structures of the ILC. To this end laboratory directors and heads of funding agencies will develop this plan in close collaboration with the overall Global Design Effort. The money will also be spent to arrange for the required meetings as necessary.

The plans for developing the detailed siting model for Europe again involve only manpower since the available engineering tools are available in-house and available for use.

RTD – WP6-WP8: The three technical work packages serve one common overall goal: the establishment of a viable solution for the production process for cavities of highest gradient. As such they include the purchase of pre-processed Niobium cavities, of RF-couplers and the tuners, which are referred to as consumables/prototypes in the table. The associated manpower is large. It will be used to prepare the processing of the cavities in an industrial mode, which above all include the monitoring of the processing parameters.

The funding in RTD is not sufficient to procure cryomodules for the cavities. We anticipate that over the course of the project and the establishment of a global ILC project the R&D funding for the ILC will globally be increased. Such extra funds would make it possible to place the cavities into cryomodules. Note, that this test is not mandatory to actually perform the high-gradient optimisation and rather targeted towards a future “string-test” of several cryomodules as has been outlined by the so called S2-Task Force of the GDE.

Table 9 Overview of resource usage

Work-package	Participant	Type	Cost in €			
			Direct	Indirect	Total	Request
WP1	DESY	Personnel Audit	280000 1250	168000 750	448000 2000	263333
	CEA	Audit	2000	0	2000	2000
	CERN	Audit	1250	750	2000	2000
	CNRS	Audit	2000	0	2000	2000
	INFN	Audit	2000	0	2000	2000
	UOXF.DL	Audit	2000	0	2000	2000
		WP1 Total	**292000**	**168000**	**460000**	**273333**
WP2	DESY	Personnel	140000	84000	224000	149800
	CERN	Personnel	150000	90000	240000	107000
	UOXF.DL	Personnel	226006	135604	361610	149388
		WP2 Total	**516006**	**309604**	**825610**	**406188**
WP3	DESY	Personnel	140000	84000	224000	43691
	CNRS	Personnel	140000	84000	224000	62416
	INFN	Personnel	70000	42000	112000	0
	UOXF.DL	Personnel	185572	111343	296915	92437
		WP3 Total	**535572**	**321343**	**856915**	**198544**
WP4	DESY	Personnel	140000	84000	224000	149800
	CERN	Personnel	125000	75000	200000	133750
	CNRS	Personnel	35000	21000	56000	37450
	INFN	Personnel	70000	42000	112000	74900
	UOXF.DL	Personnel	152835	91701	244536	163533
		WP4 Total	**522835**	**313701**	**836536**	**559433**
WP5	DESY	Personnel	140000	84000	224000	149800
	CERN	Personnel	100000	60000	160000	107000
	CNRS	Personnel	35000	21000	56000	37450
		WP5 Total	**275000**	**165000**	**440000**	**294250**
WP6	DESY	Personnel Consumables/ Prototypes	700000 1440000	420000 864000	1120000 2304000	1728000
	CEA	Personnel Consumables/ Prototypes	186666 165600	149332 0	335998 165600	292199
		WP6 Total	**2492266**	**1433332**	**3925598**	**2020199**
WP7	CNRS	Personnel Consumables/ Prototypes	315000 559992	189000 335995	504000 895987	671990
		WP7 Total	**874992**	**524995**	**1399987**	**671990**
WP8	INFN	Personnel Consumables/ Prototypes	175000 480000	105000 288000	280000 768000	576000
		WP8 Total	**655000**	**393000**	**1048000**	**576000**
		Total	**6163671**	**3628975**	**9792646**	**4999937**

B3 Impact

B 3.1 Strategic Impact

ILC-HiGrade directly addresses the two most critical parts of the preparation of the ILC project for approval by governments: the development and industrialisation of the superconducting accelerating cavities; and the coordination and development of the governance and management structures of the project and how they interact with governments and funding organisations.

There is complete agreement that the industrialisation and reproducibility of the superconducting accelerating structures is the single most important open question in the ILC project. The superconducting technology was very largely developed in Europe and Europe still has a lead in the understanding of and research into this technology. ILC-HiGrade will substantially leverage this lead, which is being rapidly eroded by very substantial development and investment in test and production facilities in the USA and in Asia. This will allow Europe to continue to make very important contributions to the resolution of the remaining open questions, in particular gaining the required accelerating field per meter and improving the reproducibility of the cavities. A very important part of this process is working closely with European industry, which has already made a major contribution to the success of this technology working within the framework of the Tesla Technology Collaboration and ensuring that European companies are in a position to make competitive tenders for the major high-technology ILC work packages. The European ILC Industrial organisation EIFAST will be closely involved with this process.

The transition of the ILC project from the current phase to a much more detailed engineering design will be crucial and the steering of the engineering design will evolve throughout the roughly three years anticipated for this phase and the current project. The team working on this project comprises the key individuals who will influence the direction of the project and the implementation of robust project management. Their contribution is essential to coordinate the European activity to have the maximum possible effectiveness. Amongst others the team contains leaders from the two major particle physics laboratories in Europe, DESY and CERN, where much of the key technical work will be centred. By freeing some of these individuals from teaching, and administrative commitments on other projects, this project will allow them to concentrate on the key developments to ensure that the ILC will be approved.

B 3.2 Plan for use and dissemination of foreground

The Coordinator is responsible for the dissemination of foreground and will be specifically supported in this task by the Scientific Assistant. The main objectives for the use and dissemination of the results are threefold:

The outcome of the RTD work, i.e. the experience in production of at least 24 fully dressed superconducting RF cavities, needs to be channelled into the R&D and industrialisation efforts of the ILC developments. As all relevant parties working in Europe on R&D for cavity production are partners in the project, the dissemination of the project results is evident and will be eased by the regular workshops in the context of the GDE Engineering Design Phase.

The support and coordination measures of the project, aiming for the preparation of the realisation of the ILC, need to be effectively joined with the efforts ongoing in the other regions of the world under the umbrella of the ILC Global Design Effort and the relevant international bodies like FALC and ICFA. Again, by proper construction of the Consortium where all relevant parties are partners of ILC-HiGrade, the dissemination of the results is guaranteed.

The outreach activities for the ILC in Europe will be strengthened via the ILC-HiGrade project. As one Work Package (WP3) with significant resources is dedicated to outreach measures, the transfer of knowledge outside of the project into the broader public is well prepared. An important objective of the outreach activities is the preparation of information material about the ILC in the main European languages. This outcome of WP3 will be a corner element in building support for the ILC in Europe as well as raising the awareness for the importance on basic research altogether.

Nevertheless, a couple of proven measures will support the dissemination process:

- Internal notes and ILC-HiGrade reports will be used for internal communication and should eventually lead to scientific publications
- Annual ILC-HiGrade Workshops and Reviews will take place and will give the project members as well as the ILC community a platform for communication and scientific exchange. These workshops will also have a significant impact on the policy building process
- Workshops and meetings on Work Package and Task level
- A website dedicated to collect and disseminate information inside and outside ILC-HiGrade

A plan for the dissemination of foreground will be maintained during the project. On the same grounds, the already existing ILC Communication Plan for Europe will be adapted and maintained for the realisation of the project objectives.

B4 Gender aspects

It has long been recognized that women are underrepresented in physics in general and in large physics research organizations. Programmes are in place in all institutes to address this issue in a proactive manner.

People working in the context of this Consortium are employed according to the rules of the respective home institutes. All these institutes have taken active measures to achieve a stronger representation of women in their institutes. This is achieved e.g. by an active employment programme where in all cases women are explicitly requested to apply for advertised positions. Gender equality is actively addressed by institutional childcare and flexible working time for young families.

The work packages in this project have been verified to be compatible with gender mainstreaming.

Concerning the implementation of measures in its gender action plan, the Consortium strongly supports the European initiatives underway to promote gender equality, notably the

EQUAL community initiative programme, as well as the work of the European Parliament's Committee on Women's Rights and Equal Opportunities.

General rules of gender equality and anti-discrimination, e.g. equal payment, punishment of sexual harassment etc., are already in place and being implemented by means of legal regulations or are otherwise mandatory with the partners.