CHAPTER 8

Organization

Contents

8.1 Globalization of the Project

Globalization has become fairly common today, and is widely observed in many activities. The scheme itself is not the goal of high-energy physicists, but globalization would be a key element for us to share the opportunities, responsibilities, costs and benefits of the research from the LC.

High-energy physics has been keeping an international nature from its early days. Because its mission is to clarify the most fundamental laws of Nature and the Universe, new discoveries and achieved results are the common assets of every human being. Hence, our basic principle is that high-energy physics should be pursued independently of any political, national, ethnic, or gender constraints. The opportunity for research must be, and has been, equally open to all scientists in this field, as formulated in the ICFA guidelines of 1971. This should also be applied to countries that have not been at the frontier of high-energy physics research.

We should maintain this tradition and consider the intended LC project as one that will provide a novel and unique chance to extend international cooperation on a global scale. One can expect that the globalization thereof will offer more outcomes for science, technology and education in the world during the long lifetime of the LC project. This is one of the most important aspects that the LC project can contribute to the world. In order to establish a partnership with various countries, it is indispensable to understand the cultural differences as well as the wide range of levels in the economical and technological development of each country. This project will therefore help us to better understand each other.

Seeing the scale of the LC project, it seems hard for a single nation or a single region to support the entire budget for construction and operation. Also, any single region in the world will have substantial difficulty to sustain the required expert human resources by itself. Since the project definitely requires state-of-the-art high technologies and the help of industries, we have to collect all of the necessary technological ideas from the whole world. Like any other energy-frontier accelerators, securing the necessary financial and human resources for the construction, commissioning, operation and upgrades of the LC facility is a major issue. Although it originally started regionally by the European community, the most recent hadron collider, LHC, is being constructed under the cooperation on a global scale for the same reason. It would be natural for the LC to extend cooperation to a global scale from the early stage of the project. By now, most players in the activity seem to share the view that there would be no other way than to build only one machine in the world. The machine, therefore, should not be isolated or monopolized. Globalization of the project is thus the most important aspect, and should play a key role in organizing such a laboratory.

The linear-collider project must be conducted as a truly global-scale international adventure that is open to all countries which are interested. This is not only because the cost and human resources for the linear collider have to be carried by many countries, but also because the enthusiasm for the basic science must be shared world-wide, which will lead to further progress in understanding Nature.

To meet the technological requirements for the new accelerator, intensive R&D projects are going on among the three regions by international collaborations, as described in Chapter 1. For instance, the Accelerator Test Facility (ATF) has been constructed at KEK and operated by an international cooperation in order to realize the required beam emittance. The KEK-SLAC collaboration is developing key elements for an X-band linac, and also a final focus design was investigated where many institutions participated. Similar examples can be found for the development of a superconducting accelerator for the TESLA project at DESY and the two-beam accelerator CLIC at CERN.

While there are several choices for the baseline design, the physics target and the required machine performance are not very much different. This is also a reason why the world is reaching a common view on the project. Based on the experiences and developments accumulated so far concerning the technology for a LC, the time is already ripe to establish an international partnership among countries toward the realization of the project on a global scale.

This global laboratory will match the current policy of the Japanese government, as outlined in the Science and Technology Basic Law (1995), the Science and Technology Basic Plan (1996), and the Second Science and Technology Basic Plan (2001).

In parallel to the "Linear Collider Project Committee", a committee ("JLC Globalization Committee") was organized at KEK in July, 2001, to scrutinize the *internationalization* of the GLC project to be conducted in Japan and KEK, itself. [1] Assuming a new laboratory to be built and to operate the LC, called the Global Linear Collider Center (GLCC), and being open to the world, the mandate inquires how such a center might be organized and operated, and how the KEK laboratory, itself, should relate to the center, such as: 1) the basic structure of GLCC, including the management and decision-making process, 2) the relationship among the various national governments, 3) the relations of GLCC with KEK, the Japanese Government, participating institutions, governments of participating institutes, HEP-related NGO's (ACFA, ECFA, ICFA and HEPAP), and experimental groups, 4) a roadmap to establish the organization, and so on. After one and half years of consideration, the committee published its final report in December, 2002 [1]. The following sections describe the basic proposal concerning the organizational issues, as investigated by the committee for GLC. The Linear Collider Project Committee and Japan Association of High Energy Physicists (JAHEP) have agreed to adopt the recommendations of the report.

8.2 Necessary Features of the Linear Collider Laboratory

The organizational structure of GLCC has to be considered from various aspects. Among them, the

[1] The committee members are W. Bartel (DESY), A.E. Bondar (BINP), M. Gomita (KEK), W-S.Hou (National Taiwan Univ), K. Hübner (CERN), J-S. Kang (Korea Univ.), S. Komamiya (Univ.Tokyo), S. Kurokawa (KEK), D.W.G.S. Leith (SLAC), M. Nozaki (Kobe Univ.), S. Olsen (Hawaii Univ.), D. Perret-Gallix (CNRS), Y. Shimizu (KEK), N. Toge (KEK), S. Traweek (KEK, Visiting from UCLA), S. Wang (IHEP-Beijing), S. Yamada (KEK) (Chair), S. Yamashita (Univ.Tokyo) and M. Yamauchi (KEK).

following are the key features of the new international organization (henceforth, simply called "the Organization") that have to be satisfied in launching this international project.

Execution of the project and the organization responsible for it must successfully address the following requirements:

- **Long-Term Stability**
  The Organization must be stable in its relation with the supporting governments given the long duration of over 20 years or more, and the complexity and large size of the project. Governmental support and a solid international legal base must be prepared to assure a long-term commitment from the participating countries or regions. The Organization, however, has to be flexible enough to allow short-term decisions in order to respond quickly to the demands of an efficient operation of the project.

- **Timely Start**
  Because of the strong demand for having the operation of the LC facility concurrent with that of LHC, a fast and smooth start-up of the LC project is of critical importance from a scientific point of view, as clearly expressed in the statements of ACFA, ECFA and HEPAP.

- **Governance**
  As in the case of other large international scientific projects, the LC facility will be the result of the initiative of a large, international group of scientists interested in this new, advanced tool. In order to respond in an optimal and effective way to the scientific needs, the management of the project must be in the hands of scientists or engineers, assisted by a high-level administrator, who has the full confidence of this group. The oversight of the project will be exercised by the Council, which includes representatives of responsible agencies from participating nations. It is expected that the governments will act in the Council after close consultation with their national particle-physics communities.

- **Equal Opportunity**
  The partners involved in the project should be treated on an equal footing regarding scientific activities, although there will be different levels of contributions among them. This includes: as equal access to facilities as possible, an equitably equal role in the decision-making process, and an equal opportunity to access scientific outcomes of the project.

- **Attractiveness**
  For the linear collider center to remain a landmark of science for a long time, it has to be widely accepted by the general public. Especially, it must be attractive to the younger generation of scientists, not only in the high energy physics, but in other fields of research, and to industry and politicians. Harmonious development in science as a whole must be seriously considered. The application of new technologies developed in the LC project must be encouraged. The LC project must be conducted under careful and continuous reviews by the science communities. In the field of particle physics, interference with other projects in both accelerator-based and non-accelerator physics should be minimized.

It should be noted that the primary objective of the Organization is to build an accelerator facility with a specified energy and luminosity and to carry out a successful research program. Consequently, the following considerations need to be taken into account:

- When construction of the LC is started by the Organization, a clear choice of the technological design for the LC must be at hand, and its total construction and operation costs must be known, and agreed upon between the partners.
- When construction of the LC is started by the Organization, clear agreements on the cost and work sharing among the international partners must exist. The total sum of the contributions pledged by the partners need to satisfy the perceived resource requirements.
- Some of the details will require negotiations which may have to continue after this Organization is formed. However, a set of definitive agreements need to be in place by the time the actual construction of the LC begins.

In the management and operation of GLCC, the following matters must be guaranteed:

1. **Continuity of the design, construction and operation**
   One team with a strong and stable nucleus around the Director must have the responsibilities for the engineering design and, after approval, for tendering, production, construction and then operation.
2. **Legal status**
   GLCC must have an appropriate legal status, within the host country and between participating nations or regions, which allows settling of following issues:
   - Immigration/visa/residence issues,
   - Tax issues,
   - Property issues,
   - Safety issues,
   - Disposal and dismantling,
   - Proprietary issues.
3. **Transparent management**
   The LC center has to handle a complex management involving international resources (both funding and human) for a long time. The management and decision-making process must be completely transparent at all levels of its managerial structure. This is particularly important in GLCC, where the goal can be achieved only with long and continuous efforts of all the participants.
4. **Efficiency**
   The administration and management structure of GLCC must be designed to optimize the efficiency of the project. To make tendering open to the world is one of the clear prerequisites.

5. **Health of participating institutes**
   Investment by all governments in the new project will help fulfill the expectation of reducing their investments in the local laboratories, and probably change the scope of those institutions. A scheme for the participation of the staff members of the contributing laboratories will have to be devised to keep these laboratories active and to provide support through high-quality technical personnel to the new laboratory.

8.3 Possible Organizational Scheme for the Linear Collider Laboratory

8.3.1 Possible Schemes

This section discusses possible schemes for the Organization that would be responsible for the construction, operation and upgrades of LC. In the context outlined in Section 8.2, the JLC Globalization Committee considered the following two schemes as representative possibilities:

1. **Extension of an existing laboratory or institute**:
   In this case, an existing laboratory carries the bulk of the responsibility for the construction, commissioning and operation of the LC facility. The extended laboratory needs to accommodate the functionality of the Organization that is required to effectively execute a major-scale international collaboration. In the case of Japan, the laboratory to be extended would be KEK.
2. **Creation of a new international laboratory**:
   In this case, a new international organization needs to be formed and become responsible for the construction, commissioning and operation of the LC facility. Thus, the creation of this laboratory needs to be based on an international agreement. In the case of Japan, GLCC is formed as legally separated from KEK, although KEK will be one of the primary collaborating institutes.

In the following, the rationale for these schemes as well as possible advantages and potential issues are summarized, as examined by the Committee.

Extension of an Existing Laboratory

The extension of an existing laboratory is considered to be appropriate when the host country (or the host region) commits a substantial fraction (for instance, more than three quarters) of the construction

cost. In this case, the bulk part of the budget management work becomes a single-nation (or single-region) issue, and it is more appropriately handled within the framework of a national (or a regional) institute.

However, even in this case, because of the unprecedented magnitude of the technical complexity and the required amount of expert manpower, an international collaboration on a major scale will still be inevitable in the construction of the LC facility. Therefore, globalization of the project in many of its aspects is necessary and essential. For instance, unless managed with adequate openness in many of the decision-making processes, an excessive dominance of the host laboratory or the host nation could produce adverse effects against a healthy, long-term international collaboration at the LC facility.

The host laboratory, in the case of Japan, will be KEK (or its future incarnation). In this case, an LC center would be created as a new branch of KEK, and the center would be controlled by its project director, who would report to the director of KEK and to an international steering body. The remaining contributions necessary to construct the accelerator would be requested from abroad, as was done for the construction of HERA at DESY. In the areas of human resource and scientific management, provisions must be made to support this international collaboration. This, in turn, would have a major impact on the ways that the host laboratory (e.g. KEK) operates. The government needs to be put on notice of this issue, if this scheme is found to be necessary to pursue seriously.

If the LC project is fully supported by the Japanese government as an extension of KEK, with a full understanding of the issues discussed above, this scheme can be realistic. It is expected to incur a relatively small lead time for the formation of a new management structure, since a prototype management structure already exists in the form of the existing laboratory. Consequently, it may be capable of a "jump-start", if an adequate budget is approved in a timely fashion.

However, this scheme for extending KEK may be less attractive to Japan because this form does not lend itself very well to making a contribution to the globalization of science, and may be expected to receive less intellectual input, especially human resources, to the project from outside. [2] In addition, at this point in time, it is perhaps too optimistic to expect a single nation to support more than three quarters of the construction cost for the LC in a timely way.

Therefore, in our subsequent studies, we do not consider an "extension of an existing laboratory", supported dominantly by a single nation (or few nations), to be our first choice to pursue. We restrict ourselves to maintain this scheme as a potential alternative, should the governments find this to be a better approach for reasons to be determined in the future.

Creation of a New International Laboratory

The creation of a new international laboratory is considered to be more appropriate when a number of partner nations bring in equitable amounts of financial contributions. In this case, the budget execution by the Organization needs to be made more directly accountable with respect to the funding

[2] An exception may be the restructuring of KEK to renew it as a fully international institute. In this case, the process is almost equivalent to the creation of a new international laboratory discussed in Sec. 8.3.1.

agencies of the partner nations. Also, some built-in mechanisms need to be incorporated in the Organization so as to ensure that the partners are treated on an equal footing. An international laboratory is considered to be a suitable entity to fulfill such requirements. Some of the specific issues will be the subject of discussion in subsequent sections.

The underlying principles of the Organization are as follows:

- The laboratory is supported in cash and by in-kind contributions from a number of nations who agree, through government-level agreements, to participate in the construction and operation of the LC facility and research work there.
- The laboratory management is executed by its staff members who joined the Organization from the member nations (and elsewhere).
- The laboratory incorporates a mechanism (council) so that all the aspects of its scientific, administrative, and management activities are overseen and reported to representatives from the member nations.

When such a laboratory is created in Japan, a natural assumption will be to create it as a new, international legal entity, which is separate from KEK. The latter could continue its function as a national laboratory, being one of the contributing/participating laboratories to GLCC, and would remain the supporting laboratory for the Japanese high-energy physics community while carrying out the detector and accelerator work required for the construction and R&D necessary for upgrading, which are the Japanese contributions to the global laboratory, and which cannot be delegated to Universities. The construction and operation of the LC will be under the full responsibility of this new international laboratory, GLCC.

On the other hand, when managing matters related to civil engineering or interactions with municipal governments concerning the living conditions of the staff in Japan, the assistance extended by KEK could be very helpful, particularly in the early stage of the project. There would be many other areas where contributions and assistance by KEK are of special value, if desired by GLCC, in terms of smoothing out the construction process of the LC facility, due to the local expertise accumulated at KEK.

Therefore, although the project is a fully international one in this case, one should consider special roles of the host country and KEK for a smooth start of the project.

8.3.2 International Organization

As has been concluded by the JLC Globalization Committee, it is highly desired to create an international Organization, which is based on a treaty-type agreement among the participating governments, by the time of the beginning of the construction of the LC.

As discussed in Sec. 8.3.1, this scheme is expected to be capable of satisfying all of the desired features, as laid out in Sec. 8.2. It should also be pointed out that the work that is required to establish this

Organization should not incur significant additional time if the tasks are to be carried out in parallel. For instance, the process of negotiating and settling on the agency and government agreements on the contributions, the completion of R&D for a rational technology choice and a solid cost estimate will at least take as long as the preparation of the government-level treaty-type agreement. Once the agreement is signed, its ratification is expected not to take more than several years. [3]

The following points are worth reemphasizing:

1. The most important mission of the LC laboratory is to successfully build an LC facility and operate it. This requires accurate knowledge of the project cost (both financial and human resources), its sharing among the partners, and the commitment by the partners. It would be extremely problematic to start construction of the LC while the entire sum of the contributions by the existing partners are known not to satisfy the total needs, or the commitments by some of the partners are not based on solid approval by their governments and the relevant parliamentary bodies. Therefore, the long-term, financial commitment by each partner will have to be backed up by government approval before the start of the construction.

2. Independent of organizational models, parliamentary approval, rather than just an exchange of Memorandum of Understanding (MoU) between agencies or governments, will be mandatory to launch the large-scale international project and to share a substantial amount of funding. This certainly is the case for Japan, and is likely to be so in other countries. Furthermore, the LC project needs partners not only to participate, but also to establish the international Organization of the new laboratory. Consequently, a well-defined scheme of international co-operation including the organization will have to be prepared by government-level negotiations between the participating countries or regions, and inter-governmental agreements will have to be approved by parliamentary bodies.

3. If the consensus to be formed among the international community of High Energy Physics is firm enough to convince the funding agencies and the legal bodies to commit a large-scale expenditure, then the creation of an international Organization to conduct the project based on treaty-type international agreements may not be too time-consuming. An estimate of this treaty process is as short as 2–3 years.

4. Under special circumstances, some nations may prefer to contribute to an international Organization for the LC as a group, or through another representative body, such as CERN, rather than signing independently on the treaty-type agreement. Some nations may prefer to let their respective research institutes sign on the laboratory-level MoU's (Memorandum of Understanding) with the LC Organization. All of these special cases may be handled adequately if the international Organization possesses an appropriate legal status.

For these reasons, in the rest of the discussion we primarily consider a treaty-based international laboratory, unless otherwise stated. It is to be established by joint efforts of governments, scientists

[3] For instance, in the case of CERN it has taken about two years.

and engineers from around the world. It is noted that this laboratory, if created, would be the first international laboratory on a global scale for particle physics.

An idea for forming a world-wide collaboration as a prototype of the LC laboratory among those laboratories who are interested, is a worthy further pursuit, particularly in light of offering a very useful platform for co-examining many of the issues associated with a full-scale collaboration in great detail. It should also help accelerate the R&D process and to develop engineering designs of the LC facility. Such a world-wide collaboration is also considered to be a key to demonstrate the feasibility of the global-scale cooperation to governments and to the public, which is surely highly desirable to accelerate the governmental approval process.

Note that this world-wide cooperation should be considered as an intermediate stage of the process, rather than an ultimate form of the Organization that is responsible for the construction and operation of the LC laboratory, since such a joint project among laboratories may not be able to assume long-term funding and provide the stability that is required to complete the construction of the LC, operate it over many years and, eventually, upgrade it. The scheme is further discussed in Sec 8.3.6.

Possible Legal Basis of the Laboratory and Relation between the Laboratory and Countries or Regions

The legal status of the laboratory is to be defined by a government-level agreement among the participating nations through a treaty or an equivalent contract, and needs to comply with relevant international laws. A notable example is CERN, although it was conceived and created as a regional international organization. Because of the international treaty nature, the agreement requires the approval by the parliamentary bodies in each participating nation. This is desirable because it provides stability in view of the large financial commitment. The "treaty" has to define the following items:

1. Term of the Organization, with provisions for possible extension.
2. Organizational structure of the laboratory, including the functions of the director, the directorate, Council, and their nomination and appointment processes.
3. Accession and termination processes of the membership for the participating nations.
4. Representation of funding and supporting bodies from each member nation / region. Provisions for group participation, etc.
5. Legal status of the laboratory staff.
6. Application of or exemptions from local or domestic laws concerning taxes, insurance, and operation licenses for equipment.

Some additional considerations are noted below:

- How the financial, in-kind and resource contributions (facility or seconded personnel) are to be assigned to and balanced among the partner nations.

  The structure of the Organization has to be designed so that it can cope with the participation by a number of nations in which different funding/support schemes exist for science and technology. The representative(s) of each country/region or group of countries should be chosen appropriately. It should also be noted that the forms of the contribution or participation by partner nations may be changed during the course of the project. Reevaluation of the form and approvals of new partners must be possible in a flexible way.

- How the Organization handles cash funds.

  While the bulk of the contributions by the participating nations may be made in the form of in-kind contributions, a common fund has to be established by cash contributions both in the construction and in the operational phase. Especially in the operational phase, the fraction of the cash contribution will be significant.

  The Organization should be allowed to obtain loans from banks with the agreement of the partner nations. It is mandatory that the global lab is authorized to award multi-year contracts and budget holding with partner nations and the Japanese government.

8.3.3 Basic Structure of the Laboratory Management

Fig. 8.1 gives a possible structure of the laboratory based on an international Organization. It shows the basic topology, as drawn from an example seen at CERN. Basically, the Organization consists of a governing Council (or Councils) and the Director (or Directorate), who is responsible for managing the divisions within the laboratory for handling scientific, technical and administrative matters. In addition, various types of advisory bodies and ad-hoc panels may be created to assist in the operation of the laboratory.

Director

The Director (Directorate) is responsible for execution of the project and the day-to-day management of the laboratory with the resources that are made available for the GLCC. Because of this responsibility, the Director is given authority over resource allocation within the laboratory. The Director also appoints the executive managers within the laboratory for sections of administrative tasks and for science/technology groups. These key personnel should be staff members of the laboratory. The GLCC Director employs/promotes key staff members (division leaders). There should be no limitation by nationality. To select the best persons, the Director forms a search committee in the consultation with Council. The key staff members need approval by the Council.

The Director is also expected to take initiative to improve, strengthen and extend the collaboration between major laboratories in the world for construction, and operation and to upgrade R&D.

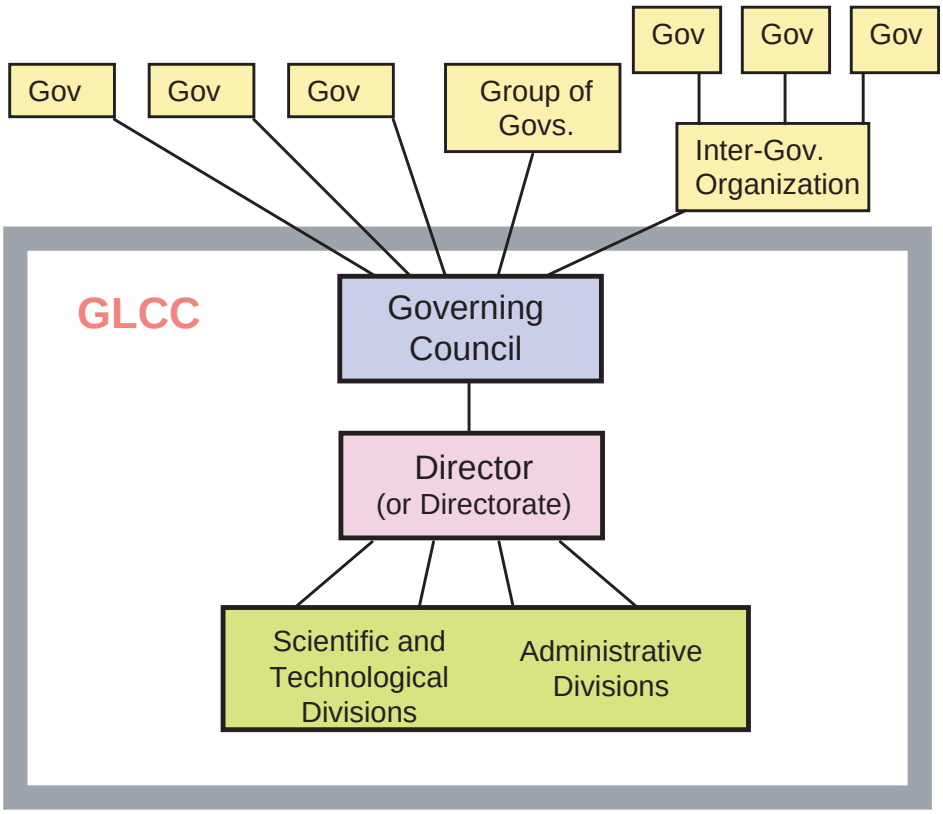

Figure 8.1: *Possible organization chart of the LC laboratory.*

Since the total amount of the human resources with sufficient expertise for the design, construction, operation of the accelerator cannot be expanded as required, external human resources will be necessary from participating institutes, including KEK, and companies. In this case, the GLCC Director asks the external institutes or companies for seconded people. The nominations of seconded persons are to be made by the management of the external body, and appointed by the GLCC Director. Contracts are to be made between the GLCC Director and the management of the external body.

Council

Since resources made available for the GLCC are to be contributed by the participating nations, there has to be a platform by which representatives from these nations determine the strategy and key managerial and administrative policy issues to be executed by the Director. The main objective of the Council is to serve this purpose.

The members of the Council would consist of termed representatives of the funding bodies of the participating nations or regions and prominent scientists who are appointed by the funding bodies and being part of the national delegations. [4] Representatives of the users of the GLCC facility should also be included in the Council.

The tasks of the Council would include the following, which are to be done in accordance with the charter of the Organization:

- Appoint the Director of the laboratory and hold the Director accountable. The term should be defined in the charter of the Organization.
- Approve the appointment of key personnel, as proposed by the Director, in accordance with the charter of the Organization.
- Overview the scientific programs, policies and procedures of the Organization.
- Make critical decisions on assignment of contributions by participating nations, and approve the budget plan that is proposed by the Director.
- Approve the project plan, including the upgrade program, that is proposed by the Director.
- Make decisions on the accession and withdrawal of membership.

Member nations who join the construction, operation and management of GLCC are on "an equal footing". However, this does not necessarily mean that everyone has the same one vote in all decision-making process. The voting protocol in the Council could depend on the issues to be decided. Since the management concerning scientific matters of the laboratory should be based on the consensus of the scientists who support the project, most of the decision would be made by the majority of the vote with equal weight.

[4] The Council may also seek scientific opinions of Advisory Committees which consist of prominent scientists who are selected by the Council.

However, for issues related to the budget, or issues related to external human resources, the Council may have a voting procedure with appropriate weighting in proportion to the contributions by the members.

8.3.4 Roles and Relations of the Host, Users, Participating Institutes

Successful operation of the LC facility requires a broad range of support and services in addition to the design, construction, commissioning and operation of the accelerator. If this is to be done in Japan, the following will be the issues to note concerning the relationship among the key relevant parties:

- **Roles of the Host Country and KEK:**

  Special roles for the host country include providing the groups and personnel who join this project from other parts of the world with a broad range of services in areas of both the daily work and life. The help of the local, national high-energy physics community and the high-energy laboratories, especially KEK, will be indispensable, and will thus give a special responsibility to Japan as the host country.

  Although the model laboratory is a fully international one, and owned by the participating countries, at least one Japanese institute should give major support to help GLCC at the initial phase of the project. At that time the already existing infrastructure at KEK should be utilized efficiently, for example the test facility, storage, equipment, and other user facilities. The know-how accumulated at KEK for the smooth startup of the project and machine construction/operation in Japan, both in administrative tasks and in engineering tasks, must be transferred to GLCC as much as GLCC requests and should be effectively used. More detailed discussions are given in elsewhere [1].

- **Relationship between GLCC and Users/Physics Communities of the World:**

  For the successful operation of the project and optimization of the physics output, opinions from users who take physics data and analyze them should be appropriately reflected in the laboratory management and project plan. For this purpose, the user community should have representatives on the GLCC council in addition to the scientists in the delegations of the participating countries.

  ICFA, ACFA, ECFA and HEPAP are considered to be scientist-oriented organizations driven by consensus among the world/regional HEP scientists. Such organizations should give advice to the project. Their opinion may be given in an external review committee (Scientific Advisory Committee) to the GLCC. Their participation is particularly important for any major upgrades, to collect new partners, and to adapt the structure of the laboratory to a long-term road-map of the particle physics.

- **Role and Relation of Major Laboratories and Other Participating Institutes:**

A strong cooperation between participating institutes or science agencies is indispensable. A smooth transfer of human resources between existing laboratories and GLCC is necessary. The agreements among the participating institutes must include ones that share human resources, in addition to the maintenance responsibilities concerning in-kind contributions.

Another key issue is sharing of the responsibility for the R&D projects towards potential upgrades for higher energy and luminosity. Any upgrade has to be considered within the scope of the project from the early stage of the design. The agreements among the participating institutions must also cover the R&D for an upgrade.

8.3.5 Next Series of Efforts

The creation of GLCC and the successful execution of the LC project therein will require concerted efforts among multiple segments of the world community, not limited to research scientists and engineers. The subjects of the next series of efforts may be summarized into the following four items:

- Establish an agreement among scientists and engineers from around the world on the baseline technology, and the central parameters of the machine,
- Accelerate coherent efforts on R&D, engineering design of the accelerator and relevant test facilities by sharing the common assets, knowledge, budget and infrastructure,
- Demonstrate to governments that an international cooperation by this international HEP community can be successfully implemented, and
- Obtain governmental support through promoting the project in public and close communication to governmental bodies.

These efforts should be made in such a way that a world consensus eventually emerges on work sharing, fund sharing, details of the GLCC Organization, as well as selection of the site for constructing the LC facility. Once a clear consensus and design of the machines are established, the process to form the international agreement by treaties or something equivalent may take as little as 2–3 years.

8.3.6 Pre-GLCC

There have already been a number of activities in the world HEP community on various aspects of world-wide efforts towards LCs, as described Chapter 1; such as the International Linear Collider Steering Group (ILCSG) and the Technical Review Committee (TRC-II)[2] under ICFA, regional steering groups in Asia, Europe and North America. There are also activities involving government officials, like that of the Consultative Group on High Energy Physics under the auspice of Global Science Forum (GSF) of OECD.

While these numerous movements are currently ongoing towards an LC, the world does not yet have a body to pursue in a united manner the technological, organizational, political and legal matters,

with a clear goal of forming a consensus and with a suitable decision-making power at the same time. The next step will be to develop practical solutions that are agreeable to all, both politically and scientifically. A forum where government officials and scientists of all interested countries can discuss these issues needs to be formed. [5] It is our opinion that very careful examinations must be made and clear definitions should be laid out concerning the membership of such a forum and its relationship with ILCSG or regional steering groups, as well as relevant agencies and executive branches in the interested nations. It should also be recognized that some of the matters that are suitably dealt with by decision-making officers in one country, may require the involvement of political representatives in another country.

We propose to form the "Pre-GLCC" (Pre-GLC Collaboration or Pre-GLC Center) as the body to be responsible for carrying out all of the practical tasks related matters, as well as a common forum for the people who work together as a world-wide team.

Several forms of international collaborations on accelerator R&D have been quite active at TESLA, GLC/NLC and CLIC. An important responsibility of the Pre-GLCC is to coherently push the world efforts one more step ahead, based on the achievement marked by these teams. This has to be done at both the technological and organizational fronts, with a clear intention for joint construction of an LC. Obviously, close communication links, open sharing of technical information, and the cultivation of a common, collaborative spirit among various layers within the participating laboratories will be of critical importance that requires conscious efforts by all who are involved.

The following points are noted:

- **Membership:** The fastest path is to form the Pre-GLCC as a MoU-based collaboration, among the major HEP laboratories, with an endorsement of ILCSG. The initial membership of the Pre-GLCC would be those representatives of laboratories and HEP communities world-wide, which are engaged in LC development in a major way, and their physics and accelerator teams. Participating laboratories in this collaboration will create local headquarter offices to carry out the necessary tasks, e.g. regional coordination of technical and organizational research activities as part of this collaboration.

  While the main parts of the initial activities of Pre-GLCC may be adequately managed by a collaboration of interested research institutes, consultation with government representatives with suitable policy-forming authorities will become essential in a later advanced stage of Pre-GLCC. This is because the Pre-GLCC aims to form a set of prescriptions not only on technological matters, but also on organizational, legal, and political matters as well. Finally, the Pre-GLCC should also allow the later participation of laboratories, who may not be able to join in an early stage of collaboration.

- **Technology choice:** At this moment there is an ongoing, world-wide debate on the technology choice for the main linacs of LCs, i.e. the room-temperature vs. superconducting technologies. In the traditional spirit of HEP collaborations, if the world community agrees that all of the

[5] In fact, the follow-on activities has been being started by the Consultative Group on High Energy Physics under GSF of OECD.

talented and capable scientists need to work together for a common goal after all, the Pre-GLCC should be formed before, rather than after, the question of technology choice is settled. There, the Pre-GLCC should assume the responsibility of settling this technology choice issue in a congenial and agreeable way. This has to be done through fair reviews on: the potential of the technologies, the availability of the resources, and the suitability for short-term and long-term prospects for physics research.

- **R&D towards engineering design:** The Pre-GLCC should assume the responsibility for coordinating and promoting the world collaborations on the advanced stage R&D of LCs. Of particular importance is to produce a thorough engineering design of the LC with a full understanding of the construction and operation costs as well as the possibility for a future upgrades, which can withstand critical peer reviews of world-wide accelerator experts.

- **Organizational matters:** Although the Pre-GLCC is *not* GLCC, it is expected that many aspects of the organization of the Pre-GLCC can serve as a prototype for that of GLCC. This is particularly so in areas related to the organization of technical groups. With the active participation of government representatives, more thorough reviews on legal issues can also be conducted. The Pre-GLCC serves as a platform for such reviews and discussions, with all of the necessary participants readily available under an MoU agreement.

  The evolution of the management structure of the Pre-GLCC, in the course of the joint efforts, should lead to something similar to what is envisaged for GLCC. At some point, participation of government officials of suitable levels will allow the formation of a Council, which will appoint the Director (Directorate) of the Pre-GLCC, and which will act as a link to the relevant agencies of governments for the member laboratories. There, a good mixture of scientists, diplomats and government officials experienced in the management of big science projects have to work together towards the establishment of the real laboratory to start construction. It is natural to consider that this top management layer of the Pre-GLCC will be eventually be transferred to the initial Council of GLCC, which will appoint its first Director (or Directorate).

Issues concerning the choice of the GLCC site may well be beyond the scope of the Pre-GLCC, since the authority over decisions of this type naturally belongs to the executive branches in the governments of participating nations. However, the Pre-GLCC should assume the responsibility for producing critical technical inputs for this decision-making process as well.

In all of these activities of the Pre-GLCC, the high-energy physics communities of the member countries of ACFA should join as active participants together with colleagues from CERN, DESY, FNAL SLAC as well as from countries elsewhere.

Based on the matured LC technologies and the organizational scheme that results from the Pre-GLCC, together with the selection of the GLCC site, the decisions on practical work-sharing among the participating nations at GLCC are expected to be relatively straightforward.

8.3.7 Important Issues to be Solved

There are a number of issues to be solved in establishing the new international Organization or laboratory. Some of these have been discussed in Ref. [1]. These can be summarized into two categories: one relates to the Organization scheme, and the other concerns the working and living conditions for scientists, engineers and their families.

The organizational Issues are as follows:

1. How to Share the Contributions,
2. Responsibility in Operation/Maintenance and Ownership,
3. Seconded Personnel,
4. Intellectual property,
5. Procurement practices,
6. Liability,
7. Import tax and value-added tax (VAT),
8. License for operation of cranes, forklifts and so on,
9. Third party liability, and equipment insurance, and
10. Provisions for the dissolution of the organization.

There are also a number of requirements on the working/living conditions for those who work for GLCC, (visitors and accompanying persons) such as;

- Health and accident insurance,
- On-site/off-site transportation,
- Housing,
- Hospital, school, kindergarden and nursery,
- Visa and work permission for accompanying persons (including non-traditional family members.),
- Finding jobs where accompanying persons can make good use of their skills, know-how, cultural heritage, and expertise,
- Interface to religious opportunities,
- Local recreational facilities, and
- Educational program for students.

These issues should also be fully investigated in the Pre-GLCC to prepare from the establishment of a Global LC center.

8.4 Summary

Different possible models have been worked out for the organization of an international laboratory which will be built by a global-scale international collaboration for a linear collider, under the assumption that the linear collider is built in Japan. This laboratory is referred to as Global Linear Collider Center (GLCC). The studies of the organizational issues have been made while taking into account the estimated scale of the resources and time span for the construction, operation and upgrading of a TeV-scale electron-positron linear collider. Among many requirements at different levels, firm commitments of the participating partners and their stable support throughout the project are critical, while flexibility for the scientific program is important and a timely start is desired. Regarding the organization, because of the nature of the pursued science, it is important to provide openness to anybody who is interested. The management of the organization must be clear and transparent.

Two possibilities for the cooperation scheme are to be worked out while considering the above requirements. One is the extension of an existing laboratory in which the host country takes over a major fraction of the construction and operation cost. The other is the creation of a new globally international laboratory in which the costs will be appropriately distributed among the partners, while the host is expected to contribute the largest sum. These are extreme cases of the opposite ends; an intermediate model was also considered. That is, some type of joint venture of interested institutes with the purpose to construct and operate a linear collider was reviewed. Although this model was not favored because it lacks long-term stability, it can be useful to initiate a large-scale international collaboration to prepare for the desired establishment.

It was considered to be extremely doubtful whether Japan or any other single country in the world would finance such a multi-billion-dollar project, as assumed for the extension model, though a serious attempt should be made to test such a possibility. It is also unlikely for this model to secure the sufficient human resources with necessary expertise without substantial international cooperation.

From the view points of financial solidity, sharing the cost, human resources, responsibility and scientific opportunities, creating an international laboratory dedicated to the linear collider project and open to all high-energy physics communities world wide is the preferred solution. A laboratory based on an international treaty can secure financial support and stability over the duration of the project. It is recognized that the time needed to arrange a treaty-based agreement will not be longer than that needed for the parties to reach a consensus over the details of the project, which is required for any international cooperation involving a large financial commitment over a period of many years. Such a laboratory could serve as a center of excellence in Asia, and have a considerable impact on the whole world. For Japan, it will be very attractive to host such a laboratory, which would be in line with the

official science and technology strategy.

In order to start a coherent and vigorous effort toward the desired solution, it is recommended that a Pre-GLCC (Pre-GLC Collaboration or Pre-GLC Center) be initiated, based on MoUs of interested laboratories. A Pre-GLCC has a structure similar to that of GLCC and it conducts the necessary R&D for the accelerator and to study the details of the organization. In due time, government officials are required to be consulted concerning the activity.

It is a major challenge for Japan to provide the necessary infrastructure for the facility and to prepare the necessary accommodations and living conditions for a large number of collaborators with their families. Until its birth, or even at an early stage of the new organization, KEK may need to take a substantial role to handle these problems, while remaining as one of the participating laboratories.

The creation of a new treaty-based international laboratory is considered to be the best way to ensure its long-term stability and clear legal status in order to construct and operate the linear collider. An intermediate step should be taken by starting a Pre-GLCC in which any interested laboratories can join and solve the technological and scientific issues to obtain a consensus. In parallel, it can also prepare for the GLCC by cooperating with government officials to work out an agreement on its final form.

References for Chapter 8

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