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## REPORT BY THE DIRECTOR-GENERAL ON THE FEASIBILITY OF ESTABLISHING AN INTERNATIONAL ENGINEERING PROGRAMME AT UNESCO

### SUMMARY

This report has been prepared in response to 182 EX/Decision 66 and 35 C/Resolution 32, both of which requested the Director-General to conduct a feasibility study for the establishment of an international engineering programme (IEP) at UNESCO. An international ad hoc technical expert committee was convened to advise on the need for, and feasibility, structure, organization and governance of such a programme, as well as on possibilities for extrabudgetary support, recommending that a questionnaire survey be conducted as a basis for the feasibility study.

The present document recommends that the IEP be conceived with a focus on the development of engineering education and capacity-building around the world, as well as an enhanced application of engineering and innovation for development. The document is supported by 185 EX/12 Add., which contains the conclusions of the expert committee, and the results of the questionnaire survey regarding the establishment of an international engineering programme at UNESCO. It also outlines a proposal for the International Engineering Programme. Should the Executive Board so decide, a pertinent proposal could be made by the Director-General, including the programme's structure, as well as its financial and administrative implications, for examination by the Executive Board at its 186th session in the context of her submission of the Draft Programme and Budget for 2012-2013 (Draft 36 C/5).

Financial and administrative implications: see paragraphs 11-13.

Action expected of the Executive Board: proposed decision in paragraph 14.

## INTRODUCTION

1. A proposal for a feasibility study for the establishment of an international engineering programme (IEP) at UNESCO was submitted as 182 EX/66. The proposal builds upon, complements and reinforces previous decisions of the Executive Board and the General Conference regarding capacity and capacity-building in engineering. These include the proposal for the development of cross-sectoral activities in technical capacity-building in 171 EX/Decision 59 (2005) which, among others, called for activities to include strengthening of the existing engineering programme. The Executive Board subsequently adopted 182 EX/Decision 66, submitted to the General Conference as 35 C/62. The proposal for the need to strengthen engineering at UNESCO was adopted, with the recommendation that UNESCO conduct a feasibility study and submit a comprehensive report thereon to the Executive Board at its 185th session (autumn 2010). Preparations for the feasibility study began with the formation of an ad hoc technical advisory group and the organization of a questionnaire survey, and ended with the compilation of the feasibility study.

### Global trends in engineering and development

2. Engineering and technology are of vital importance as core building-blocks of knowledge that underpin and drive poverty reduction, sustainable development and the United Nations Millennium Development Goals (MDGs). There is increasing concern worldwide regarding capacity shortages, declining interest and the enrolment of young people in engineering, and the adverse effects these trends will have on human and institutional capacity in engineering and development in general. There is a particular need for human, institutional and infrastructure capacity-building in engineering and technology, especially in developing countries.

### Science and engineering at UNESCO

3. Science has been a core component of UNESCO activity since its creation in 1945 at the Institution of Civil Engineers in London. The basic and engineering sciences were once main areas of activity, in terms of regular programme and extrabudgetary activities. In recent years, however, there has been a decline in human and financial resources in engineering and technology at UNESCO, an area in which UNESCO has a unique mandate, and a consequent decline in the ability of UNESCO to assist Member States, particularly developing countries. Despite this, the engineering programme is dynamic in terms of regular programme and extrabudgetary activities – focusing on information, learning and teaching materials in such topics as sustainable engineering, technology incubators and gender issues, applications and innovation for poverty reduction, sustainable development and climate change. Particular activities include the production of the UNESCO report *Engineering: Issues, Challenges and Opportunities for Development*, due for publication at the end of 2010, the widely acclaimed Daimler-UNESCO Mondialogo Engineering Award, partnership in conferences, meetings and workshops including the World Engineers' Conventions (WECs) in Geneva in 2011, and previous WECs in Brasilia in 2008, Shanghai in 2004 and Hanover in 2000. Most recently, an "Innovation for Development" project has begun, supported by the Swedish International Development Cooperation Agency (SIDA). Many of these activities are conducted in close cooperation with the World Federation of Engineering Organisations – the major international engineering organization, representing over 100 national and international engineering bodies.

### Survey on need for, feasibility of and support for an international engineering programme

4. The feasibility study began with the formation of an ad hoc technical expert committee to advise on the need for, and structure, organization and governance of the proposed IEP and possibilities for extrabudgetary support. This committee consisted of specialists in engineering and development and professional engineering organizations around the world, including the President, President-elect and Executive Director of the World Federation of Engineering Organisations (WFEO – based at UNESCO and with which UNESCO has a Framework Agreement) and

representatives of the International Council of Academies of Engineering and Technological Sciences, Engineers Without Borders and Executive Director of the South African Institution of Civil Engineers (the proposal for the feasibility study came from South Africa). The expert committee reviewed the proposal for the IEP and the objectives, organization, findings and recommendations of the feasibility study, with reference to the similar study for the International Basic Sciences Programme (IBSP). The committee recommended that a questionnaire survey be conducted as a basis for the feasibility study, and that further consultations and production of the study report be conducted over the Internet. Several suggestions for budgetary support for the proposed IEP were made, and the development of a wider resource group of individuals and organizations was suggested. A questionnaire survey was developed and sent to national members of WFEO, and the response was analysed for inclusion in and attachment to this report.

5. The overall findings of the questionnaire survey indicate strong support for the proposed IEP from engineering organizations around the world, including comments that the proposal for an IEP was very timely in a period of increasing globalization and need, highlighting the unique position and comparative advantage of UNESCO in being able to bring organizations and resources together in such an important initiative. Many respondents expressed keen interest in working in close cooperation with other national, regional and international engineering organizations.

6. The main issues facing engineering were reported to include the increasing shortage of engineers in many countries, and the need to attract more young people to engineering, especially women. Other important issues comprise quality control, accreditation and mobility, employment opportunities, problems of brain drain from developing countries, the need for better statistics and indicators, public and policy awareness of engineering and the importance of engineering in sustainable development and poverty reduction.

7. The main value of the proposed IEP was perceived by many to include promoting cooperation, sharing of information and experience in engineering, engineering education and applications, including learning and teaching materials, staff and student exchange, educational reform and transformation, technology transfer and innovation. Many also emphasized the important role of the IEP in acting as an honest broker to promote regional and international cooperation between engineers and engineering organizations, policy-makers and the public to address the major problems facing the world.

### **Proposed international engineering programme**

8. Since UNESCO has established an International Basic Sciences Programme, it is equally important, on grounds of the role and importance of engineering knowledge and contribution to development, to establish a complementary international engineering programme, based on the existing Engineering Sciences programme.

9. In the context of document 35 C/5, engineering is of vital importance in biennial sectoral priority 1 regarding policies and capacity-building in science, technology and innovation for sustainable development and poverty eradication, but also in biennial sectoral priority 2 regarding the environment. There are also significant gender issues relating to engineering, and a particular need to develop and apply engineering more effectively for development in Africa – thus responding to UNESCO's two global priorities.

10. The main objectives of the programme would be to promote engineering education, human and institutional capacity-building and applications to address the internationally agreed development goals (IADGs). Programme activities will include the development, production and sharing of information and indicators, advocacy, policy, planning and advisory services, the publication of learning and teaching materials, curriculum development and delivery, continuing education, and distance and virtual learning in the field of engineering. The programme will promote the development, transfer, exchange and application of knowledge and innovation through international networking, cooperation and partnership. There will be specific reference to the role of

engineering in poverty reduction, sustainable development and climate change mitigation and adaptation, promotion of gender equity and empowerment of women and developing global partnerships for development.

11. The IEP would require staff and financial resources that were not taken into consideration during the preparation of document 35 C/5, and the Director-General has requested that the feasibility examination take this consideration into account.

12. The IEP would have a core professional and support staff, complemented by seconded professional staff, consultants, fellows and interns, with an advisory board consisting of leading members of the international engineering and development communities. The budget would need to be commensurate with the level of staffing and activity, based on the options presented below. The resources required may have to be provided both from regular and extrabudgetary funds.

### **Further action to be taken**

13. To meet the objectives as indicated above, the Executive Board may wish:

(a) to enlarge the activity of the engineering programme within its current structure, with increased regular programme funding and identification of additional extrabudgetary resources;

or

(b) to establish an international engineering programme as an independent programme with a status similar to that of either the International Geoscience Programme (IGCP) or the International Basic Science Programme (IBSP), which would require both increased allocations for engineering under the regular programme and budget and extrabudgetary funding.

### **Action expected of the Executive Board**

14. The Executive Board may wish to adopt a decision along the following lines:

The Executive Board,

1. Recalling 182 EX/Decision 66 and 35 C/Resolution 32,
2. Having examined documents 185 EX/12 and Add.,
3. Recognizing the vital importance of engineering and technology as core building-blocks of knowledge that underpin and drive sustainable development, poverty reduction, and the internationally agreed development goals (IADGs), and increasing worldwide concern regarding capacity shortages, declining interest and enrolment of young people in engineering, and the adverse effects these trends will have on human and institutional capacity in engineering, and on sustainable development,
4. Highlighting the particular need for human, institutional and infrastructure capacity-building in engineering and technology, especially in developing countries,
5. Considering the need for an international engineering programme as indicated in the questionnaire survey for the feasibility study and the support of principal partner organizations, especially national member organizations of the World Federation of Engineering Organisations and the call from World Engineers Conventions in 2008, 2004 and 2000,

6. Emphasizing that the goals of the international engineering programme are in line with the strategic objectives set out in document 34 C/4 and the Organization's unique mandate in the natural sciences within the United Nations system,
7. Requests the Director-General to make a pertinent proposal to it at its 186th session in the context of her submission of the Draft Programme and Budget for 2012-2013 (Draft 36 C/5), taking into account the discussion by the Executive Board at its 185th session.



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**ADDENDUM**

## ANNEX I

### Report of the Questionnaire Survey for the Feasibility Study

As part of the feasibility study, a brief questionnaire survey was developed for transmission to national engineering organization members of the World Federation of Engineering Organisations (WFEO – a close framework agreement partner of UNESCO). The questionnaire survey consisted of an introductory letter and one-page questionnaire designed to facilitate rapid response. One activity of an approved IEP would be to undertake a more detailed survey regarding engineering indicators, issues and challenges around the world.

Seventeen questions related to engineering in respondents' countries and regions in five areas: (i) main issues facing engineering; (ii) engineering capacity; (iii) engineering industry, infrastructure and applications; (iv) the main value of the proposed international engineering programme; and (v) any other comments. Eighteen national or regional engineering organizations responded to the survey: Australia, Brazil, Bulgaria, China, Colombia, France, Ghana, Germany, Italy, Kuwait, Lebanon, Nigeria, Pacific Islands, the Palestinian Territories, Spain, Tunisia, the United Kingdom and the United States of America. These reflect the six regional electoral groups of UNESCO and both developed and developing countries. Responses were complemented by verbal discussions with other WFEO national member organizations.

Overall findings of the survey indicate strong support for the proposed IEP from engineering organizations around the world, commenting that the proposal for an IEP was very timely in a period of increasing globalization and highlighting the unique position and comparative advantage of UNESCO in being able to bring organizations and resources together in such an important initiative. Many expressed keen interest in working in close cooperation with other national, regional and international engineering organizations.

In terms of the **main issues facing engineering**, issues identified by respondents included a shortage of engineers, high drop-out from engineering courses, the need for better work-based training, limited government support for engineering education and professional regulation, need to attract young people to engineering, problems of brain drain, need to strengthen engineering education and related research and development, effects of economic crisis on engineering, limited employment opportunities, infrastructure and maintenance constraints, need for better engineering standards, need for institutional quality control, need for a long-term approach, need for better public and political awareness and understanding of engineering, need for better engineering application to disasters, sustainable development, climate change, and energy efficiency and conservation. Concerning **how these issues are being responded to** at the national level, the majority of respondents indicated that the response could be improved or was insufficient, with several respondents mentioning examples of response, such as the Excellent Engineer Programme in China.

Many respondents also indicated that while the importance and status of engineering may be high, for example, compared to other professions (but declining in some countries), the **public awareness of engineering** was low in their country, with several engineering organizations mentioning the need for and implementation of such activities as public awareness campaigns, engineering days and competitions. In Italy, a large newspaper and television advertising campaign aimed at public understanding and student recruitment. Other respondents mentioned that the low awareness and perception that engineering is a hard subject discouraged enrolment. The Engineering Council in the United Kingdom reported that recent research indicated that 62% of education professionals, 35% of the public and 30% of 11 to 16 year-olds have seen, heard of or visited something in the past year that presented engineering in a positive or inspiring way, 85% of the public would recommend engineering as a career (66% in 2008), 62% of parents would recommend engineering as a career to their children (56% in 2008), 57% of the public view engineering as a desirable career (49% in 2008), 45% of 16 to 24 year-olds think of engineering as

a desirable career (40% in 2008) and 40% of 7 to 11 year-olds report that they might like to be an engineer (30% in 2008).

On the **emphasis on engineering by government**, most national engineering organizations report that there is some, but in general insufficient emphasis by governments on engineering, often with little understanding of engineering by politicians, a reactive response to perceived problems and little long-term planning. Government emphasis on engineering appears to be increasing, however, and governments are emphasizing engineering in the context of education, policy and planning, standards and regulation, as reported by engineering organizations in China, Germany, Ghana and Kuwait, often where there are more engineers, and/or where there are influential engineers or engineering organizations.

The importance of **statistics and indicators on engineering** was emphasized by most respondents, although most also indicated that statistics are often collected on an infrequent and irregular basis, by statistics offices with limited capacity in this area, with limited reference to industry and employment and significant potential for improvement. One respondent noted the need for modelling on the relationship between engineering and economic development to indicate the importance of engineering in infrastructure and industry. Many noted the need for better indicators on engineering education and employment, especially in smaller countries, and even in higher-income countries; better information- and indicator-gathering, information dissemination, publicity, understanding and response to engineering indicators; and better international classification and cooperation. Several noted the importance of national engineering organizations in the production of indicators. The engineering organization in Brazil noted that out of 150,000 students entering engineering degree programmes, only 30,000 graduate, and that only one in four graduates are considered to have good qualifications – indicating the usefulness of indicators as a forewarning to government.

In the context of **engineering capacity and education**, and the question, “**does your country have enough engineers?**”, almost all respondents reported an overall shortage of engineers and engineering capacity in their countries, with some noting certain areas of engineering, levels of educational attainment (e.g. insufficient numbers of technicians and technologists, especially in certain areas, such as the energy industry), industrial sectors and geographic regions. Some also emphasized that shortages were becoming acute (e.g. as reported by the engineering organization in Germany). Some made particular reference to certain sectors and related industries, for example with some reporting an undersupply of ICT engineers (e.g. as reported by the engineering organization in France), compared to other countries where ICT and related courses are more popular. Several mentioned the need for better long-term planning of engineering and related employment, numbers of engineers required, studies of the changing roles and needs for engineers, emerging areas of engineering (e.g. sustainable, “green” and energy engineering, nanotechnology, bioengineering, disaster prevention and mitigation) and associated employment. Mention was made of the need for better quality as well as quantity of engineers, and need for better monitoring and standards. Some mentioned the problems of brain drain and retention of engineers, often aggravated by limited employment opportunities, and consequent need for employment and job creation. Some also mentioned that the brain drain had been slowed due to the economic crisis, but that this was also limiting capacity for economic development and regeneration.

On the question of whether there **are enough young people enrolling in engineering courses**, and in what areas of engineering, most respondents reported that insufficient numbers of young people were enrolling in almost all fields of engineering. Some reported that enrolment was high in some areas – for example civil engineering in the United States of America, where it was also emphasized that a related issue was not so much how many students enrol, but how many graduate and go on to practice as engineers. Mention was also made that the increasing trend of double degrees in some countries could contribute to a shortage of qualified engineers, as the engineering element may not reach professional standard. Other respondents also mentioned issues of engineering accreditation and quality control.



The above issues are linked to and reflected in **the main issues facing engineering education**, in such areas as educational reform and transformation, curriculum development and accreditation. Engineering education is in transition in many countries, driven by such changes as the Bologna Process in Europe and moves toward similar arrangements in other countries, and the Washington Accord and related agreements regarding accreditation. Some respondents report confusion in this transition, for example relating to “3+2” and Masters degrees, which are as yet often unaccredited, and to continued professional education and associated accreditation. More generally, mention was made of the need for human and institutional capacity-building, need for reform in engineering education (and need for enhanced teaching methods and materials and use of new technology), need for support in this process (on an institutional and individual basis, e.g. with tuition fees), need for continued monitoring and quality assurance (both of degrees and of institutions, especially where there is an increasing number of private universities and colleges), need to address high mid-course drop-out rates from engineering in some countries (e.g. as reported by the engineering organization in Brazil), need for accreditation to promote the mobility of engineers, need for better facilities for teaching and research, especially in lower income countries, and the need to keep up with the ever expanding body of knowledge in science and engineering.

Gender issues in engineering are a concern in many countries, both on grounds of equity and in terms of addressing the shortage of young people going into engineering. In most countries the proportion of women going into engineering is around 15%; an increase in female students will help enrolment in general, and the transformation of engineering. The response to the question, **“are many women going into engineering, what areas and what percentages?”**, was therefore of particular interest. Many respondents confirmed this estimate, with some noting that percentages had declined slightly recently, despite efforts over the last five to ten years to promote women’s enrolment. Some respondents mentioned the difficulties of enrolling women in certain areas of engineering, including mechanical and energy engineering, whereas there is particular interest in bioengineering, computer engineering, environmental engineering and engineering management. Countries reporting higher percentages of women in engineering included Brazil, China, Colombia, France, Italy, Kuwait, the Palestinian Territories, Spain and Tunisia.

In response to the question relating to **issues regarding the mobility of engineers**, several engineering organizations reported flows of engineers in different directions – with some migrating to work in their country, some migrating to work overseas, and some leaving engineering for other employment opportunities (which may be one factor in the drop-out of mid-course and mid-career engineers in Brazil and other countries). Several respondents expressed particular concern at the brain drain of engineers into other career options. In general, there is an overall trend for brain drain from lower- to higher-income countries, and within higher-income countries, particularly to the United States of America. A net loss or brain drain of engineers was mentioned by engineering organizations from Ghana, Lebanon, Nigeria, the Palestinian Territories, and a net gain by Kuwait and the United States of America. There was some mention of restrictions relating to the mobility of engineers by various factors, including accreditation, and to issues regarding the retention of engineers, including the need to develop employment opportunities at home.

Concerning the **engineering industry, infrastructure and applications**, particular issues facing engineering reported by many respondents around the world include low relative salaries, especially from mid-career, and limited investment, especially in innovation and emerging industries and following the economic crisis, which are often reflected in shortages of engineers. The engineering organization in Brazil reports, for example, that Brazil will need to recruit 150,000 engineers by 2012, and is estimated to lose around US \$15 billion per year due to insufficient numbers of engineers for public works projects. The engineering organization in China reports similar issues regarding limited investment in the engineering industry. In other countries other issues mentioned include limited industrial and infrastructure development, lack of planning, corruption, overseas investment and imports that threaten local industry, overseas aid projects with limited local engineering input and limited opportunity for training. Some engineering organizations, including Germany, report no shortage of investment and an optimistic outlook.

On the **mention of engineering applications in such contexts as sustainable development**, respondents report such reference with respect to remediation and life-cycle costing, power, infrastructure and industry projects, project design and management, but report also that greater reference would be beneficial, given the importance of engineering in these contexts. Investment in energy, water supply, sanitation and waste management, and new, sustainable technologies and industries such as wind generators and photovoltaics, was also mentioned, and the reduction of such investment following the economic crisis.

The **main value of a UNESCO international engineering programme** was perceived by many respondents to include cooperation, the sharing of information and experience, learning and teaching methods and materials, technology transfer and innovation, staff and student exchange, accreditation and transformation. An emphasis was made on the role that such a programme could play as an honest broker between countries (North-South, South-South and North-South-South), regional and national engineering organizations to promote intercultural cooperation and awareness of the role of engineering in addressing the major problems facing the world (such as the Daimler-UNESCO Mondialogo Engineering Award). Several respondents observed that such a programme should promote the sharing of information and experience, organizing of short courses and mentoring for training and capacity-building, especially relating to standards and regulations in developing countries.

In terms of **what issues an IEP should focus on**, many respondents indicated a preference for education, training and capacity-building, standards, accreditation and mobility, sharing information and research, engineering applications and innovation for sustainable social, economic and infrastructure development and poverty reduction, engineering policy and planning, sponsoring and facilitating exchanges between developing and developed countries. **Activities that an IEP should undertake** in order to address these issues include the publication of exemplar teaching materials and curriculum development, research support and cooperation, promoting access to information, staff and student exchange and mentoring for hands-on experience through the web, teleconferences, seminars and conferences, engineering infrastructure, promoting public and policy awareness of engineering and engineering applications, for example for reducing poverty and promoting quality of life. For **other ways an IEP can help international organizations strengthen engineering**, many respondents emphasized a key role for an IEP at UNESCO in developing partnerships and networks between national and international organizations and agencies to assess and address needs, sharing information on education and training, research and development, innovation, promoting international standards, public and policy awareness and advocacy, supporting cooperative programmes, projects and activities and improving the mobility of engineers to help international and national organizations strengthen engineering around the world.

In response to the request for **any other comments**, engineering organizations reiterated their strong support for the proposed IEP, noting that the proposal for an IEP was very timely in a period of increasing globalization and need. The particular need to attract young people to engineering, facilitate mobility and promote engineering in industry and infrastructure, promote engineering applications for development in lower-income countries and develop statistics and indicators to better understand and apply engineering to the pressing issues that the world faces today and tomorrow, were emphasized by most respondents. Many respondents also emphasized the need to encourage and strengthen engineering and the engineering community, and public and policy awareness to address these issues. Many respondents also expressed thanks for the proposed IEP and the hope that the programme would become a reality to help strengthen engineering around the world. A specific need for a better understanding of how civil infrastructure in the future will be designed, built and operated in accordance with environmentally sustainable economic and social development to cope with continued population growth, especially in urban areas, was identified.

In terms of programme organization, the unique position and comparative advantage of UNESCO in being able to bring organizations and resources together was highlighted, and many expressed

strong support for working in close cooperation with national, regional and international engineering organizations. One respondent observed that UNESCO and an effective IEP could act as a forum to bring together the United States of America, China, India and other countries to explore viable paths forward for the challenges facing us all. Several respondents indicated that they would be happy to make information and teaching materials available to the IEP for use in professional development, sustainable development, the promotion of engineering ethics and good practice in all areas of engineering. Others expressed enthusiasm at the prospect of working with the IEP in helping promote the needed transformation of engineering education around the world. In view of the importance of engineering, several respondents mentioned the need for enhanced regular programme resources, both human and financial, extrabudgetary support and effective programme governance, as indicated in one remark that the IEP should be managed as a separate unit reporting directly to ADG/SC.

## ANNEX II

### Outline proposal for the international engineering programme

#### International engineering programme

*Engineering education, capacity-building and applications to address poverty, sustainability and climate change*

#### Overview

This concept paper outlines the proposal for the establishment of an “international engineering programme” at UNESCO. The main goals of the programme are to promote engineering education, human and institutional capacity-building and applications to address the United Nations Millennium Development Goals (MDGs). This proposal is a response to the calls from Member States at the UNESCO Executive Board meetings and General Conferences in recent years regarding the need to strengthen engineering around the world, through a strengthened engineering programme at UNESCO. The international engineering programme would complement and reinforce related efforts to develop engineering, and is the focus of the proposal to produce a “Feasibility study by UNESCO for the establishment of an International Engineering Programme” that was adopted and approved at the UNESCO Executive Board and General Conference (182 EX/66 and 35 C/62) in September and October 2009, with the recommendation that UNESCO conduct and submit a comprehensive report to the Executive Board at its 185th session (autumn 2010). The proposal was made by South Africa and endorsed by 31 Member States.

The development and application of knowledge in engineering and technology underpins and drives sustainable social and economic development. Engineering and technology are vital in addressing basic human needs, poverty reduction and sustainable development and in bridging the “knowledge divide”, and promoting intercultural dialogue and cooperation. At the same time, however, engineering and technology are often overlooked in the development context, and there is increasing concern around the world regarding the number of young people, especially young women, going into engineering. This will have a serious impact on capacity in engineering, and on poverty reduction, sustainable development and the MDGs in developing countries.

The overall focus, vision and mission of the proposed international engineering programme is to promote and strengthen the development of engineering education, human and institutional capacity-building in engineering, and the application of engineering and technology to poverty reduction, secure and sustainable development and the MDGs, with particular reference to such issues as climate change mitigation and adaptation and associated information, statistics and indicators. The programme will work in close interdisciplinary cooperation with other programme sectors and field offices of UNESCO, in partnership with the public and private sectors, professional bodies and NGOs, particularly the World Federation of Engineering Organisations and its national members. The programme will complement the International Basic Sciences Programme (IBSP) at UNESCO. The programme will strengthen regular programme activities in engineering at UNESCO with extrabudgetary support.

#### UNESCO and the international challenge for engineering

The vital importance of engineering and technology has been emphasized at meetings and reports of the United Nations, G8, G20, the African Union and NEPAD, the Johannesburg World Summit on Sustainable Development (WSSD) in 2002, at the WFEO World Engineers Conventions in 2000 (Hanover, theme: “Humanity – Nature – Technology”), 2004 (Shanghai, theme: “Engineers Shape the Sustainable World”), 2008 (Brasilia, theme: “Engineering: Innovation with Social Responsibility”), and the forthcoming WEC in 2011 (Geneva, theme: “Engineers Power the World”) and the World Conference on Science in 1999.

A key challenge for engineering is why young people around the world are turning away from engineering and how this may be understood and addressed, and how best to promote the public understanding of engineering. Related to this is the need for reform in engineering education to encompass wider social and ethical concerns, gender sensitivity and activity-based learning. The main applications challenge relates to how engineering and technology may most effectively be applied and innovated to reduce poverty and promote sustainable development. It is apparent that these two challenges are linked to a possible solution – many young people and student engineers are keen to address international issues, especially poverty reduction and sustainable development. This is reflected by the interest in such activities as the award-winning Daimler-UNESCO “Mondialogo Engineering Award”, the continuation of which is included as part of this programme. To promote engineering and attract young people we need to emphasize these issues in teaching curricula and practice. We also need better and more disaggregated information, statistics and indicators on engineering education, employment, research and development, applications and innovation in many countries.

Programme activities will include the development, production and sharing of information and indicators, advocacy, policy, planning and advisory services, the publication of learning and teaching materials, curriculum development and delivery, continuing education, distance and virtual learning (using the programme portal). The programme will promote the development, transfer, exchange and application of knowledge and innovation through international networking, cooperation and partnership. There will be specific reference to the role of engineering in poverty reduction, sustainable development and climate change mitigation and adaptation, promotion of gender equity and empowerment of women and developing global partnerships for development. Key activities will include the development of the UNESCO report on engineering (with WFEO), the “Engineer’s Charter” and Code of Ethics for Engineers, and development of an “International Engineering Award”.

### **“International Engineering Award”**

The proposal for an “International Engineering Award” is based on the “Mondialogo Engineering Award”, part of the award-winning Daimler-UNESCO Mondialogo partnership. From 2003 to 2010 the “Mondialogo Engineering Award” brought together 10,000 student engineers from 94 countries to develop, prepare and submit project proposals focused on the United Nations MDGs, poverty reduction and sustainable development, climate change mitigation and adaptation. The Mondialogo project has itself won several awards and has established a reputation and benchmark for the promotion of international cooperation and intercultural dialogue among young people, raising awareness of the role of engineering in international development. As Daimler cuts back on corporate sponsorship, UNESCO is keen to develop this project as part of this proposed international engineering programme.

### **Engineering education, human and institutional capacity-building**

Living in increasingly globalized, knowledge-based societies, capacity in engineering and technology is ever more essential. Capacity-building must be seen as part of a process, rather than an end in itself – including specific activities, broader issues of education and training, and organizational and institutional capacity development. Programme strategy to promote engineering education, and human and institutional capacity-building will focus on the need to develop and strengthen the following areas:

- engineering education, training, research and professional development;
- standards, quality assurance and accreditation;
- curricula, learning and teaching materials and methods;
- engineering research and development and innovation;
- distance and interactive learning (including virtual libraries and universities).

There is particular interest in the transformation and reform of engineering in such areas as problem- and project-based approaches to engineering education curricula and pedagogy. Problem-based approaches are seen as an important component of promoting interest in engineering education, and need to be linked to the UNESCO Chair in this field and related network.

The programme also recognizes the increasing need to develop capacity and apply engineering in emergency and disaster response, relief, prevention and management. Engineering plays a crucial but often under-recognized role in dealing with emergencies, disasters and post-conflict situations. In the short term, engineering-related needs include the immediate provision of food and water, sanitation, shelter, security and emergency health services. These needs are followed in the medium term by reconstruction, broad public health management and putting people back to work. Longer-term needs include broader social and economic development issues and poverty reduction. To facilitate activity in this area, the programme will develop linkages with international agencies active in these fields and form partnerships with NGOs such as Engineers Without Borders/Ingénieurs Sans Frontières (EWB/ISF), Registered Engineers for Disaster Relief (REDR) and the Disaster Relief Network. In this context, this programme includes a proposal for an “International Forum on Engineering in Emergencies and Disasters”.

### **Engineering applications for poverty reduction, sustainable development and climate change**

Poverty relates primarily to the limited access of poor people to the knowledge and resources with which to address their basic human needs in: water supply and sanitation, food production and processing, housing, energy, transportation, communication, income generation and employment creation. Engineering and technology can enable people living in poverty to address their basic needs and promote sustainable livelihood development. Programme activities will focus on promoting access to and applications of engineering and technology for poverty eradication and improving innovation systems through applied research, development and sharing of information and associated capacity-building. People living in poverty are often more exposed to emergencies and disasters, and there is an important role for engineering and technology in emergency and disaster preparedness, mitigation and response.

Engineering knowledge and technology already exist to make significant progress towards poverty reduction, sustainable development and the other MDGs, climate change mitigation and adaptation. This needs commitment, application and innovation. Climate change is happening and there is an urgent need to switch to clean and efficient technologies to reduce global warming. The proposed programme will join with UNESCO's intersectoral efforts to address climate change, including:

- climate change mitigation and adaptation;
- water supply and sanitation;
- cleaner production and recycling;
- energy efficiency and conservation, and renewable energy;
- disaster preparedness and response, including urban security;
- post-disaster and post-conflict restoration, rehabilitation and reconstruction;
- engaging engineers in decision-making, policy-making and planning.

These activities relate to various areas of engineering, including mechanical, civil, electrical and electronic, and chemical engineering; and also to several thematic areas of engineering: water engineering, environmental engineering, energy engineering, engineering and emergencies, and engineering policy, planning and management.

### **Related issues for engineering**

Related and broader issues for engineering in which the programme will be active include the need to develop:

- public understanding of engineering and technology;
- information and communication, statistics and indicators on engineering;
- women and gender issues in engineering and technology;
- engineering ethics and codes of practice;
- inter-university and institutional networking and cooperation;
- engineering and technology policy and planning to promote the above.

There is a particular need to promote the public understanding of engineering, which links to the need for enhanced information and communication and the need for better statistics and indicators on engineering. Women and gender issues also relate to broader considerations of social participation in engineering, the role of engineering in society and associated ethical issues. This will be facilitated by partnerships, networking, policy and planning.

### **Programme activity, implementation and organization**

To facilitate activity in education, training and applications, the programme will develop linkages and form partnerships with governmental agencies, universities and education institutions, international organizations (United Nations organizations and international financial institutions), and non-governmental organizations around the world. Partnerships with NGOs would include WFEO, the International Council of Academies of Engineering and Technological Sciences (CAETS), Engineers Without Borders (EWB/ISF), Engineers Against Poverty, Engineers for a Sustainable World (ESW) and Registered Engineers for Disaster Relief (REDR). Programme partnerships will include the exchange of knowledge and personnel through networks of excellence to strengthen capacity in developing countries for poverty reduction and sustainable development, as well as the capacity of UNESCO to assist in this process.

The programme will include various types of delivery mechanism or “modalities” of activity. This includes the development and publication of information and learning materials, videos and CD-ROM, curricula and teaching methods, in tertiary and continuing education. Surveys, studies and applied research will help generate statistics and indicators for information and advocacy, advisory services, engineering policy, monitoring and evaluation. Conferences and symposia, workshops, seminars, expert meetings and related training activities will facilitate dissemination, discussion and the development and implementation of programme activity. The use of ICTs will facilitate and enhance networking, distance and open learning, virtual meetings and conferences, multimedia information and training materials.

The international engineering programme would be based in and part of the Basic and Engineering Sciences programme of the Natural Sciences Sector of UNESCO, work closely with and complement the International Basic Sciences Programme (IBSP) and other programme sectors of UNESCO in education, social sciences, culture and communications, and activity in field offices. The programme will require the development of human and extrabudgetary financial resources in the engineering sciences and technology for development within UNESCO, and strong partnership with national and international organizations in the engineering community. The programme will have an advisory board consisting of members of the international engineering technology and development communities. Depending on the programme and budgetary options, the programme will require at least three core professional and support staff, and decentralized professional and support staff, complemented by seconded professional staff, consultants, fellows and interns.

The programme will work in close cooperation with governments and the private sector, professional bodies and NGOs, especially WFEO and WFEO national members. The programme would complement and reinforce efforts to develop cross-sectoral activities in technical capacity-building at UNESCO (171 EX/Decision 59, 2005) regarding the strengthening of engineering and the previous related proposal (30 C/DR.94, 1999) regarding a world network of technological universities, and an Arab Satellite University for Science and Technology, asset and reliability management and promotion of a “culture of maintenance”.

### **Overview work plan and budget**

The international programme for engineering is proposed with a six-year cycle of activity. Demonstration overview work plans and budgets for programme and budgetary options are available on request.