INTERNATIONAL COMMISSION FOR OPTICS
COMMISSION INTERNATIONALE D'OPTIQUE

ICO

The place where the World of Optics meets

Strategic Plan

2017 – 2023

Draft 4 April, 2017

- This strategic plan has been developed by the ICO Executive Committee with the participation of Maria L. Calvo (former ICO President) and Pierre Chavel (former ICO Secretary General) in order to provide a disciplined approach to the management of ICO over the period 2017-2023.
- *Contact details*: ICO Secretariat, http://e-ico.org/

ICO - International Commission for Optics

Founded in 1947, the International Commission for Optics (ICO) is a non-governmental organization representing a global membership in optics and photonics that includes national scientific bodies (53 Territorial Committees) and seven International Member Societies/Networks. Through this international network of scientists and engineers, the ICO promotes interdisciplinary research to address major issues of relevance to science, education, and light-based technologies with a major activity in developing countries. In addition, the Commission actively promotes initiatives for scientific and training activities, and facilitates science education and capacity building [www.e-ico.org].

Suggested citation: ICO (2016). ICO Strategic Plan, 2017-2023. International Commission for Optics, Paris.

ISBN-13: 978-0-9838507-4-8

Foreword

Since its inception in 1947, the ICO has served the international community of optics and photonics by fostering an exchange of information through scientific events, publications, topical schools, and technical committees with emphasis on the developing world. We contribute toward the development of the science and technology of optics and photonics as well as its application for scientific and societal purposes.

The ICO recognizes distinguished professionals in optics and photonics with three annual awards: the ICO Prize, the ICO Galileo Galilei Award, and the ICO/ICTP Gallieno Denardo Award. As of 2005, the ICO also administers the IUPAP Young Scientist Prize in Optics.

The ICO actively promoted the application of the International Year of Light through IUPAP and ICSU, essential steps on the way to securing the support of the UNESCO Executive Board. In the final stage ICO asked its Territorial Representatives to seek the support of their ambassadors to the United Nations for IYL. Three of the International Society members of the ICO were funding partners of the IYL, and the ICO endorsed the initiative jointly with IUA, IUPAP, URSI, IUTAM, IUPAB, ISPRS, IUHPST, and the two international councils for science, ICSU and ISSC.

The ICO structure has always been similar to that of the ICSU Union, consisting of 53 Territorial Committees, originally named National Committees, and 7 International Member Societies. The Territorial Committees have the mission to be representative of optics and photonics activity in a given geographical territory and to support its total financial independence. The ICO is currently a Scientific Associate of ICSU and an Affiliated Commission of IUPAP.

Optics and photonics have been identified as a key science and technology for addressing the challenges of society in the 21st century. Optics and photonics have primarily been based on physics however, many other disciplines have evolved and are now deeply connected such as mathematics, geodesy, chemistry, biology, art, and engineering.

To further our contribution to the evolution of human society and culture, we believe there is a need to scientifically expand optics and photonics by emphasizing the interaction with these disciplines. In light of this, the ICO is now in the process of applying to become a scientific union. We ask all scientific communities to recognize the significance of optics and photonics and to support the ICO to become one of the ICSU union members.

Yasuhiko Arakawa, ICO President, 2014-2017

Table of Contents

Introduction and Background

The Strategic Planning Exercise

The purpose of strategic planning is to set overall goals for a business, organization, or institution and to develop a plan to achieve them. It involves asking where the institution is, in what direction it should be headed, and what its priorities should be. Strategic planning is intended to accomplish three important tasks:

1. to clarify the outcomes that an organization wishes to achieve;
2. to select the broad strategies that will enable the organization to achieve those outcomes; and
3. to identify ways to measure progress.

The following *ICO Strategic Plan 2017-2023*, **presented in draft form**, is intended to serve that purpose and to provide a roadmap for strengthening ICO's international organization competencies in the development and expansion of Optics and Photonics. Particular emphasis is placed on special programs for young scientists; entrepreneurship; sponsorship of local, regional and international activities; and in general to offer services to the world Optics and Photonics community as a non-profit organization with particular focus on the underdeveloped regions of the world.

Authors of this document include the current members of the ICO Executive Committee—Yasuhiko Arakawa, ICO President (term 2014-2017); Duncan Moore, ICO Past President; Angela M. Guzman, Secretary General; Gert von Bally, Associate Secretary; James H. Harrington, Treasurer—and, in addition, Maria L. Calvo, former ICO President (term 2008-2011) and Pierre Chavel, former Secretary (1990-2002). We gratefully acknowledge the administrative assistance of Alana Cahoon.

A strategic plan is a living, evolving document. It is expected that the ICO strategic plan will be reviewed and updated on a regular basis.

The timing of the preparation of this document coincides with the application of the ICO to the International Council for Science (ICSU) for change in status, from that of Affiliated Commission of the International Union of Pure and Applied Physics (IUPAP) and Scientific Associate of ICSU to full Union status.[1]

Early Objectives of the ICO and their evolution

At its founding in 1947, because of the priorities of the optics industry immediately following World War II, the ICO had as its principal objectives the study of optical theory, the theoretical study and construction of optical instruments, and the physiological optics of the eye. The scope of research in Optics and Photonics has grown immensely since the discovery of the laser in 1960, and numerous research contributions and technology breakthroughs have originated in disciplines other than physics. We now consider Optics and Photonics to be a transdisciplinary area of science and technology linked to the development of the global economy. As an example, the Optics and Photonics program of the National Science Foundation of the USA involves Astronomy, Chemistry, Materials Research, Mathematical Sciences and Physics, but also several engineering disciplines: chemical, bioengineering, environmental and transport systems, electrical, communications and cyber systems. It also involves the divisions of Biological Infrastructure, and computer and Network Systems. Optics and Photonics play a key role in improving the well being of the world's people.

Membership

Currently the ICO has 53 Territorial Committee Members, geographically distributed over the five Continents representing every country with any significant activity in optics. Africa is one such member and is comprised of 20 countries. The ICO is an inclusive organization. In many cases the ICO has helped local communities from less developed countries to create their own ICO Territorial Committee and become active members of the international community. ICO and ICTP started the Winter College in Optics earlier in 1993. Since then, the College is organized annually with a high quality selection of key topics, lecturers and laboratory activities. A listing of the number of scientists included in ICO, as an approximation has been prepared. See Appendix I.

The ICO has three categories of Members.

i) Territorial Committee Members, representing identified optics communities in a set of non-overlapping geographical areas.[2]

ii) International Society Members[3]. Such members are membership organizations active in the field of Optics and Photonics on an international level. There are currently Society members: OSA (the Optical Society), SPIE (The International Society for Optics and Photonics), IEEE Photonics Society, EOS (European Optical Society), LAM (African Laser, Atomic and Molecular Physics Network), OWLS (International Society on Optics Within Life Sciences), RIAO (The Iberian-American Network on Optics).

iii) Associate Members. The Commission may also accept organizations active in Optics and Photonics as Associate Members. Associate Members pay no dues and have no voting privileges. Application for all categories of membership shall be made to the ICO Secretary and submitted to the next General Meeting for approval.

Leadership

The leadership and executive functions of the ICO resides with the ICO Bureau. The Bureau consists of the Executive Committee (the ICO President, Immediate Past-President, Secretary General, Associate Secretary, and Treasurer), the IUPAP representative, and fifteen additional members, traditionally known as Vice Presidents.[4]

Committees of the ICO Bureau include (a) the Regional Development Committee, which looks for ways to assist optical scientists and engineers in developing countries through the exchange of information with joint organization of schools, often in collaboration with the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy; and (b) the Education Committee, which coordinates the various activities oriented to the education and training in Optics and Photonics (ETOP) in collaboration with international societies members such as IEEE, OSA, and SPIE.

ICO Bureau 2014-2017	Bureau member	TC/member society
President	Prof. Yasuhiko Arakawa	Japan
Past-president	Prof. Duncan Moore	USA
Secretary	Prof. Angela M Guzman	Columbia
Associate Secretary	Prof. Gert von Bally	Germany
Treasurer	Prof. James A Harrington	USA
Vice-president elect Those in industry are marked with an *	Prof. John Harvey*	New Zealand
	Dr Franz Holler*	Germany
	Prof. Humberto Michinel	Spain
	Prof. Joseph Niemela	USA
	Prof. Seung-Han Park	South Korea
	Prof. Roberta Ramponi	Italy
	Prof. Jakub Zakrzewski	Poland
	Prof. Mourad Zghal	Tunisia
Vice-president appointed	Prof. Kent Choquette	IEEE
	Prof. John C Howell	OSA
	Prof. Stephan P. Morgan	OWLS
	Prof. Eric Rosas	RIAO
	Prof. Paul Urbach	EOS
	Prof. Ahmadou Wague	LAM Network
	Prof. Maria Yzuel	SPIE
IUPAP Exec. Council delegate	Prof. Carmen Cisneros	

SWOT Analysis

An analysis of an institution's strengths, weaknesses, opportunities, and threats often precedes strategic planning. A SWOT analysis was initiated in 2011 under the leadership of D. T. Moore. Results of that analysis include the following.

Strengths

1. ICO is a truly international organization, and offers the best opportunities for the representation in Optics and Photonics on a global level.
2. It is fully represented at the national level by its Territorial Committees (TCs). Together with the International Society Members, the ICO offers a friendly and motivating international atmosphere for research in Optics and Photonics and its applications.
3. The ICO is recognized and respected throughout the world for its sponsorship and endorsement of topical meetings, international conferences, and schools.
4. Among the member societies are the leading publishers of scientific literature and advances in Optics and Photonics.
5. ICO has strong relations with ICSU, under its current status as Scientific Associate, and with IUPAP, as an Affiliated Commission. ICO continues to establish ties of cooperation with other ICSU Scientific Associates and Unions.

6. ICO has a good relationship with UNESCO through ICTP. ICO has served in the Trieste System in Optical Sciences and Applications Advisory Group (TSOSA), established in 2006 with the purpose to offer advice on the development and coordination of activities in Optics and Photonics carried out or planned by the Trieste System. The committee was initially established with representatives of ICO, OSA, SPIE, OWLS, IAEA, UNESCO, TWAS, ICTP, the Elettra Synchrotron Facility and the Laser Lab at Elettra. In 2102, the Committee was enlarged to include representatives of the US National Academy of Sciences and the African LAM Network. The TSOSA elected the ICO Secretary as its Chair since its inception. Former ICO Secretary, Pierre Chavel was Chair of TSOSA during the period 2006-2008. Since then A. Guzman, the current ICO Secretary has chaired the TSOSA, by election of its members. ICO officers have provided the ICTP with expert advice and international contacts to help maintain the high scientific standards of the ICTP Winter College on Optics, and more recently to include hands on activities in the College, with equipment accessible to researchers from developing countries, which have been highly appreciated by the students. The ICO and the ICTP established in 2000 the International Award known today as the ICO/ICTP Gallieno Denardo Award for significant contributions in Optics and Photonics. Which recognizes the work of young researchers from developing countries who are active in optics and photonics research and have contributed to the promotion of research activities in in their own or another developing country. In September 2007, the ICTP and ICO agreed to dedicate the Award to the memory and legacy of the late Prof. Gallieno Denardo, who greatly contributed to the development of optics research within ICTP and in developing countries. The contact with UNESCO extends to the ALOP programs (Active Learning in Optics and Photonics) particularly in the Latin-American region. While ICSU has no specific signed programs with UNESCO, the future union, under provisional name of IUOP (International Union for Optics and Photonics) may contribute to provide these links in the forthcoming ICSU-ISSC merged organization.
7. ICO is not structured into individual members but into Territorial Committees (TCs) and International Society Members. The ICO TCs are official representatives of the Optics and Photonics community in identified geographical territories. There are no restrictions to membership, creating a large diversity of geographical representatives.
8. It conforms an open forum allowing the opportunity to meet researchers and educators in Optics and Photonics from all over the world.
9. The work of the ICO through its TCs is complementary to the work of the International Society members. The ICO serves to promote and spearhead the organization of Optics and Photonics communities in different territories, and the International Society members provide benefits to the individuals in those territories, with emphasis on creating local and student chapters.
10. The ICO is a 100% volunteer-managed organization. Scientists, academic and professionals drive ICO, not career staffers.
11. As stated by former ICO President Anna Consortini, "ICO is the United Nations of Optics and Photonics." The ICO continually strives to be an international organization for national and international societies in optics and photonics and serves as the sponsor, co-sponsor and/or endorsing for initiatives of those societies into the international diplomatic arena, while maintaining neutrality. For the 2005 International Year of Physics, ICO took part as a member of the International Committee since its inception and as an initiative of the ICO Secretariat. The ICO, in its capacity as Scientific Associate of ICSU and Affiliated Commission of IUPAP, helped move the initiative of an International Year of Light through IUPAP, ICSU, and UNESCO. ICO obtained the support for the initiative of many ambassadors from ICO Territories to the United Nations.
12. Being free from national ties and obligations, ICO can practice advocacy and diplomacy in favor of scientists who have been imprisoned elsewhere for defending scientific freedom and responsibility.

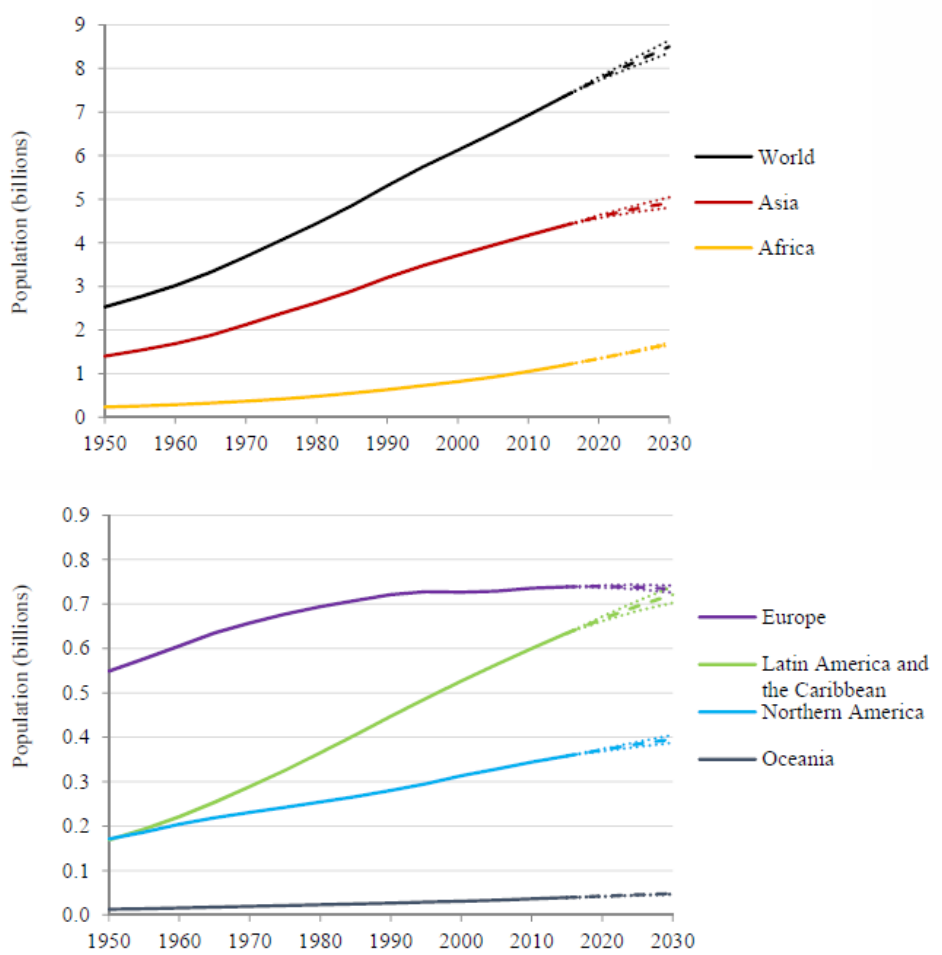
13. The ICO can provide public policy support for research and education activities in Optics and Photonics in developing countries and provide more extended local and regional support for the establishment of national initiatives in Optics and Photonics intended to develop Optics and Photonics industries that contribute to sustainable development and human wellbeing. The USA National Initiative for Optics and Photonics was born within the ICO Territorial Committee of the USA (USAC/ICO), and the Mexican Photonics Initiative within the ICO Mexican Territorial Committee. The latter, launched recently by the Mexican government, will be an integrated effort of the government, academia, and industry.

14. One of the International Society Members of the ICO, the IEEE Photonics Society, consists mainly of engineers, who do research in Optics and Photonics. This constitutes an asset for the ICO for implementing solutions to global challenges.

15. The ICO contributes to bridging the scientific gap between developed and developing countries by promoting international scientific collaboration and through its traveling lecturer program.

Weaknesses

1. ICO governance may not be well situated for major changes in demographics expected in the coming one or two decades (see figure). Relations with ICTP can continue to be strengthened through TSOSA Committee by jointly fostering high level scientific research in Optics and Photonics in developing countries, emphasizing the potential of Optics and Photonics as an enabling science for sustainable development, environmental monitoring, health, etc. , impact programs and interactive means for young scientists on a more extended basis. As to procure a major impact, ICO might fill the lack of appeal to industrial sectors as optical engineers and information scientists. We need more efficient ways of communication and need to increase our marketing



†Dashed line represents the median projection, while dotted lines represent the 95 per cent prediction intervals.
Data source: United Nations (2015). *World Population Prospects: The 2015 Revision*.

2. In some developed countries, ICO lacks major presence, so that ICO is not as recognized and visible as it might be, in part because ICO does not yet participate in a necessary higher number of international research programs aimed at confronting global challenges, although, it tries to be very active to reinforce this issue for the future IUOP (provisional name for the future International Union dealing with Optics and Photonics, the final name to be selected by the ICO General Assembly).
3. Because of its current status as an Affiliate Commission of IUPAP, the ICO cannot achieve its full potential within ICSU as a source of scientific expertise in light-based technologies for the development and implementation of environmental, sustainable development, and human health policies.
4. ICO's financial model is at present ill suited to its mission. Although there is strength in having a volunteer-run organization, it presents a great amount of work. Funding is needed from governments, industries, or through international research programs. Currently, the fees from Territorial Committee Members generate ICO's only funding source. To add an insight to the financial model there is an Annex at the end of the document showing the current budget as approved by the last GA 2014 (see page 17).
5. Demographic data indicate that in 2030 most of the population in developing countries will be young people in their stage of scholar and academic formation. The ICO may then need to continue

offering opportunities appealing to members of developed countries without losing focus on critical regions like Africa, Latin America, and less developed Asian countries.

6. Although two of eight ICO elected Vice Presidents should come from Industry, the connection between the ICO and industry needs to be improved. Optics and Photonics must be considered in the context of its dramatic technological development over the past half-century.

Opportunities

1. **Source of reviewers and articles on Optics and Photonics:** Create a group of peer review volunteers for Optics and Photonics articles in Wikipedia, or a collection of such articles in an Optics and Photonics Wikipedia for the general public.

2. **Science for policy:** Help replicate initiatives like Photonics 21 (Europe), the USA Photonics initiative, Horizon 2020, etc., in less developed countries with the aim to help solve local problems and contribute to regional sustainable development. A step in that direction was the Mexican Photonics Initiative.

3. **Sustainable energy:** Continue work in the sustainable energy area. The ICO has already held workshops on Optics and Energy. During the International Year of Light a large consortium of scientific bodies raised awareness of the ways that light-based technologies can provide solutions in the areas of energy, education, agriculture, health and wellbeing. "Study after Sunset" was one of the Programs of the International Year of Light 2015 which promoted the use of portable solar-powered high brightness LED lanterns in regions where there is little or no reliable source of light. Solar energy is becoming cost accessible for use in residential, commercial, agricultural, and even rural areas. Scientific and technological advances have been driven by Optics and Photonics, as well as by solid-state physics, thermal science, materials and chemistry. It provides a great opportunity to create a cluster of Unions within ICSU devoted to the search for the next generation technologies for solar energy conversion, widely accessible and reliable.

4. **Science education:** To further contribute to Science education and motivation of young minds towards scientific research. The ICO has experience in education activities at different levels and, in association with several of the International Society Members, holds regularly an international conference on Education and Training on Optics and Photonics. Given the wide range of applications of Optics and Photonics research, the ICO has also been involved in workshops on entrepreneurship for scientists and engineers, and some Territorial Committees have organized exhibits in museums. There is a main concern inside ICO for enhancing working in developing areas of the world, in which the technological gap is more evident than in other highly developed regions. The ICO could seek funds from funding agencies like the African Development Bank, World Bank, USAID, UNIDO and UNESCO for education and entrepreneurship programs aimed at young scientists.

5. **Union Status within ICSU:** ICO is now preparing the application to ICSU to become a Union: with the provisional name of International Union of Optics and Photonics[5] (IUOP is, in fact just one of the possible names to be considered by the General Assembly for its decision). Becoming a Union will open possibilities of direct interaction with other Unions on specific projects that require a multidisciplinary perspective, including engineering and biological sciences. A Union of Optics and Photonics has great potential to contribute to ICSU Programs with a multidisciplinary perspective and can facilitate greater effectiveness for ICO in its programs and activities.

Threats

1. The risk of isolation from the broader international scientific community because of its role as an appendage to IUPAP. One of the main roles of the ICO, to provide an international environment for optical sciences, has been diminished and needing a strong adaptation due to the vertiginous advance of communication technologies and other emerging technologies. There is then a need to enlarge its own community projection and actively join the international community of scientists, inside ICSU organization, confronting global challenges and influencing public policy as expected from a union input.
2. The second biggest threat is its financial model, which is limited to member fees. In this Strategic Plan there is included at the end of the document (see page 18) an Annex with data considerations of the current budget handled by ICO.
3. A lack of participation of early career scientists in ICO activities and governance might lead to succession problems and reduced impact in the future. ICO considers to work inside an education environment and with a projection in less developed regions of the world, while enhancing those key activities in more industrialized countries.
4. A lack of efficient and modern communication may hinder the ability to motivate and facilitate the active participation of all of its members in future programs.

Mission

The mission of ICO is to contribute, on an international basis and wide geographical representation, to the progress and diffusion of knowledge and applications in optics and photonics for the global benefit of mankind. Thus, enhancing an international cooperation.

Vision

The vision of the ICO is to be an international scientific and engineering forum, inside ICSU, engaged on sharing knowledge and expertise in Optics and Photonics that contribute to a global sustainable development and economic growth. Main activities and objectives associated to this vision are:

i) to contribute on an international basis to the progress and diffusion of knowledge in Optics and Photonics;
ii) to promote and facilitate research and other scientific and engineering activities in Optics and Photonics that involve international, interdisciplinary collaboration;
iii) following ICSU current policy, to reinforce the transdisciplinary nature of Optics and Photonics and support the establishment of new cross-disciplinary education curricula;
iv) to promote and support policy advocacy actions by national members and the international member societies;
v) to encourage a balanced geographical representation and involvement in all activities of the Union;
vi) to endorse and provide academic advice when requested for international Optics and Photonics research meetings and related events such as workshops, summer schools, topical meetings, etc., organized by the ICO territories;
vii) to represent Optics and Photonics in ICSU and liaise with other ICSU bodies as current Unions in which ICO may converge in the near future as the so provisionally proposed International Union for Optics and Photonics (IUOP) by upgrading its organizational structure to the category of a Union.

Values

ICO values include the following:

- A deep respect and appreciation for Optics and Photonics as an enabling science and as a discipline for study
- Excellence and professionalism among its members and the international societies
- Continual progress in the development of Optics and Photonics as both scientific discipline and enabling technology Strong and ongoing international collaborations
- Providing support and visibility to the activities of scientists in developing countries
- Service-oriented attitude
- Engagement in a wide range of select activities
- Providing timely information in optics and photonics to global society
- To connect the world of Optics & Photonics to the social needs and well-being through the support and connections with ICSU and ISSC

Goals and Associated Actions (•)

Short term:

1. Promote the growth of Optics and Photonics as enabling science and technology

    - Support Optics and Photonics initiatives in all countries with emphasis in education of a trained workforce able to use Optics and Photonics devices in health, energy and communications applications. The ICO is aware of the need of involving social scientists in projects in these key areas for sustainable development, in order to warrant their appropriateness to local conditions and needs, the support of local policy makers, and the required appropriation of the involved technologies by locals for their long-term success. The ICO looks forward to collaboration with the ISSC scientist in this regard.

2. Increased interaction between developed and developing countries

    - Contribute to scientific collaboration between developed and developing countries in Integrated Photonics, advanced manufacturing, and non-invasive optical techniques for diagnosis.

    - Balanced geographical representation and involvement in all ICO activities

3. Expansion of research and educational role

    - Contribute to programs that disseminate education in Optics and Photonics in developing countries, with emphasis in low-cost energy sources that could contribute to the *Energy 4 all Program* of the UN, low-cost health diagnosis devices, low-cost food monitoring, and other Optics and Photonics-based technological developments that could help to the achievement of the SDGs.

    - Promote regional research and educational programs in Optics and Photonics and its applications in collaboration with the ICTP.

4. Increased visibility and stature for ICO on the global scale

    - Support and promote policy advocacy actions by national members and international member societies.

    - Become more active in Science for Policy activities.

5. Expansion of role of ICO in international initiatives

    - Contribute in a direct manner to major international research platforms like Future Earth governed by a Council in which members of the Science and Technology Alliance for Global Sustainability participate, including the International Council for Science (ICSU), as well as through thematic clusters with other ICSU Unions.

    - Encourage/promote development of Cluster of energy: ICO (LED illumination, solar energy) + Material research + electrical engineering + environment + chemistry + physics.

    - Encourage/promote Cluster of bio photonics with IUBS and IUPESM.

    - Encourage the role of optics in developing countries with sustainable development, and provide support for national initiatives in Optics and photonics that contribute to sustainable development policies.

Medium term:

1. Increase ICO role in research and education.

    - Build an elected Vice Presidency for research able to write international research proposals for north-south collaboration in areas like human health, renewable energy, etc.

    - Establish the position of VP for education able to create workshops intended for multi-disciplinary teams of natural and social scientists, and engineers, with the aim of solving specific local problems in developing countries, like energy independence, food security, health and disaster risk monitoring.

    - In all the previous mentioned activities ICO may count on the determinant support of the International Society members and the local societies of the TC's.

2. Greater activity in ICSU programs.

    - Participate actively in the procurement of local resources and local political support for the implementation of ICSU programs at the local level.

3. Improved communication and involvement in national policy debates

    - Build a modern communication system that allows supporting or promoting the participation of Optics and Photonics experts in regional Knowledge-action networks

Long term:

1. Stabilization of the ICO

- Stabilize the structure of the Union by establishing part-time permanent staff positions for an Executive Director and a Communication Officer

- Change the U.S. taxation status of the ICO from that of a 501(c)4 organization to a 501(c)3 organization in order that donations made to the ICO can be tax deductible. This change could be done when the ICO is upgraded to ICSU Union status.

2. Prepare for a new role in ICSU

   - Represent Optics and Photonics inside ICSU and liaise with other ICSU bodies as current Unions in which ICO may converge in a near future as the International Union of Optics and Photonics (IUOP)[5] by upgrading its organization structure to the category of a Union

   - Have permanent representation in thematic clusters of Unions involving Optics and Photonics, and serve as communication bridge between researchers and governments on topics related to Optics and Photonics-based technologies

   - Establish a more fluent exchange with the Optics and Photonics community worldwide on topics related to ICSU programs that involve Optics and Photonics. Such system might be implemented through the international Member Societies.

General Strategy

1. Create commissions of experts on the topics to be worked in Union clusters.
2. Improve communication strategy and keep the ICO membership informed of possibilities of participation in ICSU programs.
3. Involve early career scientists and engineers on all commissions.
4. Create an ICO Bureau position for early career scientists and/or engineer.
5. Include in the ICO Bureau liaison members of the Union clusters.
6. Contact with the local key leaders regularly to enhance the global network of ICO

Evaluation

The position of ICO as the international organization that represents the field of Optics and Photonics inside ICSU, including issues and studies on a national and international level, will be evaluated. Key policies need to be defined. All TCs and ICO Bureau members will undertake this task.

Concluding Remarks and Summary

In this Strategic Plan, ICO presents and defines the key items that identify our current objectives, threats, and weaknesses along with information of the structural organization and future changes of our activities and challenges. The plan may be assured by the continuation of our task forces and responsible representatives in the ICO Bureau and the TCs. In these forces we may include as well our current and future partners in the world of science.

The short-term goals for the period 2017-2023 will reinforce ICO stature as an international organization based on national members and international society members for the enthusiastic global promotion and support of Optics and Photonics education and research and facilitate the full integration of the ICO with

those of ICSU Unions and reinforce the representation of the Optics and Photonics community within ICSU, acting as an international scientific and engineering organization engaged on promoting international cooperation on Optics and Photonics and on contributing knowledge and expertise in these areas to global research programs.

The Strategic Planning Committee will recommend appropriate strategies for reaching the goals, the action plan, specific responsibilities for implementing the strategy, a timeline for starting and ending the action, and how the outcome will be evaluated.

ICO is now preparing the application to ICSU to become a Union: to be proposed with the provisional name of International Union of Optics and Photonics (IUOP)[5]. Becoming a Union will open possibilities of direct interaction with other Unions on specific projects that require a multidisciplinary perspective, including engineering and biological sciences. A Union of Optics and Photonics has great potential to contribute to ICSU programs with a multidisciplinary perspective. This is especially true with the approaching merger of ICSU and ISSC. Optical scientists and engineers need guidance from social scientists to understand the needs of the communities. To effectively contribute toward the sustainable goals of developing countries, we understand the value of this collaboration. ICO is aware of the social impact that social scientists, engineers, architects and artists brought to the International Year of Light, awakening the awareness of the society on the relevance of Optics in Photonics in our lives. The ICO anticipates an open dialogue with social scientists. We further notice the importance of becoming a union to overcome some of the threats mentioned in the SWOT analysis. In this period, ICO has to connect with ICSU Unions, starting collaborations and defining specific clusters within the science world, not restricted to physics but extended to chemistry, biomedicine, biology, acoustics, astrophysics, and other relevant fields.

Among these ICSU Unions, ICO may maintain its natural links with IUPAP. Inside the future ICSU skeleton as merged with ISSC as a unique organization, the future International Science Council, ICO could remain a part of IUPAP structure under the current Affiliated Commission status. Meanwhile, the future IUOP may be created as a separate body of which ICO would be a member (similar cases already exist within the ICSU structure). It will then create and enhance links to general ICSU-ISSC programs and networking with all Unions dedicated to science and technological world, and, in addition with those involved in policies for wellbeing society.

ICO should actively participate in the major ICSU project Future Earth and bring awareness of the relevance of Optics and Photonics as enabling science for the many areas of science involved. For example, emerging techniques to monitor climate change and its impact involve new Optics and Photonics technologies.

In the mid and long term ICO will attempt to increase its role in education and research by creating elected Vice Presidencies able to propose and/or collaborate on the development of international projects. ICO will also participate in the procurement of resources for the development of those projects and for its own functioning from local governments and other funding agencies. These actions joined with an active participation in clusters and ICSU Programs are expected to stabilize the ICO and its role within ICSU in the long term.

Predicting economic growth and technological change is very difficult, even over the short term. The ICO should permanently be aware of and follow the changes in the social, economic, and political status of the world to maintain its presence in key territories, and to extend its influence to regions that may emerge as leaders in new technologies.

References

Angela M. Guzman, "ICO is steering its future in Tokyo", ICO Newsletter 97, October 2013.

Eric Rosas, "The Mexican Photonics Initiative", ICO Newsletter, Nr. 109, (October 2016).

John F. Reilly, Carter C. Hull, and Barbara A. Braig Allen, "IRC 501(c)(4) Organizations", *Exempt Organizations-Technical Instruction Program for FY 2003*, IRC, USA.

Juste J.-P. Ngome Abiaga and Pauline Venegas Hooper, "The 2015 International Year of Light", *A resilient and creative approach to counter sustainability challenges.*, ICO Newsletter 106, April 2016.

ICO Triennial Report, *Toward ICO-23*, 2014.

ICSU (2011). ICSU Strategic Plan II, 2012-2017. International Council for Science, Paris.

"Optics and Photonics: Essential Technologies for Our Nation", The National Academies Press (2013).

Population 2030. Demographic Challenges and Opportunities for Sustainable Development Planning, United Nations, New York, 2015.

The International Year of Light and Light-based Technologies 2015. A SUCCESSFUL COMMUNITY PARTNERSHIP FOR GLOBAL OUTREACH FINAL REPORT, UNESCO, 2015.

---

[1] An Affiliated Commission of the IUPAP consists of an independent international committee or organization of **physicists** with its own well-developed administrative structure and with its own members, dues structures, statutes, and assemblies. They assist on implementing IUPAP principles and participate in joint activities. As an ICSU Union, ICO will bring together scientists and engineers from different disciplines and all parts of the world, who contribute to the advancement of Optics and Photonics Science and Technology.

[2] The word "territory" does not imply any political position on the part of the ICO, which seeks to assist scientists in Optics and Photonics everywhere in the world to co-operate on an international level.

[3] In 1999 the ICO created the category of International Society Members to recognize the fact that contrary to the situation in 1947, most international scientific conferences are organized by large societies that have individual members and that are explicitly active internationally. As of today, ICO has seven International Society Members: The Optical Society (OSA) with 20,000 individual members. The International Society for Optics and Photonics (SPIE) with 20,000 individual members, IEEE Photonics Society (6,000 individual members), the European Optical Society (EOS) formed with 21 National Optical Societies in Europe and 6,500 individual members, Red Iberoamericana de Optica (Ibero-American Network for Optics, RIAO) with 7 Iberian-American Societies or national optics organizations (Colombia, Cuba, Ecuador, Mexico, Portugal, Spain and Venezuela), Optics within Life Science (OWLS) with members from 36 countries, and the African Laser, Atomic, Molecular and Optics Science (LAM) Network with 20 African countries. With this structure, ICO has a fair claim to representing the whole field of Optics and Photonics on an international scale.

[4] All members of the Executive Committee, except for the Immediate Past-President, are elected by ICO at the General Meeting. ii) The IUPAP representative appointed by the Executive Council of IUPAP under Article 7b of the statutes of the Union, and any Associate Members from IUPAP Commissions. iii) The other Bureau members, who are traditionally known as Vice-Presidents. Eight Vice-Presidents (at least two of whom are from industry) are elected at the General Assembly by the Territorial Committee Members; in addition, also at the General Assembly, every International Organization Member appoints one Vice-President up to the limit of eight; if there are more than eight International Organization Members, eight Vice-Presidents are elected at the General Assembly by the International Organization Members. The Bureau is responsible for the conduct of the ICO business between

General Assemblies. The term of office of the Bureau is three years from October 1st in the year of the election. The Article Nr. 5 of the ICO Statutes rules the ICO organizational structure and ICO Bureau organization.

List of Acronyms

ALOP	Active Learning in Optics and Photonics
EOS	European Optical Society
ETOP	Education and Training in Optics and Photonics
ICA	International Commission for Acoustics
ICO	International Commission for Optics
ICSU	International Council of Science
ICTP	The Abdus Salam International Center for Theoretical Physics
IEEE	Institute of Electrical and Electronics Engineers
IUBS	International Union of Biological Sciences
IUOP	International Union of Optics and Photonics
IUPAP	International Union of Pure and Applied Physics
IUPESM	International Union for Physical and Engineering Sciences in Medicine
LAM	African Laser Atomic Molecular and Optical Sciences Network
LED	Light Emitting Diodes
MCTP	Mesoamerican Center for Theoretical Physics
O&P	Optics and Photonics
OSA	The Optical Society
OWLS	International Society on Optics Within Life Science
RIAO	Red Iberoamerica de Optica/ Iberian American Network of Optics
SDGs	Sustainable Development Goals
SPIE	The International Society for Optics and Photonics
TCs	Territorial Committees
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations International Development Organization
USAC/ICO	The U.S. Advisory Committee for the International Commission for Optics
USAID	United States Agency for International Development

Annex I

National Societies members of ICO represented in the ICO Territorial Committees[6]

- *Academia Mexicana de Óptica* (Mexican Academy of Optics). 2,700 members.
- Armenian Territorial Committee of ICO. 38 members.
- Australian Optical Society. 300 members.
- Brazilian Territorial Committee. 252 members.
- Canadian Territorial Committee. The order of 300 individual members.
- Chinese Optical Society. The order of 15,000 individual members (corporative members are not considered).
- Colombia Territorial Committee (*Sociedad Red Colombiana de Óptica* data). 500 members.
- Cuban ICO Territorial Committee. 50 members (this number includes PhD students).
- Czech and Slovak Committee for Optics and Photonics (unavailable data).
- Danish Optical Society (unavailable data).
- Ecuador (*Sociedad de Óptica y Fotónica del Ecuador*). 29 members.
- Estonian Territorial Committee of ICO (Optics Section of the Estonian Physical Society). 30 members.
- Deutsche Gesellschaft für Angewandte Optik (DGaO, German Society for Applied Optics), the *Fachverband Quantenoptik und Photonik der Deutschen Physikalischen Gesellschaft* (Quantum Optics and Photonics Division of the German Physical Society) and the OptecNet (German (Industry) Competence Network on Optical Technologies). Estimated individual members: 3,840.
- Greece (unavailable data).
- Indonesian Optical Society. 73 individual members
- Institute of Physics in Ireland. 600 optics researchers/workers (MSc/PhD students, post-docs, academic staff, and industry).
- Institute of Physics (IoP, UK). Of a total of 41,000 members (including staff) it was estimated a 5% for UK individual members: the order of 2,000 members.
- Israel Territorial Committee. 400 members (this number includes PhD students).
- Iran Territorial Committee (Optics and Photonics Society of Iran). 1,200 members.
- Italian Territorial Committee (Consiglio Nazionale delle Ricerche). 250 individual members.
- Japanese Territorial Committee (Science Council of Japan). 2,000 individual members.
- Korea Territorial Committee (Korean Optical Society). 2,000 individual members.
- Latvian Optical Society. 20 members (data provided by EOS).
- New Zealand Territorial Committee (Dodd-Walls Centre for Photonic and Quantum Technologies). 100 individual members.
- Norwegian Territorial Committee (link provided by EOS) (unavailable data).
- Photonics and Optics Division, Argentinean Physical Association. 300 members.
- Photonics Finland. 240 members (data provided by EOS).
- Polish Territorial Committee. 300 members.
- Romania (unavailable data).

- Russian Territorial Committee (Institute of Laser Physics of the Siberian Branch of Russian Academy of Sciences) (data unavailable).

- Singapore Territorial Committee (Optics and Photonics Society of Singapore) 90 individual members (including students).
- *Sociedad Española de Óptica* (Spanish Optical Society, SEDOPTICA). 500 individual members.
- *Sociedade Portuguesa para a Investigaçao em Óptica e Fotónica* (Portuguese Society of Optics and Photonics). 74 individual members.
- *Société Française d'Optique* (French Optical Society). 834 members (the order of a 20% of the French Physical Society).
- Swiss Society for Optics and Photonics (SSOM). 293 individual members.
- Sweden Territorial Committee (data unavailable).
- Taiwan Photonics Society (TPS). 1,200 individual members.
- The Optical Society of India. 1,000 individual members.
- The Sudanese Committee of Atomic, Optics and Laser Science. 350 individual members.
- Tunisian Optical Society. The order of 70 individual members.
- Unites States Advisory Committee of ICO (USAC/ICO). 49,000 members.
- Ukraine ICO Territorial Committee. 1,200 members (this number includes PhD students and holds for the period 1971-2016 according to Ministry of Education and Science of Ukraine data)
- Venezuelan ICO Territorial Committee. 35 members (this number includes PhD students).

Annex II.

Budget

The present budget is a summary of income and expenditures, as reported by the ICO Treasurer in 2014 (Green Book *Toward ICO-23,* page 326). Prior to any consideration from the reader, one may consider that the **ICO has no current plans for changing the member fees for the next period**. This is explained below on the basis of the handled current budget. The GA will be consulted regarding budget changes related to possible upcoming modifications in the ICO structure and status.

The primary source of ICO income is the membership dues contributed by the Territorial Committees (TCs). The money that the ICO expends is used mostly to support conferences, ICO prizes, and travelling lecture awards. The consolidated budget proposed by the ICO Treasurer for the period 2017-2020 will be presented at the forthcoming ICO-24.

Approximately 46% of the Budget is spent on conferences support, 13% on the publication and distribution of the ICO Newsletter and the ICO triennial report, 20% in awards, and 15% in financial support of the Secretariat, which includes payment of the services of the ICO Webmaster and webpage hosting.

Since the General Assembly in Puebla (2011) ICO has signed a new fiscal sponsorship agreement with the Optical Society of America Foundation (OSAF) allowing charitable donations made to the OSAF to be earmarked for ICO outreach activities.

The reason for this action is that the ICO is in US an 501(c)4 organization. This means that monies donated by US citizens directly to the ICO do not exempt the donor from paying US taxes on their gift. In contrast the OSAF is a 501(c)3 organization (as is the OSA itself) and thus the OSAF can accept donations from US tax payers and their donation will be tax deductible. The Memorandum of Understanding (MoU) is now in place between the OSAF and the ICO. To date the ICO has received one donation of $25,000.

The next Table includes for comparison the budgets for the triennium 2011-2014 as well as the proposed and approved budget for the current 2014-2017 triennium (**Approved at the 23th ICO General Assembly, August 2014, Santiago de Compostela, Spain**).

Table

Budget*			
Revenue	Estimated* 2011-2014	Approved ** 2011-2014	Approved++ 2014-2017
Dues	$144,525	$144,525	$144,525
Less not collected	$21,740	$33,000	$14,000
Net dues	$122,785	$111,525	$130,525
Royalties	$397	$600	$300
Total Revenue	$123,182	$112,125	$130,825
Expenses			
Secretariat	$17,500	$20,000	$22,000
Newsletter - copyediting	$2,023	$4,000	$4,000
Newsletter - printing & distribution	$9,173	$12,000	$12,000
Printing & distribution - Green Book*	$4,000	$4,000	$4,000
Bureau expenses	$3,811	$3,000	$4,000
ICO prizes + travel	$17,650	$15,000	$20,000
Conference support	$30,300	$30,000	$32,000
ICTP school support	$15,000	$15,000	$15,000
ICO Congress	$7,500	$7,500	$8,000
Traveling lecture awards	$5,000	$5,000	$5,000
Reserves or new projects		$2,000	$2,000
ICSU dues	$2,187	$2,100	$2,100
Total Expenses	$114,144	$119,600	$130,100
Surplus/(Deficit) for 3 year period	$9,038	($7,475)	$725

*As of 1 July 2104 **: ICO-22 GA, Puebla, Mexico ++: ICO-23 GA, Santiago de Compostela, Spain

A somewhat longer-term issue is a re-examination of the units that we assess each TC as a means of determining their dues. The current ICO dues rate is based on $235/unit. The number of units for any TC varies from 1 to 18. The units that each TC is assigned are based on information from the World Bank on the economic status of the various countries. The ICO established the numbers of units many years ago (according to IUPAP criteria). It is in the ICO concerns to re-evaluate the units assigned to each territory in light of economic changes since the units were established. ICO wants to be certain that the units are assigned equably. While several proposals for readjusting the units have been discussed in various past GA, there has been no reallocation of units to date*. **At this time we do not envision an increase in the $235/unit dues in the foreseeable future**. **And, in the hypothetical case of ICO to become a union, the same ICO dues rate would be maintained**. We stress the fact that under the current budget ICO develops all the proposed triennial activities and that this is mainly due to the very careful analysis of the needed expenditures, in particular, picking up the opinions at the ICO Bureau.

The annual budget of the ICO is approximately €41,000. As a comparison with other unions, one may notice that six of the 30 ICSU Unions have smaller budgets than does the ICO. Ten ICSU Unions have budgets inferior to 55,000 euros and pay ICSU dues of approximately 1,300 euros. The ICO currently pays

500 euros, without having the right to vote. Only two of the ten smaller Unions have staff, all others have a structure similar to that of the ICO.

This Plan presents goals for the long term that might require contracts with UN bodies or local Academies of Science and/or governments, as well as to open the possibility of accepting direct donations through a change of tax status in the USA. At this stage, it is not accurate to preview the opportunities that may arise for the ICO in the international context if it becomes a Union. It is possible that in the long term, the ICO can promote global initiatives with specific local activities whose cost be covered with local resources. Already the ICO has gained experience in this regard with the financing of local ALOP Workshops in Latin America.

Document prepared by Maria L. Calvo, Angela Guzman and the concurrence of Alana Cahoon.
4 April 2017

[5] One may notice that all ICSU Unions start their name with "International Union."
[6] All data in this Annex I were provided by the representatives of the ICO Territorial Committees to the ICO Secretariat, except for the USAC/ICO that was estimated, see below. Not all Associate Members are included. Territorial Committees not appearing in the list are those with unknown data.

* Comment: The units were changed in the last ICO GA (2014). A readjustment was done. No new update is being planned in the forthcoming GA 2017.