

TRIENNIAL REPORT OF THE ICO TO IUPAP

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Evolving With an Evolving World



Like any organization that thrives across more than a few decades, the ICO has grown and evolved to match the changes in the world in which it operates. It was founded as an affiliated commission of the International Union of Pure and Applied Physics in 1947, and since its inception, the ICO has grown to become a truly global society, including members from 52 territories around the world. Despite this success, we must constantly strive to expand the ICO to other members to offer them support for their optics endeavors, and to benefit in turn from the advances that will be made increasingly possible with cross-boundary collaborations. Last year at the ICO's Strategic Planning Committee Meeting in Tokyo, key proposals were set forth to help strengthen the international reach and nature of the organization.

Global economies continue to recover from some of the most challenging economic times that the world has faced since the ICO was founded. Aiding economies and creating jobs are among the greatest needs across the globe and must be a primary focus for the ICO now and in the years ahead. To that end, a number of ICO members, myself included, worked with the National Research Council last year to help lay out its review of the future of optics and critically, its economic impact, which can help the ICO to educate policy makers about the advantages of supporting optics and photonics research.

The Global Reach of the ICO

Former ICO President Anna Consortini once called the ICO “The United Nations of Optics.” The ICO has been devoted to bringing together optics researchers from around the globe since the first day it was founded, but as always, more can be done. One of the attributes that sets the ICO apart from other major optical organizations is that the ICO's annual meetings are held throughout the world instead of only within the borders

of the United States. At the 2013 Tokyo meeting, a great deal of discussion was given to ensuring our annual meeting would be held in a developing nation every third general assembly. This is something no other optics organization does, and is an endeavor the ICO must necessarily take upon itself, both for the good of the organization and the good of optics research as a whole.

Hosting in developing countries provides a unique opportunity for all members of the ICO. The prestige of hosting an international conference of this sort can bring a great deal of attention to optics in these countries, and helps raise the level of support for the researchers there. Many scientists conducting exceptional work in countries such as Cuba or Iran find it extremely difficult to meet scientists from the field from the U.S. and other developed countries for political reasons. Often, financial resources are limited, and travel isn't an option. By bringing the ICO into those countries, we foster the ability to talk directly with fellow researchers when we might not otherwise be able to. That exchange of knowledge will pay great dividends in the years to come.

The discussion of international reach included the way in which the ICO assesses dues, and while that may appear to be a minor consideration, it can have a profound effect on the success of optics and photonics programs in countries that are limited in the resources they can dedicate to optics research.

The first dues system was developed after the Second World War and was based strictly on population. It was updated several years later to the current system, which was designed to ensure that a country such as the U.S. does not dominate the commission, but that system has not kept pace with changes in demographics or research abilities.

A number of new algorithms for fee assessment are now under consideration. The exact formula is still being discussed, but they all take into account a combination of the gross national product of a country and the H-Factor of the country. GNP is used as an indicator of how productive a country is, and the H-Factor—a metric of frequency of citations—gives an indicator of the quality of the research being performed. With these two key indicators, representing quantity and quality, we believe we can create a method of determining fees in a way that is much more equitable across countries.

Photonics in the New ICO Objective

If inclusiveness was the theme of the Tokyo meeting, it certainly didn't stop at the issues surrounding political borders. Much discussion centered on the term "photonics" and whether photonics is a distinct discipline apart from optics, or whether optics is a wide umbrella that includes photonics. Clearly, this is an important question as it drives directly to the name of our organization. At length, the decision was made to keep the ICO's name intact but to rewrite the commission's objective statement to expressly include photonics.

The first sentence of the new ICO Objective is: “The objective of the International Commission for Optics (ICO) is to contribute, on an international basis, to the progress of the science of Optics and Photonics and its applications.” The entire objective statement likewise reflects the addition of photonics wherever applicable.

The Economics of Optics

Though most members of the American public stare at phone and computer displays hundreds of times a day, or use lighting and data storage, or benefit from medical science, far too few have a true awareness of the fundamental role optics and photonics plays in these technologies. The economic benefit of optics and photonics research to governments around the world needs to be underscored. An initiative to heighten general appreciation for our research by American and European countries can motivate other countries to launch their own campaigns to strengthen and support optics research and education.

In the 2013 edition of the National Research Council’s report, *Optics and Photonics, Essential Technologies for Our Nation*, the impact of the optics and photonics industry on the U.S. economy was considered in depth for the first time. For this report, economists were enlisted to properly catalog the effect our discipline has on national industry.

One of the key findings in the NRC’s report is the need for industry participation in furthering optics and photonics research. For both intellectual and financial reasons, industry cooperation is key to accelerating exploration with real-world implications, but given how broadly optics spans disciplines, smaller companies are more likely to be the participants than the larger firms of the past, such as the famed Bell Labs or Eastman Kodak. This dispersion of talent and resources makes meaningful collaborations more difficult.

Lastly, such consortia may not necessarily align well with the long-term research goals of basic-research-focused entities if industry plays the predominant role in setting the agenda. Given the clear benefits of working closely with industry, a way of mitigating the issues surrounding research consortia needs to be addressed. Economic opportunities will be hard to come by if R&D investment for long-term optics and photonics research is not coordinated at a national level, mitigating the risks to industry of far-horizon research aims and bringing together the wide array of photonics applications under a single, addressable umbrella.

To that end, the NRC report states: “Accordingly, the committee's judgment is that the time is overdue for a federal initiative in photonics that seeks to engage industry, academic, and government researchers and policy makers in the design and oversight of R&D and related programs that include federal as well as industry funding.”

Toward a National Photonics Initiative

Despite the ubiquitous and critical nature of optics and photonic applications in every aspect of modern life, data on the industry's output, employment, and R&D investment are not reported by U.S. government statistical agencies. The diversity of optics applications, while a demonstrated strength for the field, complicates accurate reporting and analysis of the field's economic impact. Even the government's own research investment dollars are not collectively measured, making it difficult to state the case that such investment has a measurable economic benefit to the nation.

Likewise, private organizations that monitor venture capital investment are limited in their scope of what constitutes photonics-based or photonics-enabled research because, like the U.S. government agencies, they have no umbrella definitions under which to categorize the myriad applications that optics impacts. As direct government investment gives way to industry-collaboration incentives, monitoring the private sector investment in photonics becomes increasingly crucial.

To overcome these issues, the NRC committee recommends that the federal government develop a *National Photonics Initiative* to collect all the academic, industrial, and government research data in one place, as well as enlist the researchers and policy makers to work together to lay out a properly integrated method of managing R&D spending on optics and photonics across all industries and government agencies. We on the committee believe, as do so many of us in the ICO, that our field is growing at an extremely rapid rate, with advances and applications that tend to be indicative of a nascent discipline, rather than a well-established one. That swift pace of progress comes in large part from the breadth of applications of which optics and photonics has been a key component over the last decade, but that same breadth of applications has impeded government and industry gaining an overarching grasp of the field. Without proper quantification of the impact of optics and photonics, it's difficult to chart a strategy to nurture the field on the large scale.

One key recommendation to improve the analysis of data in the optics and photonics sector is to develop a set of North American Industry Classification System (NAICS) codes that cover all aspects of the field. The NAICS is the standard used by federal agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. Such a system would include the reporting of federal photonics-related R&D investment for all federal agencies and programs.

A national photonics initiative would not only aid all parties in measuring and monitoring

optics and photonics activity and impact, but it would also offer the federal government a tool to justify programs that provide matching funds for industry-led research consortia. By identifying critical technical priorities for long-term R&D funding, proper coordination across industries, academia, and government laboratories will allow for greater progress in the field. The committee even suggested an area that would likely win early interest and approval; large-scale data communications and storage. Using the National Nanotechnology Initiative as a template, we believe a National Photonics Initiative will have a dramatic effect on the state of U.S. optics and photonics R&D funding, which may then serve as a template for our members around the globe.

The International Year of Light

One last point I'd like to touch on in this report is a look toward the future; 2015 to be exact. I had the distinct privilege of presenting the proposal for the International Year of Light and Light-Based Technologies to the IUPAP General Assembly, which along with several international organizations, including the EPS, ICTP, and the LAM Network, supported the idea to the United Nations General Assembly. The assembly has officially proclaimed 2015 to be the International Year of Light, recognizing "the importance of light and light-based technologies in the lives of the citizens of the world and for the future of development of the global society on many levels." With the importance clearly demonstrated by the NRC report on how public awareness of optics and photonics is an important driver in the global economy as well as everyday life, it is tremendously exciting to have this opportunity right before us to reach the wider public and policymakers and demonstrate how our discipline plays—and will play—a vital role in the standards of living around the world.

The international optics community will realize that for them, and ICO, this is also the greatest opportunity in our lifetime to gain strong visibility and respect for optics as a separate discipline within the scientific community.

And for the general public, a year where the people are made aware of light's integral function in energy, climate change, communications, agriculture, architecture, archeology, entertainment, art, and culture will have a dramatic and far-reaching effect on how funding and research in our beloved field of optics and photonics is carried out in the decades to come.

It's truly an exciting time to be part of the ICO.