SPIE.
The international society for optics and photonics
Photonics Industry Update 2019

Stephen G. Anderson
Director, Industry Development, SPIE

International Day of Light
16 May
The World Economy

- Global GDP ~$75T

The Photonics Economy

- Products and services $7-12T
- ~13% of global GDP

Gross Domestic Product (GDP) by Country 2017

https://howmuch.net/articles/the-world-economy-2017
Optics + Photonics: Essential Technologies for our Nation 2012
Overview

- SPIE at a Glance
- Photonics Industry Overview
- Four “Hot” Apps
- Trends & Summary
SPIE at a Glance

- 264,000 Constituents
- 19,000 Individual Members
- 650 Corporate Members
- 7,400 Student Members
- 166 Countries
- 25 Conferences Annually
- 11 Scholarly Journals
- 500,000 Digital Library Papers
# 25 Conferences and Exhibitions

## NORTH AMERICA

### SPIE Photons West
- **2-7 February 2019**
  - San Francisco, California, USA

### SPIE Defense + Commercial Sensing
- **14-18 April 2019**
  - Baltimore, Maryland, USA
- **22-26 September 2019**
  - Interlaken, Switzerland

### SPIE Medical Imaging
- **16-21 February 2019**
  - San Diego, California, USA
- **15-20 February 2020**
  - Houston, Texas, USA

### SPIE Translational Biophotonics
- **May 2020**
  - Houston, Texas, USA

### SPIE Advanced Lithography
- **24-28 February 2019**
  - San Jose, California, USA

### SPIE Smart Structures + Nondestructive Evaluation
- **3-7 March 2019**
  - San Diego, California, USA
- **28-30 April 2020**
  - Anaheim, California, USA

### SPIE OPTIFAB
- **11-15 August 2019**
  - San Diego, California, USA

### SPIE Photonics West
- **23 March-2 April 2020**
  - Strasbourg, France
- **21-27 June 2019**
  - Munich, Germany

### SPIE Photonics West
- **9-12 September 2019**
  - Strasbourg, France
  - Biennial event

### SPIE Photonics West
- **2-8 September 2020**
  - Munich, Germany
  - Biennial event

### SPIE Internet of Things + Security + Defence
- **1-4 April 2019**
  - Prague, Czech Republic
  - Biennial event

### SPIE Digital Optical Technologies
- **24-27 June 2019**
  - Munich, Germany
  - Biennial event

### SPIE Biomedical Optics
- **OSA 2019**
  - Orlando, Florida, USA
  - Biennial event

### SPIE Biomedical Optics
- **23-27 June 2019**
  - Munich, Germany
  - Biennial event

### SPIE Micro/Nano Materials and Applications
- **December 2019**
  - Sydney, Australia
  - Biennial event

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**LEARN MORE**

[www.spie.org/conferences](http://www.spie.org/conferences)
Covering all major market segments

- Consumer & Entertainment
- Defense, Security, Law Enforcement
- Biomedical, Medical Imaging, Health Care (BioPhotonics)
- Solar PV & Alternative Energy
- Sensing, Monitoring, Measurement, & Control
- Optical Communication, Information Processing, & Storage
- Lighting & Displays
- Semiconductor Processing / Manufacturing
- Advanced Manufacturing with Photonics
Largest annual optics event in the world. More than 23,000 attendees and 1400 exhibitors
SPIE Digital Library

- 11 peer-reviewed journals
- 500,000 papers
- E-books
SPIE Community Support

More than US$4 million in (2018)

- $900,000 in Scholarships
- $90,000 in Education Outreach Grants
- Educational outreach kits, posters and videos
- Summer schools, science fairs & best paper prizes
- Free SPIE Digital Library for developing nations
- Support for women in optics
- International Year of Light Founding Partner
- International Day of Light Steering Committee

Your Membership Makes a Difference!
307 Student Chapters
54 Countries
7,400 Student Members
SPIE Support for Industry

Business insight, opportunities, and networking

- Industry and market data
- International advocacy and pro-industry support
- Corporate membership
- Marketing opportunities
- Training and education
- Recruitment services
- Awards programs
- Cluster support
- News and information daily
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Increasing value

- Photonics-enabled services
- Photonics-enabled products
- Photonics products
- Core components and materials

- There is no clear definition of the photonics market
  - Economic codes NAICS (US) and NACE (EU) do not have a category for photonics
  - Many companies in the enabled (vertical) markets do not self-identify as photonics firms

- Market estimates and economic impact assessments vary widely
  - Lack of consistency
  - Exchange rates can be misleading

Investors and governments depend on economic assessments
Photonics Value Chain

Core components and materials
- Materials, LEDs, lasers, detectors, optics, sensors, filters, optical fiber

Enabled-services
- Internet, streaming video and audio cloud storage services, e-commerce

Photonic products
- LED lamps, cameras, displays, optical scanners, marking and inspection systems

Enabled-products & markets
- Lighting, autonomous vehicles, TVs, smart phones, AR/VR, vision & imaging systems
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# Global Overview of Components Production 2012-2016

## Industry Trends: Companies, Revenues, Jobs

<table>
<thead>
<tr>
<th></th>
<th>2012 (adj)</th>
<th>2014 (adj)</th>
<th>2016</th>
<th>4-year CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies in market</td>
<td>2,714</td>
<td>3,194</td>
<td>3,321</td>
<td>+5.2%</td>
</tr>
<tr>
<td>Photonics revenues</td>
<td>$181 B</td>
<td>$206 B</td>
<td>$227 B</td>
<td>+5.8%</td>
</tr>
<tr>
<td>Photonics Jobs</td>
<td>719K</td>
<td>906K</td>
<td>945K</td>
<td>+7.1%</td>
</tr>
</tbody>
</table>
Geography of Production (2016)

Company Count by Country
3321 Companies in 52 Countries

Revenues by Country
$226 B

67% of global revenues originated in the US and Japan combined
Components Revenue History by Region 2012-2016

Global components CAGR >5%: Share shift as China gains

CAGR = 5.8%
Company Size Distribution with Share of Total (2016)
Company Size Distribution with Share of Total (2016)

The majority of revenues originate from a minority of companies

- 2360 companies (2.6% of revenues)
- 82 companies (73.1% of revenues)
Outlook: Core Components Revenues 2012-2020

Forecast extrapolated from a review of industry analysts’ projections for 302 public companies representing 74% of total photonics components 2016 revenues.

Global components CAGR through 2020 >4%
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Enabled-services
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Photonics-Enabled Markets

Photonics-enabled markets up 20% over four years (CAGR 4.5%)
Top Five Growth Segments (2012 – 2016)

Solar PV (↑15%)

Defense and Security (↑15%)
Resurgence in defense procurement, emerging imaging systems.

Advanced Manufacturing (↑8%)
Implementation of robotics and vision technology. 3D/Additive manufacturing.

Sensing, Monitoring, and Control (↑7%).
The Internet of Things is driving demand for a wide variety of photonic sensors.

Biomedical (↑7%)
New diagnostic tools, point-of-care testing, and wearables all contribute to growth.
Outlook: Enabled Markets Revenues 2012-2020

Forecast derived from a compilation of multiple reports covering more than 100 photonics-enabled applications and many geographical regions.

Enabled markets projected CAGR 10.5% through 2020
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Enhanced reality CAGR range is wide: 40%-80% to 2021
Healthcare: Functional Brain Imaging (fNIRS)

- Near infrared spectroscopy for functional optical brain imaging.
- Changes in near-IR light provide indirect and direct monitoring of brain activity.
- Non-invasive, safe, portable, and low-cost

Promises MRI like information from a wearable device
Healthcare: Medical Imaging and Deep Learning

- Deep learning, AI (artificial intelligence), machine learning, neural networks
- Early reports of deep learning-based computer-aided diagnosis for breast cancer, lung cancer, and Alzheimer's disease show promising results for detecting and staging the diseases
- Potential to perform automatic lesion detection, suggest differential diagnoses, preliminary radiology reports.

“IT is evident that deep learning has pervaded every aspect of medical image analysis. This has happened extremely quickly: the vast majority of contributions, 242 papers, were published in 2016 or the first month of 2017.” A Survey on Deep Learning in Medical Image Analysis. Litjens et al. Jun 2017
Autonomous Mobility
LIDAR

Automotive and LIDAR System Market Outlook

- Total market: $1.3B
  - Robotic vehicles: $45M
  - ADAS vehicles: $262M
  - Topography: $806M
  - Wind: $201M
  - Industry: $15M

2018: $1.3B, 29% CAGR

2024: $6.0B
- $1.2B CAGR 7%
- $1.4B CAGR 113%
- $2.8B CAGR 55%
- $432M CAGR 9%
- $172M CAGR 25%

Drones, AVs, robotics, mapping, industrial, military, wind

Source: Yole | Images Waymo, Velodyne
Advanced Manufacturing: 3D Printing/Additive

Industries that tend to produce low-volume, complex, high-value-add parts are well-suited to 3D printing/AM

Strong growth over next few years

3D/AM Forecast ($M)

- 2019
- 2021
- 2023

Source: Wohlers Associates

End-users by Industry

- Aerospace 19%
- Industrial/Business Machines 20%
- Consumer Products 12%
- Medical/Dental 11%
- Academic Institutions 8%
- Government/Military 5%
- Other 7%
- Automotive 16%
- Architectural...
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Mobile Everywhere

- Information flows in and out via the photonics-enabled internet
- User interface (display, lasers, and camera) is photonics enabled
- Mobile devices dominate global electronics demand
- Demand for functionality drives miniaturization
- Enable other applications

Mobile everything: IoT and 5G will boost demand

By 2022, the average smartphone will generate 11 GB of mobile traffic per month, up from 2 GB per month in 2017 (36% CAGR)

Source: Statista | Cisco
Smartphones in Healthcare

Analyzes blood, urine, or saliva samples

Resolves single strands of DNA for remote diagnostics

Measures hemoglobin in blood using phone camera

With digital technologies, cloud computing and machine learning, the medicalized smartphone is going to disrupt every aspect of health care. First FDA-approved smartphone-based home Urinalysis kit available!

Smartphone add-ons enable low-resource diagnostics
Quantum Technology (QT) Global Investment

Government-led Spending (Worldwide) in 2015

Estimated annual spending on non-classified quantum-technology research, 2015, €m

Mostly research | 7000 researchers, €1.5 B ($1.7 B)

Investments are targeting major high-tech markets
Quantum Markets

Quantum devices are not all optical but have many common photonics-related needs:

- Precision light sources
- Sensitive detection
- Precision microwave sources

Total market for quantum-enabled devices >$40 B by 2024
Photonics is a global economic growth engine
Has consistently outpaced global GDP

Core Components (2016) revenues ~$227 B (↑4.3% CAGR 2016-2020)
Employed almost 1 million worldwide

Enabled Markets (2016) revenues >1.8 T (↑10% CAGR 2016-2020)
Employed about 4 million worldwide

Photonics technology will continue to grow
Advances will outpace effects of price erosion in commodity markets while novel technologies are adopted in others

The 21st century will depend as much on photonics as the 20th century depended on electronics.
More industry information:

http://spie.org/industry-resources/information/market-intelligence
QUESTIONS?