Future of Metrology Market
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<td>Appendix</td>
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The Future of Metrology
8 Transformative Forces Reshaping the Future of Metrology

- Big Data
- Additive Manufacturing
- Cyber Security
- Inline Inspection
- Augmented Reality
- Simulation
- Industrial Internet
- Enterprise Integration

Note: Highlighted enabling elements in red will be presented at length in the following presentation.
Enterprise Integration
Enterprise-Level Integration
Offering end-to-end quality inspection solutions will be the key to success.

- Inspecting every facet of manufacturing and integrating all types of inspection results will help end users to create true corrective and preventive processes and action plans to achieve ‘Zero’ errors in manufacturing.
- Quality inspection service providers need to build solutions for the vertical and horizontal quality inspection market to retain prominence.
Enterprise-Level Integration Using Software

Over the next 3-5 years, most metrology companies will invest more than 50% of their R&D budget in coding enterprise-level software solutions.

Software Evolution: Innovation Needs to Drive Structural Transformations in Stakeholder Relationship

**Product/Solution Design**
- Restricted/Closed Innovation
  - Technology-based Software
- Expansive Innovation Capabilities
  - Process-based Software
- Open Innovation Platform
  - Total Quality Process Management Software

**Competitor Landscape**
- Niche Product Market
- Exclusive Business Focus with Strategic Value Addition
- Broad Ecosystem with Diverse Supplier Presence

**Status Quo**
- Industry 4.0 Impact Time Frame: 3-5 Years

**Key Features of Open Innovation Platform**
- Data Collection
- Data Storage
- Agility
- Timely Actions
- Standardization

F R O S T & S U L L I V A N
Three Possible Diversification Opportunities

Diversification through merger and acquisition (M&A) activities will be the key initiative of metrology companies over the next 3-5 years.

1. **Metrology Market**
   - Carl Zeiss acquired Steinbichler Optotechnik gmbh
   - Perceptron acquired Coord3
   - Quality Vision International acquired ShapeGrabber

2. **Adjacent Markets**
   - Ametek acquired Amptek, Inc
   - Olympus NDT acquired Innov-X Systems Inc.

3. **New Markets**
   - Marposs acquired Millennium Automation
   - Hexagon Manufacturing Intelligence establishes strategic alliance with INOS Automation
   - TKH Group acquired LMI Technologies
Industrial Internet—Measure, Think, and Act
Digitization of Industrial Measurement Throughout the Supply Chain

Revenues from ERP software will surpass the hardware revenues over the next 5-8 years.

Suppliers

- Inspect the manufactured components
- Share the quality inspection data with the prospective buyer
- If the OEM is satisfied with the quality inspection data, then the supplier can ship the components to OEM.

OEMs

- Integrate RFID/Sensors along with shipment carriage to monitor the components during transportation
- Permanent monitoring throughout the product’s life cycle

End Users

- Establish process and quality inspection throughout the supply chain
- Centralized global data for future references
- Permanent monitoring will help manufacturers design effective root cause analysis, corrective and preventive strategies, and help manufacturers achieve the utopian vision of ‘Zero errors in Manufacturing’.
Predictive Analytics

Predictive insights will allow metrology companies to sell more knowledge-based services and create a new breed of client engagement models over the following years.

Evolution of Big Data Analytics for Industrial Measurement, Global, 2000–2020

Year


PHASE 1

Inspection Data Reporting

PHASE 2

Data Monitoring

PHASE 3

Data Analysis, Mining, And Evaluation

PHASE 4

End-to-end Consulting Solution (Predictive Analytics)
Metrology Services 2.0
Metrology services 2.0 will create recurring revenue opportunities, allowing metrology companies to engage with customers throughout the product life cycle.

- **Reactive Maintenance**
  - Run to failure approach—only appropriate for low impact failures

- **Scheduled Maintenance**
  - Traditional approach with fixed scheduled for preventive maintenance

- **Preventive Maintenance**
  - Preventive schedule optimized based on failure history

- **Predictive Maintenance**
  - Predictive maintenance based on real-time diagnostic information from smart metrology machines

Metrology Services 2.0 will create recurring revenue opportunities, allowing metrology companies to engage with customers throughout the product life cycle.
Inline Inspection
Optical Scanners—Key Technology for Growth

Most metrology companies will reduce their focus on engineering traditional coordinate measuring machines (CMMs). Metrology companies will aggressively expand their optical scanner portfolio over the next 3-5 years.

Increased Penetration of Optical Metrology
Inline Metrology—Market Size and Forecasts

Speed, accuracy, and flexibility are key attributes that enable optical scanners to replace traditional CMMs.

Global Inline Metrology Market Revenue by Key Technologies: 2014 and 2020

- **CMMs**
  - 2014: $100.0 million
  - 2020: $150.0 million
  - CAGR = 4.8%

- **Optical Metrology**
  - 2014: $100.0 million
  - 2020: $250.0 million
  - CAGR = 11.0%
Key Application Areas
Horizontal arm machine and gantry-type CMM will be replaced with optical scanners at a significant rate over the next 3-5 years

Penetration of Optical Scanners in the Global Inline Metrology Market Revenue by Key Automotive Application Areas, 2014

1. Frost & Sullivan finds that attaining absolute measurement results through optical scanners is the utopian ambition of several dimensional metrology manufacturers.

2. If absolute measurement can be achieved using optical scanners, several industry experts believe that it could signal the end of the CMM era in the quality inspection process.

3. Top 5 CMM manufacturers believe that CMM will not be a key product portfolio in the next 5-8 years. Hence, CMM manufacturers have started investing in optical metrology.
Emerging Application Areas for Optical Scanners—
The optical scanner product line will enable metrology manufacturers to increase their initiatives towards diversifying their end-user target market.

Market-openness refers to the competitive landscape; we looked at a number of companies currently engaging in the market.
Conclusion
Conclusion

1. Combined synergies of the core metrology market, ICT, and automation industry will offer new value to end users.

2. Strategic shift in business approach towards services will be driven by the end-user need for reduced total cost of ownership (TCO).

3. Open-source enterprise software is likely to foster high degree of innovation across the value chain and create new revenue generation stream.

Three Key Takeaways
Planned and Existing Research Studies Available—Dimensional Metrology
# Upcoming Topics in Dimensional Metrology

## Upcoming 2015-2016 Tentative Titles

*Draft Titles, subject to change based on client feedback*

- Coordinate Measuring Machines
- Optical Digitizers and Scanners
- Vision Measuring Machines
- Vision Sensors
- Laser Micrometers
- DM Services
- DM Software

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>2016</td>
<td>Global Thin Film Metrology Market</td>
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<td>2016</td>
<td>3D Scanners: The Big Disrupting Market Shift—Threats and Opportunities for Metrology Vendors</td>
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<td>2016</td>
<td>Rethinking Business Models in the Metrology Services Market</td>
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<td>Global CMM Sensors Market</td>
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<td>Surface and Contour Measurement Market</td>
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<td>2016</td>
<td>Beyond BRIC—Emerging Market Hubs for Metrology</td>
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<td>Global Microscopes Equipment Market</td>
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## Existing Topics in Dimensional Metrology Research Program

### Published Research—Legacy Content (Partial List)

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<td>NF4D</td>
<td>Computed Tomography: The Next Big Technology in Dimensional Metrology?</td>
<td>2015</td>
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<tr>
<td>NEFD</td>
<td>Global Integrated Automotive Test Solutions and its Future</td>
<td>2015</td>
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<tr>
<td>NDC7</td>
<td>Current and New Opportunities for Metrology in the Automotive Industry</td>
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<td>ND05</td>
<td>Analysis of the Global Measurement Gages Market</td>
<td>2014</td>
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<td>9840</td>
<td>Analysis of the Industrial X-ray Detectors and Sources Market</td>
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<td>Analysis of the Global Metrology Probes and Scanners Market</td>
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<td>World Optical Digitizers and Scanners Markets</td>
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<td>NB16</td>
<td>Analysis of the Global Metrology Services Market</td>
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<td>9840</td>
<td>Metrology Market for Automotive Applications</td>
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<tr>
<td>F329</td>
<td>World Optical Digitizers and Scanners Markets</td>
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- Vision Sensors
- Laser Micrometers
- DM Testing Services
- DM Software
Aravind Govindan

Functional Expertise
• 7 years of expertise in strategy consulting and market research in the mechanical test market under measurement & instrumentation. Particular expertise in:
  — Market Sizing, forecasting, identifying emerging trends and growth regions
  — Developing strategies for market entry, market development and market penetration
  — Identifying innovation in the industry covering technology and products

Industry Expertise
• Experience covering broad range of sectors, leveraging long-standing working relationships with leading industry participants’ CEOs, Boards and Senior Executives.
  — Published more than 10 reports covering the Dimensional Metrology industry.
  — Extensive syndicated research and consulting experience tracking a wide range of test & measurement markets including material testing, nondestructive testing, analytical instrumentation

Career Highlights
• Presented a webinar on Understanding Industry 4.0 and its impact on inline metrology market. Developed business insights on the relevance of Big Data, smart factories and Metrology Services 2.0 in the dimensional metrology domain.
• Published several articles on the dimensional metrology market in international magazines such as Quality Mag, Today’s Motor Vehicles and Quality Manufacturing Today among others.
• Quoted in international publications on trends and analysis in the global test & measurement instrument.
• Extensive industry experience having worked on consulting assignments with the biggest names in the measurement & instrumentation field including Faro Technologies, Creaform, MTS, SGS, Micro Ecoder Inc (MEI) and Nikon Metrology among others.
• Worked on go-to-market strategies, market penetration, opportunity assessment, mergers and acquisition and diversification strategy projects among others
• Visited various international metrology trade fairs including IMTEX and Control Fair.
• Prior market research experience in leading firms such as Aptara, GE Converteam and Hewlett Packard.

Education
• Master of International Business from University of Sydney, Sydney, Australia
• Bachelors of Commerce from University of Madras, Chennai, India
The Frost & Sullivan Story
The Frost & Sullivan Story

Emerging Research 1961–1990
1961

Growth Partnership 1990–Today
1990

Visionary Innovation Today–Future
Today

Pioneered Emerging Market & Technology Research
• Global Footprint Begins
• Country Economic Research
• Market & Technical Research
• Best Practice Career Training
• MindXChange Events

Partnership Relationship with Clients
• Growth Partnership Services
• GIL Global Events
• GIL University
• Growth Team Membership
• Growth Consulting

Visionary Innovation
• Mega Trends Research
• CEO 360 Visionary Perspective
• GIL Think Tanks
• GIL Global Community
• Communities of Practice
What Makes Us Unique

- **Focused on Growth**: All services aligned on growth to help clients develop and implement innovative growth strategies.

- **Industry Coverage**: Continuous monitoring of industries and their convergence, giving clients first mover advantage in emerging opportunities.

- **Global Footprint**: More than 40 global offices ensure that clients gain global perspective to mitigate risk and sustain long term growth.

- **360 Degree Perspective**: Proprietary TEAM™ Methodology integrates 7 critical research perspectives to optimize growth investments.

- **Career Best Practices**: Career research and case studies for the CEOs’ Growth Team to ensure growth strategy implementation at best practice levels.

- **Visionary Innovation Partner**: Close collaboration with clients in developing their research-based visionary perspective to drive GIL.
Our Industry Coverage

- Aerospace & Defense
- Measurement & Instrumentation
- Consumer Technologies
- Information & Communication Technologies
- Automotive Transportation & Logistics
- Energy & Power Systems
- Environment & Building Technologies
- Healthcare
- Minerals & Mining
- Chemicals, Materials & Food
- Electronics & Security
- Industrial Automation & Process Control
Our Research Methodology
Integration of Research Methodologies Provide 360° Perspective

Idea Generation for Growth Pipeline
Comprehensive Evaluation of Opportunities
Reduced Risk and Enhanced Accuracy
Best Practices in Strategy Implementation
Foundation for Visionary Perspective
Innovative Growth Strategies
Our Services

Growth Partnership Services

GIL Global Community

GIL University

Growth Consulting

Events
GIL Global Community:
Growth, Innovation and Leadership

- CEO Roundtables
- Best Practice Research
- Mega Trends
- Analyst Briefings
- Webinars
- GIL Events
- Newsletters
- Growth Workshops.

GIL Event Schedule

GIL Japan, JANUARY
GIL Silicon Valley, FEBRUARY
GIL South Africa, MARCH
GIL Malaysia, APRIL
GIL London, APRIL
GIL Japan, JULY
GIL Korea, JULY
GIL Africa, AUGUST
GIL Silicon Valley, SEPTEMBER
GIL India, SEPTEMBER
GIL Dubai, NOVEMBER
GIL APAC, OCTOBER
GIL China, NOVEMBER
GIL Latin America, DECEMBER
Our Global Footprint 40+ Offices
Scanning the Globe for Opportunities and Innovation