Challenged by newcomers proposing innovative low-cost solutions for consumer applications, established MEMS players must develop new strategies to ensure continued growth.
• This 2014 edition of “Status of the MEMS Industry” presents the MEMS device market and key industry changes and trends.

• Yole is actively following the market evolution of more than 220+ MEMS applications and is tracking 350+ MEMS companies → this report combines all these applications into 15+ major MEMS devices: IJ heads, pressure sensors, microphones, accelerometers, gyroscopes, magnetometers, IMUs, micromirrors, MOEMS, microbolometers, IR sensors, microdisplays, microfluidics, RF MEMS, Oscillators, micro tips, and emerging MEMS devices.

• Based on the thousands of direct interviews Yole Développement analysts are conducting annually in the MEMS field with MEMS manufacturers, system manufacturers integrating MEMS and MEMS designers, MEMS equipment and material manufacturers, and MEMS technology developers, this 11th version of the “Status of the MEMS Industry” provides up-to-date analyses and data on MEMS markets.
2012-2019 MEMS Markets (US$M)

MEMS market forecast 2012-2019 value (in M$)
April 2014

+13% growth

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2012-2019 MEMS Markets by Application (US$M)
Evolution 2009-2013: Maintaining growth is a challenge for consumer applications
Example of supply chain & infrastructure

15+ detailed supply chains
Consumer MEMS challenges

PRICE PRESSURE
- Mobility
- Connectivity everywhere
- E-Health
- Social networking
- Internet of Things

SIZE REDUCTION
- New MEMS design
- Above IC
- 3D integration
- New wafer bonding

MORE INTELLIGENCE
- Closer integration with processing
- Better performance
- Software
- Sensor fusion
- Stronger RF specifications
- Data discrimination

HIGH VOLUME PRODUCTION
- High volume production
- Shared fab infrastructure

FABLESS MODEL
- Fabless model
- MEMS across multiple markets

NEW APPLICATIONS
- Internet of Things
- LBS
- E-Health

MEMS ACROSS MULTIPLE MARKETS
- MEMS across multiple markets
Accelerometer MEMS size evolution

MEMS Size (mm²)

All are 3-axis accelerometers
US$ values are Production Cost

ST LIS3L02AE

ST LIS331DLH

VTI CMA3000

BOSCH BMA180

Kionix KXTE9

ST LIS3DH

ADI ADXL346

ST LIS302DL

ST LIS3L02AE

ST SMI540

ST LSM330

ST LSM303D

MCube BI3L

BOSCH BMA250 / BMC050

ADI ADXL362

BOSCH SMI540

BOSCH BMA355

ST LSM330

AUTO

$0.03-0.075

CONSUMER

$0.075-0.1

>$0.1

n.a.
New approaches to overcome MEMS challenges

**Maximum optimization**

- Single 3A gyro design (STM, Invensense)
- Single 3A accelerometer + 3A gyro structure (STM, Invensense)

**Design**

- Single 3A gyro design (STM, Invensense)
- Single 3A accelerometer + 3A gyro structure (STM, Invensense)
- TSV via last (STM)
- TSV via first (STM)
- TSV in ASIC (Bosch)
- 3D MEMS with TSV (mCube)
- Eutectic Au-Si bonding (Maxim)
- Eutectic Al-Ge bonding (Bosch, Invensense)
- CMOS-MEMS (Invensense)
- TSV platform (Teledyne Dalsa)

**Process**

- BAW resonant sensor (Qualtré)
- M&NEMS (Tronic’s)
- NEMS gas chromatography (APIX)
- Suspended Microchannel Resonator (Affinity Biosensors)
- Quartz Crystal Microbalance (Q-Sense)

**Breakthrough**

- Single 3A gyro design (STM, Invensense)
- Single 3A accelerometer + 3A gyro structure (STM, Invensense)
- TSV via last (STM)
- TSV via first (STM)
- TSV in ASIC (Bosch)
- 3D MEMS with TSV (mCube)
- Eutectic Au-Si bonding (Maxim)
- Eutectic Al-Ge bonding (Bosch, Invensense)
- CMOS-MEMS (Invensense)
- TSV platform (Teledyne Dalsa)

**New detection principles**

- BAW resonant sensor (Qualtré)
- M&NEMS (Tronic’s)
- NEMS gas chromatography (APIX)
- Suspended Microchannel Resonator (Affinity Biosensors)
- Quartz Crystal Microbalance (Q-Sense)
From micro machines to MEMS to NEMS...

From micro machines to MEMS
- FIRST INTEGRATED SENSOR
  - Ex: SA20 Sensonor for Airbag systems.
- CAPACITIVE COMB DRIVE BECOMES DOMINANT
  - Ex: ST, Bosch ...
- PACKAGING / INTEGRATION AS ENABLING TECHNOLOGY
  - Ex: SiTime, ST, Bosch ...
- MIX MEMS (thick layer) & NEMS (gauge) FOR MIN AREA & IMPROVED PERF.
  - Ex: Tronics

MEMS to NEMS
- DISRUPTIVE APPROACHES
  - Ex: EPFL, CNRS, CEA Leti, Caltech, Berkeley ...

NEMS

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Available MEMS reports

Technologies & Sensors for the Internet of Things
New!

MEMS for Cell Phones and Tablets
New!

Status of the CMOS Image Sensors Industry
New!

Status of the MEMS Industry
New!

MEMS Microphones
New!

Inertial MEMS Manufacturing Trends 2014
New!

MEMS Pressure Sensor

MEMS Front-End Manufacturing Trends

Infrared Detectors Technology & Market Trends

RF Filters, PAs, Antenna Switches & Tunability for Cellular Handsets

IMU & Gyro for Defense, Aerospace & Industrial
New!

Emerging MEMS

Technology Trends for Inertials MEMS

Ferro-Electric Thin Films

Trends in MEMS Manufacturing & Packaging

Motion Sensors for Consumer & Mobile applications

Sensor fusion of acceleros, gyros & magnetometers

Thin Wafer Handling

MEMS Cosim+ MEMS Manufacturing Cost Simulation Tool
Yole activities in MEMS

MEDIA
News portal/Technology magazines/Webcasts/Communication services

REPORTS
Market & technology/Patent Investigation/Reverse costing

CONSULTING
Market research/Technology & Strategy/Patent Investigation/Reverse costing

YOLE FINANCE
M&A/ Due Diligence/ Fundraising/ Technology brokerage

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Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media in addition to corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing (technology or process), Yole Développement group has expanded to include more than 50 associates worldwide covering MEMS, Compound Semiconductors, LED, Image Sensors, Optoelectronics, Microfluidics & Medical, Photovoltaics, Advanced Packaging, Manufacturing, Nanomaterials and Power Electronics. The group supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.

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