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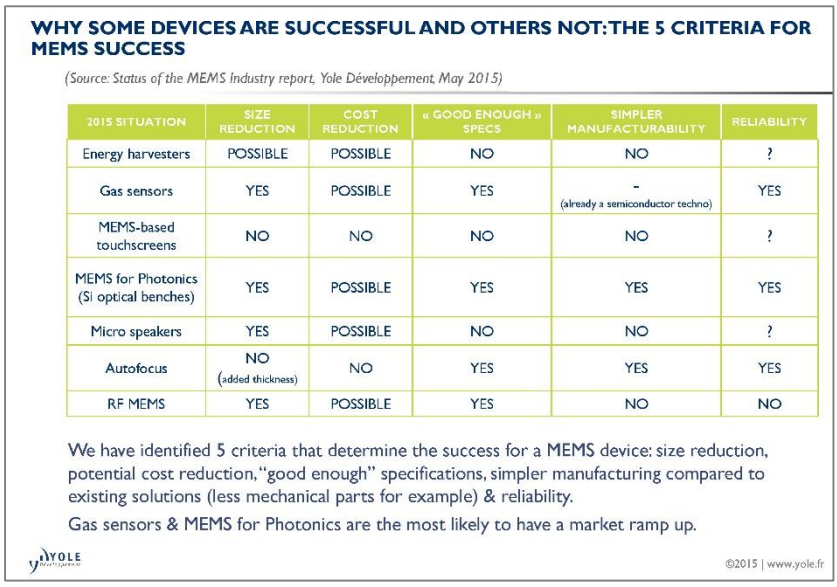
The MEMS business is growing

Status of the MEMS Industry report, Yole Développement, May 2015

LYON, France – June 9, 2015 *– Back in 2000, the total MEMS market was already growing strongly, reaching $5B revenue for slightly over 1B units. By 2014, MEMS had become an $11.1B business. "At Yole Développement (Yole), we expect a $20B business in 2020 with 30B units", says* ***Jean-Christophe Eloy, President & CEO, Yole.***

This expansion started with Knowles' microphones in 2003 and with STMicroelectronics' accelerometers in 2005, both products targeting consumer applications. Since 2009, consumer applications have enjoyed significant volume growth – and according to Yole's latest analysis, Status of the MEMS Industry (May 2015), around 17% CAGR (in units) is expected between 2015 and 2020. However strong price pressure, -5% a year at best, will result in 3% CAGR revenue growth over the same time period.



WHY SOME DEVICES ARE SUCCESSFUL AND OTHERS NOT: THE 5 CRITERIA FOR MEMS SUCCESS

(Source: Status of the MEMS Industry report, Yole Développement, May 2015)

2015 SITUATION	SIZE REDUCTION	COST REDUCTION	« GOOD ENOUGH » SPECS	SIMPLER MANUFACTURABILITY	RELIABILITY
Energy harvesters	POSSIBLE	POSSIBLE	NO	NO	?
Gas sensors	YES	POSSIBLE	YES	- (already a semiconductor techno)	YES
MEMS-based touchscreens	NO	NO	NO	NO	?
MEMS for Photonics (Si optical benches)	YES	POSSIBLE	YES	YES	YES
Micro speakers	YES	POSSIBLE	NO	NO	?
Autofocus	NO (added thickness)	NO	YES	YES	YES
RF MEMS	YES	POSSIBLE	YES	NO	NO

We have identified 5 criteria that determine the success for a MEMS device: size reduction, potential cost reduction, "good enough" specifications, simpler manufacturing compared to existing solutions (less mechanical parts for example) & reliability.

Gas sensors & MEMS for Photonics are the most likely to have a market ramp up.

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The "sensorization" of our life is just beginning. Much expected growth in MEMS sensors comes from wearable and Internet of Things (IoT) applications. Another interesting phenomenon is that the automotive industry will also drive the MEMS industry, integrating ever more sensors. Indeed, making cars autonomous is the target. But growth in these applications will mean incredible price decreases, with a production cost of a few cents only for some devices. *"For example, it costs just $0.025 to produce a Bosch BMA355 accelerometer (Source: Bosch Sensortec BMA355 3-Axis MEMS Accelerometer reverse costing analysis, Jul. 2014, System Plus Consulting)",* details Jean-Christophe Eloy. Motion sensing functions are becoming as cheap as temperature sensors were a few years ago.

The coming growth creates new production and technology challenges. How is it possible to deliver annual price decreases of 5% and still make enough margin to be able to reinvest?

The solutions include larger volumes but also integrating multiple sensors in a system or even in a single package. This combo approach is strongest for consumer applications with closed combos for motion sensing and open combos for environmental sensing, including humidity, pressure and gas sensors.

In parallel with existing application growth, at Yole, we believe that new MEMS devices are arriving. Gas and chemical sensors are based on semiconductor technologies. MEMS technology can reduce their size by as much as a quarter and also reduces cost, thus expanding the market. Our analysts believe MEMS devices will be increasingly used where applications have form-factor and cost issues, for example in the consumer and wearable segments.

In another part of the MEMS industry, MEMS micromirrors have a new interest from the market for optical datacom, delivering impressive growth for Calient (Calient's expansion in Europe – June 2014 press release). MEMS micromirrors also provide real added value for human-machine interfaces, a trend confirmed by the Intel's acquisition of Lemoptix. Yole's analysis also shows more industrial applications like lithography, high speed printing, and front lighting for automotive, as well as multiple other high-end applications. So, according to Yole's analysts, micromirrors are poised for rapid growth.

The evolution of the MEMS industry is inducing changes in the market structure. Some past market leaders are now struggling to grow, Yole has found. Competition is still very open. From the analysis of the top 250 MEMS players Yole does every year, the 2014 TOP 30 MEMS players ranking shows a clear emergence of what could be a future "MEMS Titan": Robert Bosch. Robert Bosch's MEMS revenues have risen by 20% to top $1.2B, partly driven by Apple iPhone 6 sales.

Meanwhile, the gap between STMicroelectronics and other MEMS companies has widened to more than $400M. Compared to 2013, the top five remains unchanged but Robert Bosch now accounts for one-third of the $3.8B MEMS revenues shared by the top five MEMS companies, who in turn share around one third of the total MEMS business.

Among the ten or so MEMS Titans that currently command most of the MEMS market, Yole distinguishes "Titans with Momentum" from "Struggling Titans".

- In the first category, we include Robert Bosch, InvenSense, Avago and Qorvo. The case of Robert Bosch is particularly noteworthy as it is today a strong MEMS company serving dual markets – automotive and consumer – and having the right R&D and production infrastructure.

- On the "Struggling Titans" side, we have STMicroelectronics, Hewlett Packard, TI, Canon, Knowles, Denso and Panasonic. These companies currently are struggling to have efficient growth engines for sales and value.

Without doubt, both Bosch and InvenSense are still growing while others, like STMicroelectronics or Knowles, are suffering a slowdown or a MEMS sales decrease.

Volume growth means that the MEMS market is entering a new investment cycle. MEMS manufacturing on 300 mm diameter wafers will be an interesting topic in the coming years and could emerge as a way to decrease prices and stay ahead of the competition. We believe at Yole that the main motivations to move to 300mm MEMS manufacturing will be a mix of technical requirements. Those motivations include:

- Economically providing a CMOS layer with small critical dimension as required by the increasing amount of data to process
- Wafer level integration with MEMS parts, or lowering costs, increasing volumes and attracting more customers for a foundry
- Manufacturing big MEMS devices like micromirrors or microbolometers for better costs

Even if 300mm production infrastructure is not appearing rapidly, the investment in 200mm is now continuing with significant momentum. So, yes, the MEMS market is very active and dynamic!

Yole will be part of SEMICON West 2015 program. **Claire Troadec, Technology & Market Analyst, Semiconductor Manufacturing at Yole,** will share its vision of the MEMS industry with the following participations:

- A presentation entitled *"What does the Future Hold for MEMS"* on July 14 at 10:30 am, TechXPOT South area. Abstract is available on SEMICON West 2015 website.
- A panel discussion entitled *"Creating solutions to address common challenges facing the MEMS, Sensor and Semiconductor Industries in the next decade"*. The MEMS Industry Group/SEMI joint workshop will take place on July 15 at 1 pm. The program is now available.

To meet Yole's team, ask for a meeting or visit us at your booth (#2635).

More information about MEMS technology & market trends is available on www.i-micronews.com, MEMS & Sensors report section or here.

About MEMS Industry Group (MIG)

MEMS Industry Group (MIG) is the trade association advancing MEMS and sensors across global markets. Over 170 companies comprise MIG! MIG Connects the MEMS and sensors Supply Chain. MIG Champions MEMS and sensors in established and emerging markets. MIG Commercializes MEMS and sensors.
As the "go-to" resource for globally linking the MEMS and sensors supply chain to strategic markets, MIG helps companies in and around the MEMS and sensors industry to make meaningful business connections. Device manufacturers, software designers, materials and equipment suppliers, foundry partners, market analysts, and OEM integrators all plug into the MIG network to form alliances that will move their businesses forward. MIG membership features a number of exclusive benefits … Visit http://www.memsindustrygroup.org/

About SEMI

SEMI is the global industry association serving the nano- and microelectronic manufacturing supply chains. Our 1,900+ member companies are the engine of the future, enabling smarter, faster and more economical products that improve our lives. Since 1970, SEMI has been committed to helping members grow more profitably, create new markets and meet common industry challenges. SEMI maintains offices in Bangalore, Beijing, Berlin, Brussels, Grenoble, Hsinchu, Moscow, San Jose, Seoul, Shanghai, Singapore, Tokyo, and Washington, D.C. For more information on SEMI, visit www.semi.org.

About "Status of the MEMS Industry" report:

- Authors:

Dr. Eric Mounier has a PhD in microelectronics from the INPG in Grenoble. At Yole Développement, Eric is in charge of market analysis for MEMS & Sensors, visible and IR imagers (CIS, microbolometers), semiconductors, printed electronics and photonics (e.g. Silicon photonics).He has contributed to more than 200 marketing & technological analysis and 100 reports. Eric is also an expert at the OMNT («Observatoire des Micro & Nanotechnologies») for Optics.
Claire Troadec is member of the MEMS manufacturing team. She graduated from INSA Rennes with an engineering degree in Microelectronics and Material Sciences. At Yole Développement, Claire is in charge of marketing analyses for MEMS & Semiconductor Manufacturing, including innovative equipment and materials, as well as marketing & strategic analyses on MEMS manufacturing players.
Guillaume Girardin works as a Market & Technology Analyst for MEMS devices and technologies at Yole Développement. Guillaume holds a Ph.D. In Physics and Nanotechnology from Claude Bernard University Lyon 1 and a M.Sc. in Technology and Innovation Management from EM Lyon School of Business.
Yann de Charentenay has worked for Yole Développement in the field of MEMS, materials and compound semiconductors since 2003. He has contributed to more than 60 marketing & technological analysis.

- Companies cited in the report:

AAC, Advanced MicroSensors, Aichi MI, AKM, Alps Electric, Amphenol (GE Sensing), Analog Devices, Asia Pacific Microsystems, ASMC, Avago Technologies, Bluechiip, Boehringer Ingelheim Microparts, Calient, Canon, Ccmos, Chirp Microsystems, Cyrrus Logic (Wolfson), CSMC, Delfmems, Denso, Discera, DRS Technologies, Endevco Meggitt Sensing Systems, EPCOS, Excelitas, First Sensor Technology, FLIR Systems, FormFactor, Freescale Semiconductor, Fujifilm Dimatix, Gettop Acoustic, Globalfoundries, Goertek, Goodrich-Ais, Hewlett Packard, Hitachi, Honeywell, Hosiden, IMT, Infineon Technologies, InvenSense, Kaiam, Kionix, Kistler, Knowles Electronics, Kulite, L-3 Com, Lemoptix, Lexmark, Magnity, Maradin, Maxim, mCube, Measurement Specialties, Melexis, Memjet, MEMSCAP, Memsic, Micralyne, Micrel, Microvision, Murata, Nippon Signal, Omron, Panasonic, poLight, Pyreos, Qmicro, QMT, Qualtré, Raytheon, Robert Bosch, SCD, Seiko Epson, Semefab, Sensata, Sensirion, Sensonor, Si Time, Silex Microsystems, Silicon Sensing Systems, SMIC, Sony, STMicroelectronics, Synkera, Systron Donner Inertial, Teleldyne Dalsa, Texas Instruments, Touch Micro-systems, TowerJazz, Qorvo, Tronics Microsystems, TSMC, ULIS, UTC Aerospace Systems, UMC, Vesper, Wispry, Xaar, X-Fab, Yamaha… and much more

- Rates: Euros 5,990.00 (Full report - Multi user license).

For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr or +33 472 83 01 90).
"Status of the MEMS Industry" report from Yole Développement will be available on May 20, 2015.

About Yole Développement

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole Développement group has expanded to include more than 50 collaborators 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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