SMT PERSPECTIVES AND PROSPECTS

Outlook for the New Year

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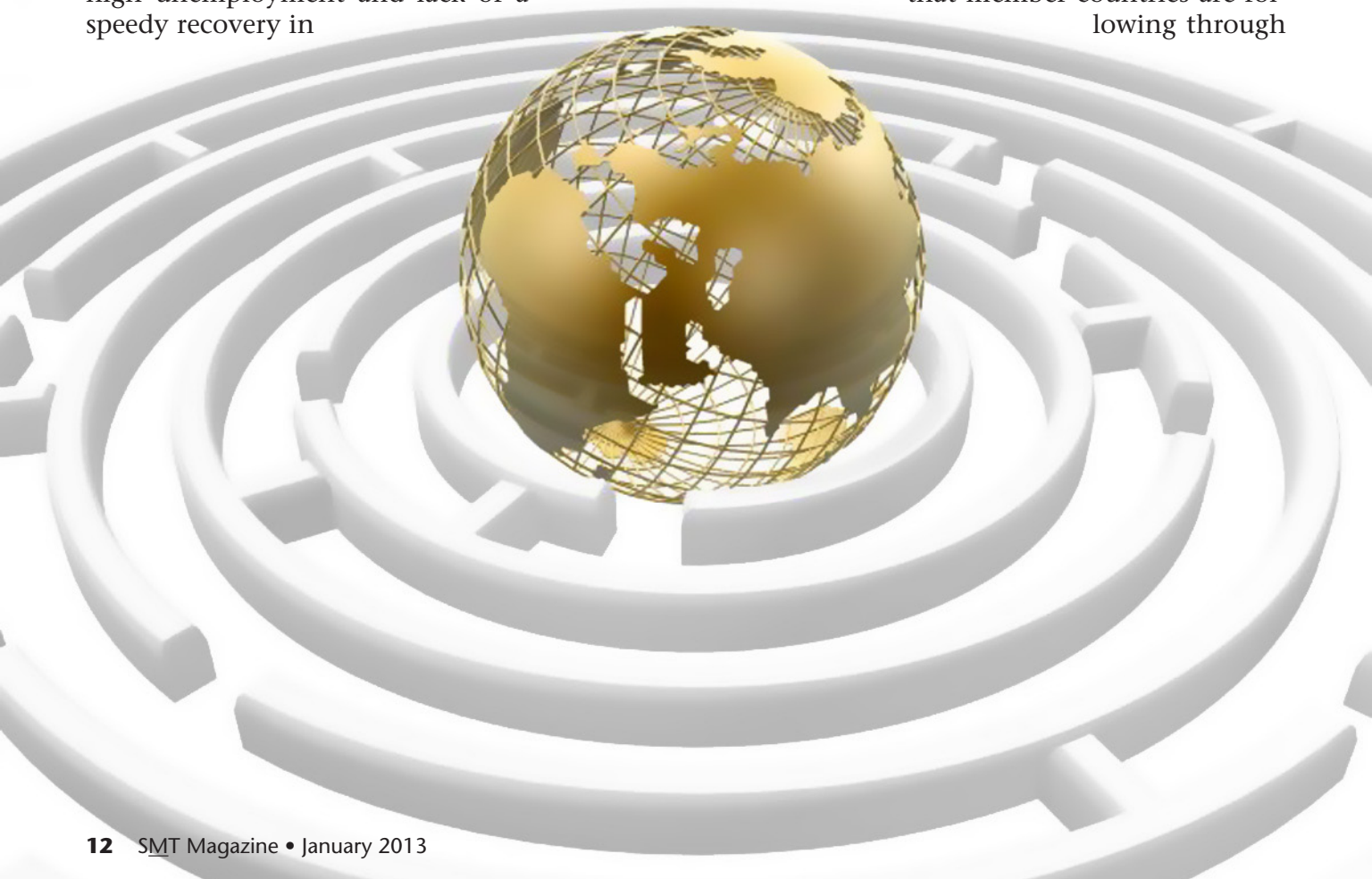
SUMMARY: After protracted high unemployment and lack of a speedy recovery in the U.S., and in the absence of clear solutions to the Eurozone's financial crisis and China's lower manufacturing activities in 2012, will the grim global economic outlook extend to 2013?

Once again the time to look at the year ahead has arrived. In this month's column, I will take a long view on market thrusts in the anticipated global economic landscape, as well as technological trends in selected areas deemed critical and relevant to the industry. Each of these areas will be highlighted, but more detailed discussions will be addressed in my future publications and presentations. After the protracted high unemployment and lack of a speedy recovery in the U.S., and in the absence of clear solutions to the Eurozone's financial crisis compounded with China's lower manufacturing activities in 2012, will the grim global economic outlook extend into 2013? Is there light at the end of the tunnel? How will the global economy affect business?

Global Economic Outlook

The two largest economies of the world, the U.S. and China, are showing signs of improvement in Q4 2012, a trend expected to continue into 2013. Alarming news from the Eurozone has surfaced, although solutions—economic, financial, or political—are to be concocted and implemented. Common mechanisms to ensure that member countries are following through



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on fiscal plans and an agreeable banking regulatory framework are yet to be formulated. The sense is that when any viable solution is in sight it will be a great relief to the market. The region's strongest economy, Germany, saw its central bank issue a downbeat forecast. As the third largest economy, Japan is expected to mildly contract from the 2012 level to below 2.0% GDP, due largely to the country's large export component and continued strength of the yen. An uptick in South America is expected in 2013. Globally, IMF forecasts a GDP rate of 3.2%, which is still below the average of 3.5%.

At the time of this writing, political hurdles in both the U.S. and the Eurozone have yet to be overcome: A fiscal cliff still looms for the U.S. and the Eurozone's debt crisis has yet to abate. Pro-growth political resolutions and economic policies in either the U.S or Europe, or both, will brighten global growth prospects and drive a faster recovery. If these hurdles are not conquered, the global economic outlook in 2013 will suffer.

Heading into 2013, the unemployment rate in the U.S. will decline. The general consensus points to a U.S. GDP of 2.5% or better. If the belief that economic stimulus is justified when unemployment is above 6.5% and inflation is lower than 2% is put to work, we can also expect further stimulus by the U.S. central bank.

In corporate America, where and how cash-rich multinational corporations (collectively holding more than $1 trillion in cash) will invest—overseas or domestic, dividend increase or share buyback—will impact the job market and the U.S. economic outcome, pending government policies and tax reforms. The continued spending inertia by holing cash and taking a conservative stand appears to be the course of action.

China, along with the U.S., will lead the way out of the global economic malaise. Asia continues to be a high-growth region as the world's economic engine. China will play a dominate role, enhancing the realization of the China factor by exerting its influence in both inside and outside the continent.

Overall, sign posts, hard indicators, and soft inferences signal mild economic growth during 2012, but do not expect an exciting 2013.

The China Factor

Yes, there is a China factor. A leadership change has occurred in China once every decade. The new seven-member Chinese leadership selected by credentials and seniority was elected November 2012. This new leadership is the very first generation with no involvement in the revolution that occurred from 1949 to the 1960s. Will this transition of power steer different economic and political policies? My sense is that these new leaders will shape the country's needs with the priority of balancing domestic consumption and exports, harmonizing urban and rural societies, containing inflation, and make a better effort to meet the demands of the people while exercising assertive foreign policies. With all three of the country's largest trading partners in either recession or a slow growth mode, China has more reason to pump up its consumption-oriented economy to spur long-term growth and social stability.

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The Chinese government may set its GDP target at 7% (lower than the 7.5% of 2012). If so, it implies that the new government is willing to accept a slower economy by morphing into a consumption-oriented economy in lieu of investments. This strategy will serve as a stepping stone to a long-run wholesome economy on the world stage. In the range of 6 to 8% GDP, a higher percentage does not necessarily translate into a more robust economy. Quality does count.

The country's twelfth Five-Year Plan, spear-

headed by the State Council, the Ministry of Industry and Information Technology, and the Ministry of Science and Technology of the People's Republic of China, stipulates seven national strategic industries: Energy-saving and environmental protection, alternative energy, alternative-fuel cars, high-end equipment manufacturing, biotechnology, new-generation information technology, and advanced materials. China has indicated that it would provide financial and tax support to these industries over the next decade in hopes of making these sectors account for approximately 8% of China's GDP by 2015 and 15% by 2020.

Heightened emphasis on innovation and technology is embedded in the Five-Year Plan. Also embedded is the construction of "smart" cities, low-carbon emission vehicles, information technology infrastructure, and an environmentally-friendly water and energy system. The goal is to make non-fossil fuel account for more than 11% of primary energy consumption.

The country has made enormous strides, yet much more remains to be done. The country is well aware of the need to build world-class companies with leading global brands at the expense of state-owned or controlled enterprises.

As China becomes the world's largest consumer of semiconductor products, mobile devices, smart phones, PCs, LEDs, solar panels, medical devices, home appliances, and construction equipment, the demand for various industrial, consumer, medical, energy, and information technology-related products and services will escalate, requiring new materials, advanced manufacturing infrastructure, and high-performance electronics.

Electronics Industry: Hardware

Several major events are expected to propel the electronics market. First, a movement toward a "smart" world will continue to drive electronic hardware in product innovation and manufacturing efficiency, with mobility and wireless being the primary thrusts.

In the semiconductor sector, Intel, the top captive semiconductor manufacturer, continues its commitment to capital expenditure to advance manufacturing prowess. In parallel, the No. 1 pure-play semiconductor foundry, Taiwan Semiconductor Manufacturing Company (TSMC), has set aside US $10 billion for capital expenditure in 2013, making it the No. 2 capital spender in the world semiconductor industry, after only Intel Corporation. The majority of capital spending in manufacturing will occur in Taiwan, China, and Korea.

Technologically, efforts and commitments to scale-up wafer size and shrink transistor circuitry will continue. The multi-billion dollar plan to build chips on 450 mm wafers is moving forward by both OEMs (Intel, IBM) and foundry manufacturers (TSMC) with a target volume production date of 2018.

A plan to manufacture below 22-nanometer transistors processors is in the works by both OEMs and foundry houses using legacy immersion lithography technology on 10 nm and 16 nm transistors while extreme ultraviolet lithography is being developed with high potential down the road.

Migrating to a 450 mm wafer is a major technological move to further shrink transistors below 22 nm. These plans and commitments will lead to further advances in the chip industry to deliver increased functionalities and reduced cost in electronic and optoelectronic products that serve a broad spectrum of industries.

As ICs move to below 22 nm, production of the next level of connections calls for new designs and new materials in second-level IC packages and third-level PCB connections. No new forces are on the horizon for second and third levels of interconnections, yet activities are abundant to offer graduate technological advances including optical interconnections, embedded passives, and printed electronics. Development in high-density packages, including 3D packages, system-in-package, and BTC packages will continue. Thermal stability of PCBs, under the high manufacturing temperature imposed by the assembly process, continues to be the most critical performance parameter. Although a PCB possessing a higher glass transition temperature (Tg) is readily available, Tg does not represent the PCB's heat tolerance ability. Other properties, such as thermal decomposition temperature, thermal expansion over a temperature range, out-of-plane and in-plane thermal expansion, and moisture absorption all

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contribute to the overall performance, i.e., internal structure integrity.

Additionally, in new product introduction, market seasonality has begun to shift. Foundry manufacturers are expected to increase shipments of new designs from the third to second quarter to provide OEMs a longer sale period, as driven by the market demand of smartphones and tablets.

Indeed, the market has spoken.

Electronic Hardware Manufacturing

What challenges await the electronic hardware manufacturing sector? The broad answer is how to produce high-quality, reliable products at a competitive cost in a competitive amount of time while generating a target operating margin and profit at any locale in the world. Specifically, attention should be paid to the following areas for OEMs and EMS providers alike:

- Strategic alignment with core competency in niche areas;
- Moving up operating margin through niche services;
- Time-to-market from design to end-use customers;
- Manufacturing flexibility from design to production flow to supply chain agility;
- Supply chain infrastructure and execution;
- Inventory management and optimization;
- Physical proximity to customers;
- Partnership with customers;
- Partnership between OEMs and EMS providers;
- Innovative capability;
- Ability to foresee emerging technologies;
- For OEMs: Outsourcing versus insourcing;
- For EMS providers: Offshoring versus onshoring; and
- Tie-in with advanced manufacturing.

In the context of competitiveness in the global marketplace, advanced manufacturing will gain further momentum in 2013. I define advanced manufacturing as manufacturing capability and leadership capacity to sustain, grow, and excel in the global landscape to meet both anticipated and unpredictable challenges by leveraging technologies and business model. This topic will be discussed in future columns.

Addressing inventory management is imperative to the success of a manufacturing operation and its optimization is paramount to a healthy balance sheet and cash flow. Companies must keep track and control of days of inventory as well as the actual dollar value of inventory. Doing well in this area mitigates the mishap of production outpacing demand and eschews a cash flow trap.

The success of an EMS provider hinges on how well it can formulate a strategic and technology partnerships with an OEM to collaboratively tackle end-market challenges by formulating strategic solutions.

When assessing outsourcing versus insourcing for an OEM and offshoring versus onshoring by an EMS, the cost is not the sole variable in the equation. The cost of ownership drives the business model.

Solar Photovoltaic Market & Technology

The reality is beginning to set in. A rebalancing, consolidation, and shakeout are expected to continue in 2013, but with much less drama. Despite today's market turbulence, the bottom-line is that solar global GW installation will increase although some countries (Japan, the U.S., China, Canada, and Australia) will see a high growth rate and those in Europe (Ger-

many) will remain in a stagnant growth mode in 2013.

As the result of the fast decline of module prices, solar panels become more attractive. The Chinese National Development and Reform Commission (NDRC) set a new domestic installation target of 21 GW by 2015 from its original 5 GW. This quadrupling of the domestic installation target came after its already increased revision from 5 GW to 15 GW in May 2012.

This upward revision of targets will support prices, help absorb an excess supply of panels, and will further stimulate the rapid growth of China's PV market from 2013 to 2015, although benefits may not be evenly distributed and beneficiaries may vary.

In technology, activities are alive and well in advancing thin film efficiency and reliability. Thin film still has much future potential. In 2013, thick-film crystalline silicon technology should remain prevalent in the marketplace.

Again, a viable solar operation requires a business plan positioned to weather the industry's boom-and-bust cycle. It takes four core competencies to do business in the solar space: Technology capability, manufacturing prowess, operational agility, and strategic foresight. They are key to the future of a company, be it a cell and module maker or a materials and device supplier. Sustained success requires these integrated forces to defy the impact of unwanted external conditions. After all, these requirements are not that different from running a viable business in other industry sectors.

In the solar space, some market segments are in distress while others are thriving. When taking all factors into consideration, the industry remains rewarding, perhaps one of few that have reachable, handsome growth prospects in the visible future.

Environmentally-friendly Lead-free Electronics & Regulatory-compliant Manufacturing

The industry, technology, and manufacturing are expected to move smoothly with incremental improvements. Introduction of new or modified lead-free solder alloy materials will continue. The medical electronics sector will join the world of lead-free electronics.

The New Year will be the first calendar year that the Securities and Exchange Commission (SEC) rule requires supply chain diligence and specialized reporting by companies that manufacture or contract to manufacture products that contain certain minerals originating from the Democratic Republic of the Congo and adjoining countries. And the first required report must be filed by May 31, 2014.

This conflict mineral disclosure requirement includes specific elements: Tungsten, tantalum, tin, gold, and their derivatives. Environmental stewardship for global sustainability continues to be an important corporate business policy for 2013. **SMT**

Dr. Hwang will present a lecture on "Preventing Assembly Defects and Product Failures" at IPC APEX EXPO, February 18, 2013, in San Diego, California.

Dr. Hwang, a pioneer and long-standing contributor to SMT manufacturing since its inception as well as to the lead-free development, has helped improve production yield and solved challenging reliability issues. Among her many awards and honors, she has been inducted into the WIT International Hall of Fame, elected to the National Academy of Engineering and named an R&D Stars to Watch. Having held senior executive positions with Lockheed Martin Corporation, Sherwin Williams Co., SCM Corporation and IEM Corporation, she is currently CEO of H-Technologies Group providing business, technology and manufacturing solutions. She is a member of the U.S. Commerce Department's Export Council, and serves on the board of Fortune 500 NYSE companies and civic and university boards. She is the author of 350+ publications and several textbooks and an international speaker and author on trade, business, education and social issues. Her formal education includes four academic degrees, as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. Contact her at (216) 577-3284; e-mail JennieHwang@aol.com.