SMT PERSPECTIVES & PROSPECTS

New Year Outlook: What Can We Expect in 2014?

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Once again, it is the time to look at the year ahead. This is a relished tradition as I am on the spot to think critically about the next 12 months and then have the opportunity to cross-check the predictions 12 months later. My 2013 outlook was, by and large, on or very close to target (Year-in-Review, December 2013). In this piece, I will take a long view on market thrusts in the anticipated global economic landscape, as well as technological trends in selected areas deemed important and relevant to the industry, which are tailored to the target readers of this magazine. Each of these areas will be highlighted, but more detailed discussions will be addressed in my future publications and speeches.

Global Economic Outlook

Overall, the U.S. economy in 2013 was not too hot and not too cold, rendering the Federal Reserve's inaction in rolling back the stimulus program in bond buying. In 2014, the first and second largest economies, respectively, U.S. and China, are expected to show improved outlooks over 2013, while the third largest economy, Japan, launches bold new fiscal policies and economic stimuli. With Japan holding the highest debt levels in the world (at 230% of GDP), Abenomics needs to show real progress; it will be a tricky maneuver. China and Japan both happen to have recently installed new leadership, which will exert new influences and economic policies.

Across the Atlantic Ocean, progress has been made. The signposts indicate that the financial crisis is ending in the Eurozone. Countries such as Italy and Spain are exiting recession. However, the ECB is pondering the challenge and impact of the worryingly low inflation rate. The U.K. sees recovery gaining pace. The Bank of England believes the U.K. economy is recovering so quickly that it will likely consider raising interest rates in 2014[1].

However, a sound economy exists only if there is political and social stability. To that end, the standoff between China and Japan over territorial disputes could skew the global economies if it escalates to a dangerous stage. Such an escalation is unlikely, but not impossible. Eschewing any adverse complications calls for one of the most sensitive and intricate ex-

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ecutions of the U.S. diplomacy and the foreign policies. Navigating between the two disputing countries takes more than the assessment of the current parameters and environments. It also needs both retrospective and prospective understanding of the two countries in relevant economic, political and cultural terms, which are profoundly complex. Brinkmanship would not be an effective tactic. A gingerly and delicate treatment is in order.

The year 2014 appears to be an extension of another relatively low interest rate economy even with a modest interest rate increase, which is good for borrowing money to conduct business and corporate-finance activities. The 2013 U.S interest rate of 0.25% was at a historical low, far below the average (6%, with the all-time high of 20% in the 1980s), and the Eurozone was at 0.25%, also a record low, and U.K was at 0.50%.

In corporate America, a rising tide (stimulus and low interest rate) has raised all boats in the stock market. But many premier companies are taking a hard look at their business strategy and focusing on enhancing operating margin and profitability. It is an arduous and critical thinking process, but it has to be done in order to be competitive. This process includes where and how the cash-rich multinational corporations (collectively holding more than $1 trillion in cash) are going to invest—overseas or domestic; dividend increase or share buyback; operation expansion or mergers and acquisitions. The strategic outcome will impact the job market and the U.S. economy, as will government policies and tax reforms. At the date of this writing, December 1, 2013, the U.S. fiscal policy's holding pattern poses uncertainty and risks to the 2014 economy, and thus to corporate actions.

Judging from the Chinese government's decision not to pump funds into the economy and its implementation of new reform policies, the commodity prices, tightly linked with the supply and demand dynamics, are expected to stay flat or decline further. Another good sign is that U.S. manufacturing activity is in upward trajectory[2].

Going into 2014, the U.S. unemployment rate should see moderate improvement, hovering around 7%, but reaching the 6.5% milestone is perhaps a stretch, unless the new Fed Chair's emphasis on employment out of the central bank's dual mandate—maximum employment and stable prices—exerts "miracle" muscle on reducing unemployment. And the Eurozone continues to struggle with a double-digit high unemployment rate.

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2014 is also the year that the U.S. Federal Reserve looks for clarity on growth in order to taper bond buying. In my view, the Fed should and perhaps would pare back the stimulus in the spring (if not in December 2013), at least moderately. With increased underlying strength, the U.S. economy is expected to grow at a faster pace than 2013, barring political debacle in Washington. There is a good chance that the U.S. GDP may recover to 3% or better.

Overall, for the first year since 2008, you don't have to be an optimist to see the glass as half full. And China's economy (as does its politics) continues to be a factor!

China Factor

China is gaining traction in global trade. The country has just hit another milestone as the use of the yuan (renminbi) in trade finance overtook the euro and the yen, although the yuan is still far behind U.S. dollar. This is not to say that China's banking and financial systems are well established. However, this milestone indicates that foreign (non-Chinese) companies are getting more comfortable trading in Yuan, in addition to garnering some pricing advantages.

It is crucial for China's new leadership to implement structural reforms in 2014. Within the context of "planned reform," the timing

happens to be good from the standpoint of the state of the world economy. With all three of its largest trading partners in a slow growth mode, China has more a reason to gear up its consumption-oriented economy to spur long-term growth, sustainability and social stability. Its government increasingly recognizes the market role in economy in order to move to a sustainable path that is to depend more on domestic demand and less on exports and government spending. The country has just formed the National Development and Reform Commission to design and coordinate its reform. The new leading group's duties, apart from economic reforms, are to plan and carry out reform on modernizing China's "governance system" and "governance capability." The core issue of the reform is "to better handle the relationship between government and the market"[3].

With the formidable task in hand, the country's stability is the new leaders' number one "wants and needs." Consequently, the official growth target is not expected to be higher than 7%. However, take note that, in practice, China has always exceeded its target in recent years.

China's twelfth Five-Year Plan is the national master blueprint to achieve medium-term economic and social objectives. The country must stay on its course to develop seven strategic priority industries: new energy (e.g., nuclear, solar, wind); energy conservation and environmental protection (e.g., energy reduction target); biotechnology (e.g., drugs, medical devices); new materials (e.g., high-end semiconductors, rare earth); new IT (e.g., broadband network); high-end equipment manufacturing (e.g., aerospace, telecom equipment); clean energy vehicles.

China plans to provide financial and tax support to these industries over the next decade in hopes of making these sectors account for around 8% of China's GDP by 2015 and 15% by 2020. The broad-based goals to be achieved are: sustainable growth; moving up to the value chain; reducing disparities; scientific innovation with R&D spending increase to 2.2% of GDP; environmental protection; energy efficiency; and domestic consumption.

To foreign companies, these goals bear a plethora of business implications. I see specific opportunities in individual areas and industry sectors.

For Chinese companies, iconic branding is a dream come true. Many have gained understanding on what it takes to globalize through the thoroughly planned strategy executed relentlessly over sustainable years—Samsung and Singapore Airlines are two admirable models. As more indigenous companies aspire to be a global brand, more global competition in all industry sectors is in the works.

Electronics Industry: Hardware

Five words cover the essence of electronics hardware: smart, mobility, connectivity, wearability and innovation.

Technology never holds still. Technology advances will prop further mobility and connectivity in 2014. The growth and volume of electronics hardware will be driven by mobile devices, and high reliability and high performance electronics will propel new materials innovation.

In semiconductor sector, Intel, the top captive semiconductor manufacturer since its inception, made an astounding announcement that the company will open up its fab factories to outside business, serving as foundries as well. The company will compete head-on with other giants, such as Samsung and Taiwan Semiconductor Manufacturing Company (TSMC). Its unprecedented strategy of giving up its long-standing captive status will change the dynamic of foundries business among the top players, and may spill over to the industry.

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In manufacturing technology, 28 nm node has demonstrated high yield and low-cost manufacturing. Samsung and TSMC reportedly will use the 20 nm node technology to manufacture Apple chips in 2014. Additionally, the manufacturing prowess in 14 nm node will be unveiled by Intel. As the 20 nm is being established, 2014 is also the year to lay the ground work for developing 10 nm capability on 450 mm wafers.

Building chips on 450 mm wafers in volume production is moving forward by both OEMs and foundry manufacturers. Establishing 450 mm wafers are a major technological move, so is to further shrink transistors below 20 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. In the wafer fab equipment market, a year-over-year growth rate of more than 30% brings 2014 to the projected spending of $39.5 billion.

In optoelectronics, new materials for LEDs, such as gallium nitride-on-silicon, is expected to see market penetration in 2014.

As ICs move to 20 nm and below, a continuing effort to make the next levels of connections to reach the end-use products calls for new designs and new materials in the second level IC packages and the third level connection in PCBs. In 2014, major new thrusts are not in sight for the second and third levels of inter-connections, yet activities are abundant that offer gradual technological advances, including optical inter-connections, embedded devices and printed electronics. The development in high density packages, including 3D packages, system-in-package and BTC packages will continue. Overcoming the design and manufacturing hurdles, the packages with 0.3 mm pitch BGA architecture will be entering into the mainstream.

To maximize the yield and reduce cost, PCBs' thermal stability, 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 (T_g) is readily available, T_g, per se, does not represent the PCB's heat tolerance ability. Other properties, such as mechanical properties, thermal decomposition temperature, thermal expansion over a temperature range, out of plane and in-plane thermal expansion and moisture absorption all contribute to the overall performance (i.e., internal structure integrity).

Electronic Hardware Manufacturing

Going forward, the three business models in electronics hardware manufacturing, OEM (original equipment manufacturer), ODM (original design manufacturer), and EMS (electronics manufacturing services) will shift and the demarcation among them will be blurring. The challenge to companies will be crafting a clear vision and formulating a strategy based on not only the core value but also the deep understanding of the market and its trajectory.

Nonetheless, the bottom-line objectives in executing the business remain the same: to produce high quality reliable products at a competitive cost, in a competitive timeline while generating target operating margin and profits at any justified locale in the world. Specifically, attention goes to the following areas:

- Strategic alignment with core competency in niche areas
- Moving up in operating margin through niche products and 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 with individually justified external services (e.g., outsource)
- Innovative capability
- Ability to foresee emerging technologies
- Tie-in with advanced manufacturing

In the context of competitiveness in the global marketplace, advanced manufacturing will gain further momentum in 2014. As one example, to slash production lead times and to advance a product's characteristics, additive manufacturing (3D printing) has opened up

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new space. 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 a well-positioned business model." This is a separate topic to be discussed in future columns.

I cannot emphasize enough that inventory management is imperative to the success of manufacturing operations, and its optimization is paramount to the healthy balance sheet and cash flow. Companies must keep track and control of both days of inventory as well as the actual dollar value of inventory. Doing well in this area mitigates the mishap of production outpacing demand as well as eschews cash flow trap.

When assessing the viability of out-sourcing, regardless of on-shore or off-shore, the cost is not a sole variable in the equation; rather, the cost of ownership drives the business model.

Solar Photovoltaic Market and Technology

The painstaking rebalancing, consolidation and shakeout are ending.

All signposts indicate that 2014 is looking brighter throughout the solar industry and the "healthy" companies who have served the solar sector during the boom and bust times will win big and the sustainers will be handsomely rewarded. Companies that have a solid strategy and have thus survived the last two-year "massacre" have raised their shipment guidance. Overall, 2014 will be a rebounding year, with the explanation below.

In 2014, the global end-use market will be growing or stabilizing—U.S., China and the rest of Asia-Pacific will grow and Europe will be stabilizing. Japan's lucrative feed-in tariff scheme will accelerate its solar deployment. Solar global GW installation will hit 45–55 GW level.

In the U.S., more than 9.4 GW of cumulative solar electric capacity was installed in 2013. The Federal Energy Regulatory Commission (FERC) stated that solar is one of the fastest-growing sources of new energy in the United States. To spur new solar deployment nationwide, FERC issued a new order that allows solar projects that meet certain requirements to qualify for a "fast track" interconnection process, thus eliminating the need for costly and time-consuming studies. This new development will help reduce interconnection bottlenecks.

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China's Bureau of Energy proposed to increase solar power installations from the previous target of 10 GW to 12 GW in 2014. The prevalent view is that reaching 15 GW is likely. This time around, on top of the elevated installation target to help the industry, Beijing is accelerating its build-up of solar power plants, which will undoubtedly help solar panel sector. This action is expected to rectify any residual imbalance that wrecked the industry for the last two years in an extraordinary way. Obviously, this action is good for "healthy" pure-solar-players who survived the two-year downturn, such as Canadian Solar, Trina, Yingli, and First Solar, but not the "unhealthy" companies, who are goners.

In photovoltaic cell technology, while thick film and thin film are co-existing in the marketplace, the quantum dot technology is burgeoning in the laboratory prototype, which is poised to leapfrog the existing technologies. In the marketplace, thin film has lost market share during last two years due to the market turmoil and lack of scale. Going forward, the advanced thin technology coincides well with the future growth of mobile devices.

In terms of regional market, there will be a market re-distribution geographically. The solar PV market is shifting from Europe to Asia Pacific. However, not to ignore Europe; it remains overall a vast pool of end demand for solar energy, accounting for nearly a third of global demand at 10–12 GW in 2014. Europe will be stable in 2014 and will remain a key region for business.

For suppliers in materials, components and devices in the supply chain of the solar industry, the healthy companies with a solid business model will also be rewarded substantially. In the solar space, when taking all factors into consideration, the industry remains rewarding, perhaps one of a few that have reachable, handsome growth prospects in the visible future. After going through the growing pains, the industry is expected to get stronger.

Environment-Friendly Lead-free Electronics and Regulatory-Compliant Manufacturing

The industry's technology and manufacturing are expected to move ahead with incremental improvements.

On conflict mineral disclosure requirements, 2014 will be the first filing year to comply with the Securities and Exchange Commission (SEC) rule. The rule requires supply chain due diligence and specialized reporting by companies that manufacture or are contracted to manufacture products that contain certain minerals originating from the Democratic Republic of the Congo and adjoining countries. Conflict mineral disclosure requirements include specific elements—tungsten, tantalum, tin, gold and their derivatives. Make a note that the category of derivatives is a tricky area.

In 2014, more electronics sectors including medical devices will join the world of lead-free electronics to comply with RoHS. Additionally, RoHS will be deployed to more countries.

Introduction of new or modified lead-free solder alloy materials will continue through sound scientific (metallurgical) execution in an effort to improve the performance and reliability and to alleviate production and reliability issues of tin-copper and tin-copper-silver systems. On reliability, high-quality work has been conducted and abundant data generated. One challenging effort is not to make a conclusion when a conclusion is not ready to be made. Publications that deviate from this principle are not in short supply. Going forward, it is hoped that this necessary principle would be followed so that reliability means reliability.

Overall, environmentally friendly electronics is becoming a given. Corporations' environmental stewardship for global sustainability, driven by regulations or other causes, continues to be one of important corporate business policies in 2014. **SMT**

References

1. Financial Times
2. Institute of Supply Management
3. China Daily
4. SEMI World Fab Forecast report

Upcoming Appearances

Dr. Hwang will present a lecture on "Preventing Manufacturing Defects and Product Failures" at IPC APEX EXPO 2014, on March 24 in Las Vegas.

Dr. Hwang, an international businesswoman and speaker, and business and technology advisor, is a pioneer and long-standing contributor to SMT manufacturing since its inception, as well as to lead-free electronics implementation. Among her many awards and honors, she is inducted to 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 Corp., Sherwin Williams Co., SCM Corp, and IEM Corp., she is currently CEO of H-Technologies Group, providing business, technology and manufacturing solutions. She has served on the U.S. Commerce Department's Export Council, Chairman of Assessment Panel on DoD Army Research Laboratory, various national panels/committees, and the board of Fortune 500 NYSE companies and civic and university boards. She is the author of 400+ 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. For further info, go to: www.JennieHwang.com. To read past columns, click here.