Interview – Jennie S. Hwang, PhD., D.Sc.

Jennie S. Hwang is an industry icon. For nearly 30 years she has been involved in the electronics industry. On top of her regular jobs, she has been a past president of SMTA, celebrated author of numerous books and articles, and an advisor to government agencies and the U.S. Congress on the electronics industry, diversity, forecasting future disruptive technologies and globalisation. She also serves on university, civic and Fortune 500 company boards.

Trevor Galbraith spoke to Jennie about her unique industry heritage and her views on the challenges ahead.

Jennie S. Hwang

Q1. How long have you been in the electronics industry? Can you give us a potted history?

I have had the privilege to work in the electronics industry during the most dynamic period of last three decades, from the inception of surface mount technology for PCB manufacturing to today's environment-friendly electronics, to the on-going integration and convergence of data, voice and video.

The electronics industry reached the 1 trillion dollar mark in 2000 and became the largest employer, surpassing the automotive industry.

SMT, a critical manufacturing technology, has been the backbone of electronics miniaturisation. Its glamour is wavering with time, yet its importance is lasting. I personally witnessed and engaged in SMT manufacturing through the transition from production yield zero to six sigma, meanwhile the industry has tackled the endless changes and advances from chip level to board level.

Since the discovery of the electron in1897, the electronics industry's essential milestones include the invention of the transistor in 1947, the introduction of the microprocessor in 1972, and the genesis of Internet hardware in 1990s. In chip level, among exciting technologies, the expanded silicon technology (strained silicon, SiGe and silicon photonics), 300mm wafer, finer than 45 nanometer circuitry and increased efficiency of subsequent interconnections in the packaging and board levels have and will continue to fill the market demand in lower cost, higher functionality, lower power consumption and concurrent capability of digital processing and analog radio frequency broadcasting.

Components and packaging have evolved from 50 mil pitch PLCC and LLC to 20 mil pitch QFP and SOIC to BGA, CSP and flip chip DCA to wafer-level packaging, stacked and 3D packages.

It would be remiss not to mention CFC elimination/no-clean solder paste era and the initiation of lead-free electronics. I vividly recall that many then felt that CFC elimination and giving up RMA solder paste were 'impossible.' CFC-free conversion turned out to be a smooth process with total

success. I also recall that the first round of no-clean solder paste was not impressive to say the least. In no time, solder suppliers were able to improve and offer the no-clean pastes that could outperform the sage RMA pastes. The industry's ability in both the speed and the quality of adapting to changes has been utterly stunning.

Q2. Is it true that Dr Ning-Cheng Lee was a former student of yours?

This is an unexpected and actually a surprising question, but an interesting one. Back in the early 1980s, while I was leading and growing the electronics business on the senior management team at SCM Corp. (then a Fortune 500 company), I personally hired Dr. Lee as a research chemist and we immersed Ning-Cheng into the electronic solder arena swiftly. He was a great addition to our solder business then.

Q3. As CEO of a solder company, you must have experienced a roller-coaster ride with the sharp rises in metal prices. Do you see this settling, or do you think that there will be continuing rises as the world's supplies of metals used in electronics are challenged?

Metal prices buoy and sink with various factors, such as supply and demand, regional mining issues, sourcing issues, imports and exports dynamics, and international trade agenda. Precious metals and commodity metals are all subject to the intricate supply-and-demand balance. With the increased globalisation, the balance factor is becoming more complex.

Metal prices have always been fluctuating, but never in such a steep upswing as that we have experienced during the last three to seven years. Copper prices have surged by 400% from 2003 to the first quarter of 2007. Other metal prices have also multiplied. As well recognised, this upswing is due largely to the increased demand, as the result of production introduction, ramping up and, most significantly, the large consumption from the emerging markets. For example, China, the world's largest consumer of copper, constitutes 65% of the copper consumption growth since 2000.

To your second part of question, no, I do not expect that there will be straight-line rises on metal prices to the degree that we have experienced. Recently, the copper price has eased, and it is expected that copper price will continue to ease. Nickel price encountered precipitous plummeting from about $50,000 a metric ton to about half of that lately.

One thing that is good or not so good, depending on your perspective, is that the electronics industry does not dictate the metal prices; other high volume usage industries do. Metals that are used in electronics constitute only a small fraction of the total consumption of each respective metal. Thus, although the price is in sync with the market, the metals are available for electronics.

It is a fact of life of doing business to react to and, more desirably, prepare for the global metal price. Historically, the demands have been met by the supply over time.

Q4. Why has the US government lagged behind the rest of the world with lead-free legislation?

The U.S. has always been the vanguard in lead legislation and the associated technologies across the industries. The U.S. is also a pioneer in the research and technology of lead-free solder, as evidenced by the lead-free plumbing industry back to 1970s. For lead-free electronics, a scattered effort was made before the late 1980s, yet a concerted effort started around 1989, when the lead reduction or elimination was included in the U.S. government Mantech program as one of subset objectives to fulfil the advancement of military electronics in cost and performance, as well as for the betterment of environment. I was invited as the advisor to the program.

As to manufacturing of lead-free electronics, U.S. indeed has lagged behind, due partly to the lack of federal legislation mandate. Although several bills were introduced to the U.S. Congress between 1990 –1994, the industry essentially deterred the legislation attempt from 1995 to 2002.

Q5. Will affordable and reliable conductive adhesives ever become a reality?

Actually, at the time of SMT implementation, conductive adhesives in comparison with solders were scrupulously explored, and solders were consequently chosen. Since then, conductive adhesives have made major strides in technological development. However, I do not see conductive adhesives covering the broad spectrum of electronics becoming a reality in the mainstream manufacturing, at least not in the foreseeable future.

There are technical, as well as manufacturing, hurdles yet to be overcome, namely the resistance stability over the entire service life, the balance between strength and impact resistance and the competitive manufactuability of circuit cards on the production floor.

Q6. Some technologists foresee the future of packaging technologies to be the build-up of flexible circuits with embedded components on a wafer. What new technologies do you see becoming mainstream in our industry?

Photonics on silicon and new applications in LED and flexible electronics are among the promising new technologies. However, true flexible electronics is not expected to materialise within next five years. In a big picture, the answer here is echoed with the key words 'mainstream,' 'disruptive' and 'timeline.' Within the packaging and assembly sectors, hardly a disruptive technology would become a mainstream in less than five-year timeline. Yet a myriad of incremental technological advances are expected to contribute to reducing the system cost, facilitating manufacturability and developing new and better end-use products.

Going forward, indeed, the convergence and integration of functionality will be the main thrust of the industry. The market, as well as emerging technologies, will be driven by wireless, digital and consumer electronics.

Q7. What are considered disruptive technologies in general and to our industry in specific?

Many innovative technologies are considered to be enabling rather than disruptive. A disruptive technology is poised to exert unexpected, pervasive, rapid and unrelenting effects, which causes disorder and habitual interruption and which changes the landscape of status quo and existing infrastructure. For instance, digital photography is a disruptive technology. In our industry, when the electron was discovered, that was a disruptive discovery. When the transistor was invented, that was a disruptive technology, so was SMT manufacturing of PCBs. The advent of the personal computer was disruptive. Many view that open source software is disruptive. CFC elimination and lead-free conversion can hardly fall in the disruptive category. I am recently appointed to the Committee on Forecasting Future Disruptive Technologies, commissioned by U.S. Department of Defence, Homeland Security and National Research Council. I defer the specifics until the report is ready to be released.

Q8. Do you have a view on the recent round of mergers and acquisitions in our industry?

The success of a merger is closely linked with the initial true motivation of the merger and the subsequent operating integration and execution. There have been huge successes and miserable failures.

It is widely known that the reasons for a merger include expanding geographical presence, complementary businesses, increased market segments, enhanced competitive position, new growth opportunities, improved customer services, operating synergies, strategic synergies, diversification, larger and more competitive organisation, achieving global reach and the best interest of the stockholders.

Overall it comes down to the assessment of risks and challenges vs. rewards and opportunities.

When/if a merger is initiated with unsound or untimely reason, a larger company may not be a more competitive company, albeit the scale does matter in some businesses. The board and management of the combined unit must have a well-thought out plan, swift integration and seamless execution and must have the thoughts and ambitions of growth and profitability.

A forward-looking board and CEO can make a not-so-good merger a success. On the other hand, a merger with an apparent good reason may not lead to a success under a mundane board and management.

Within our industry, some mergers and acquisitions seem to have more merit than others do.

Q9. The convergence between telecom applications and computers are the driving force behind virtually all high-volume products at the moment. What other innovations do you see that may develop into high-volume applications?

Innovations in optoelectronics, photovoltaics, display technologies, embedded technologies and nanotechnology (non-fad apps) are the main thrusts.

Several key advancements are of particular interest to meet market demands. For example, semiconductor material by continuing to expand silicon technology to produce low cost and high performance products; the 'well-rounded' printed circuit material possessing controlled CTE, moisture resistance, reduced impedance, increased dimensional stability, increased thermal stability and low cost; and the materials, design and processes that can minimise the heat exposure, eschew potential heat-related damages during manufacturing and service, enhance green environment and lower energy consumption. Overall, market push, global competitiveness and the ever-shortening life cycle of electronic gadgets have been driving and will continue to drive technological development. Additionally, environment-friendly manufacturing and the delivery of environmentally benign end-use products that are safer at the end of product life cycle have become essential to technology-business competitiveness. This is a continuing challenge to the industry.

Q10. What impact do you think the ascendancy of China as a manufacturing hub and major wealth creator will have on western civilisation?

China's industrialisation and economic reform is an integral part of globalisation. Just by its sheer population, the country is of paramount importance to the global market.

In this globalisation era, innovation economy is being fuelled by the ever-fast information flow, new knowledge generation, and the way the information and knowledge are used. To produce more with less people and lower cost is becoming every operation's on-going goal, making ever-increasing productivity a relentless target. The ability to timely move the scientific discoveries from the laboratory to the manufacturing know-how to the marketplace, the prowess of practical knowledge and entrepreneurial spirit are the niche of the workforce. Under such a global environment, I would expect that the dynamic among the three continents continues to be fluid. However, one thing for sure is that all three continents are expected to face fierce competition across continents and national borders.

With the rapid technological changes and the powerful tools that are available to doing business, the cornerstones of corporate strategy and national strategy are to raise the intellectual bar, climb up the food chain and move up the technology curve. In the long run, innovation and competitiveness are key to each country, thus to a constantly rejuvenating economy. Only a strong economy creates jobs, prosperity and civilisation.

Considering the various forces - political, economical or societal - coming from different directions, China as a manufacturing hub and new businesses land would lift the competitive bar and thus accelerate the global development and civilisation.

Going forward, the competitiveness across the industries relies on the efficient use of materials, introduction of better products and the relentless innovation for unique or desired properties and performance. The competitive edge stems from visionary anticipation and intimate understanding of the global trends and market drivers, in conjunction with the timely execution of broad-based knowledge and information.

Q11. What were your three most fulfilling experiences, and where do you think you will be in five years time.

There were manifold fulfilling and learning experiences in my professional journey. Three struck me first:

- My job with my first employer (Lockheed Martin Corp., then Martin Marietta) back in late 1970s. I was on the fast-track management under the all-male working environment while in my 20s. I quickly won the confidence and respect from my superiors, who were 20 - 30 years older and had initial reservations about a young woman's management. I learned that, as the first woman on the job, it was critical to learn the subtle balance between the core elements for an executive woman: competency, capability, intellect and femininity.
- The preparation and delivery of my commencement address to university graduates (classes of 2001 and 2007). To share with and to inspire so many promising young men and women who are going on their new stage of lives and careers was exceptionally invigorating.
- The opportunity to visit SMT operation and facilities of almost all OEMs in 1980s and later on the EMSs around the world. The interaction with diverse people while providing hands-on solutions to challenging problems and issues was valuable and enjoyable.

Going forward, slowing down is not a choice. I couldn't wait to go on my 4th decade and perhaps 5th decade career. Professionally I see myself in two primary roles. I will continue to be dedicated to our industry, help move into lead-free electronics and provide business and manufacturing solutions, as well as disseminate new knowledge to the workforce. In a broader role, I relish my service on the government committees to advise Congress on relevant issues, as well as my service on the corporate board to formulate corporate strategy and envision the future for growing international business in this feverishly competitive global marketplace.

Dr. Hwang, as always it is a pleasure. Thank you very much.

Trevor Galbraith.