

## The Foxconn Robots of the Future – Human or Machine?

A great deal of hand-wringing and speculation has occurred recently over the announcement by Foxconn that it plans to install an estimated 1 million robots over the next three years, up from about 10,000 robots in use now. The company's chairman, Terry Gou correctly stated to his staff that he planned to move its more than 1 million employees up the value chain beyond basic manufacturing work. Critics fear that the change would result in a company that was previously 'mostly human' into being one of 'mostly robot.' The critical question becomes, 'what kind of robots' do you want to have?

Machine robots do have a way of replacing inefficient human labor activities as the automotive industry can attest. In that sector, robots do a much better job of painting, welding and assembling cars than do humans. As a result, we find the percentage of assembly done by robots in making cars increasing every year - now without apology. The benefits of using robots with regard to quality, accuracy and improved productivity (no breaks, sick days, down-time or accidents) is beyond dispute, much to the frustration of humans who lose these relatively low-skilled jobs. The result has been much cheaper and higher quality automobiles as repetitive human tasks are replaced by machines, thereby forcing people to migrate to higher value-add work activities that are uniquely human.

The high-tech electronics industry is one of the most automated sectors in the world. The assembly of printed circuit boards (PCBs) today is almost 100%, being manufactured by robotics using surface mount technology (SMT). The only parts that are not SMT are those components that are 'odd' shaped components that are not easily conformable to Pick & Place equipment because there is no standardized packaging. While special machines exist to automate the assembly of these odd components, electronics manufacturers cannot always justify their cost if they are low volume suppliers, instead electing to use humans to place and solder these parts manually. As with the automotive industry, the automation of PCBAs in electronics products has led to higher quality, lower cost and enormous strides in productivity. Today, end users benefit by purchasing superior performing products at continually lowering cost (think of the computer notebook just ten years ago compared to the one today).

Robot technology in manufacturing PCBA's has advanced mainly in speed and in handling smaller pitched components. The so-called 'box' side of the product assembly (that is, the finished product steps as compared to the PCB board side assembly) is still largely dependant on manual labor although significant inroads in robotics have been made in the boxing and palletizing of finished products. Yet, greater improvements can be achieved in automating the assembly of subsystems and modules such as power supplies, LCD displays, batteries, keyboards, connectors - and even the riveting and screw driving of the final assembly. Only a small percentage of robot technology has been applied to these tasks because to date, the cost of labor in China (and other low-cost regions) has offered such a gap as to not justify the capital investment needed from a robotic solution.

Labor cost is only one element of the total cost of assembly in the electronics industry. There exist both hard and soft dollar costs that are becoming increasing vital to companies like Foxconn who deal with

such massive volume of electronic product assemblies. In 2010, there were manufactured over 362 million PC products (including Tablets) and over 1.3 billion mobile handsets – with nearly all of the PCs and most of the handsets made in China. It is estimated that Foxconn alone produced over 80 million PC products and perhaps as much as 0.5 billion mobile handsets. To manage this, the company employs over 500 SMT robotic lines throughout China in its factories that operate 23 hours a day, seven days a week. Given the scale of such an operation, it begs the question of where could additional efficiencies be found by robots to remove excessive costs and improve productivity further.

There are undoubtedly many factors in addition to improving costs that are driving Foxconn to consider robots in its future manufacturing operations. In 2010, the company endured considerable negative publicity from the result of twelve suicides by workers driven to despair based on the working conditions of its factories. Employees report a military-style culture that discourages talking during work and intimidating rules that some workers say make them feel like human robots. Indeed, there are many tasks involved in the assembly of electronics products that still remain repetitive, exhausting, and alienating. Despite such boring jobs, most workers are thrilled to have a relatively high paying job that offers lots of overtime, thus keeping thousands of Chinese citizens employed well enough to feed them and their families, and to send money home.

The risk of employee discontent plus the potential defection of key customers (such as Apple), coupled with the positive attributes of robotic automation, has led Foxconn to make a very logical choice; invest in robots to perform those tasks that are the most monotonous and repetitious now experienced by human workers. The implementation of such robots will surely lead to a loss of certain human jobs, with the end result of forcing people to decide how they 'move up the value-chain beyond basic manufacturing work' – vis-à-vis Chairman Gou's prescient statement.

An example of how robots replace human workers will perhaps make the practicality of this step clearer.

The average cycle time for the assembly of most components done by hand is 3 seconds. This doesn't sound like much until you have to do this 50,000 times a day – enough to drive the most dedicated worker to despair. An average robot is able to mount odd parts at a rate of 1 second per part. This means one robot can do the work of three human workers over the course of three production shifts. To state it another way, one robot can replace 9 workers (= 3 workers x 3 shifts) in odd component assembly. Considering that the average cost of an unburdened<sup>1</sup> worker in China is approximately \$3,750 a year, one robot can save up to 9+ human worker costs, or \$34,000 a year in hard dollar savings (soft dollar savings are gain from no longer having to absorb the social and overhead burden costs). A general rule of thumb in the capital equipment sector is that new equipment purchases should achieve a two year payback, which in this case would equate to \$68,000 over two years. In essence, the robot would have to cost less than or equal to this amount – a very realistic figure given the cost of today's robots. Recent salary increases in South East China only improve the return on investment and make it more financially acceptable.

In electronics assembly today, experts claim that you will find 2-3% of all components will be 'odd' parts in a typical PCBA electronics assembly. Add to this the manual efforts required in the final box assembly

of the end product (the enclosure, display, battery, keyboard, power supply and chip arrays) - of which possibly as much as 50% of the handling can be automated - and you will conclude that it is a very powerful argument for a second generation of augmented<sup>2</sup> product assembly by robotics. As a result, the claim by Mr. Guo that Foxconn foresees a million new robots in the next three years is one that is not only imminently practical, but inevitable.

Please don't mis-interpret the math of these calculations. One million robots do not equate to the replacement of 10 million jobs because not all robots are created equal and besides, Mr. Gou may have been indulging in hyperbole. Yet, a likely reduction in human labor by 20% or more is reasonable and feasible, and such moves keep the company financially healthy as well as its suppliers. Unskilled human workers will clearly suffer yet must reconsider what better knowledge-based contribution they make to earn a living. Happily, at least in our opinion, these workers will no longer have to endure the mindless and soul-starving experiences of performing manual activities that a machine can do much better and faster. Another important indirect benefit is that we can be hopeful that we will see less suicides of despair among the unskilled work force in China and other regions.

Randall Sherman is president and principal analyst of New Venture Research, a market research and consulting firm specializing in the electronics manufacturing industry. We would like to thank Mr. Sjeff van Gastel, Manager of Advanced Development at Assembleon, for contributing key ideas to this article.

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<sup>1</sup> Burden in most factories includes overhead, markup and social benefits such as healthcare, dormitories, vacation/sick pay and other amenities found on campus. Our research shows that a fully burdened wage rate can be 2-3x the base wage rate which naturally underestimates the gains realized by robots of human worker replacement.

<sup>2</sup> Augmented is intended to mean the next generation of robots that are more flexible and more human-like in their capabilities. One example is ABB's 'FRIDA' robot that can demonstrate the versatility of a human worker in electronics production line assembly.