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Robots vs. human wages: the next potential \$trillion growth & jobs opportunity
Today robomation may be like when the auto replaced horses and their workers



Manufacturing is moving more to robots replacing mechanical jobs, just like jobs related to horses and buggies were replaced as the car was introduced. Tens of thousands of jobs were lost in the diaper manufacturing sector dealing with waste management of the "exhaust" from the back end of horses. The average horse produced 45 pounds of dung per day (plus a gallon of urine). There were winners (carmakers) and losers (stable owners, dung cleaners, feed producers, trainers, et cetera.)

This was the early days of the "teamsters" that developed into the labor union first called "Team Drivers' International Union." A good teamster knew how to manage horses, to get them to pull heavier loads while keeping them in good physical condition and keep them clear of accidents on the busy streets of NY and San Francisco.

Earlier, over 5 million horses were the backbone of the Civil War. Horses moved guns, carried generals and delivered messages. General William T. Sherman told his troops: "Every opportunity at a halt during a march should be taken advantage of to cut grass, wheat, or oats and extraordinary care be taken of the horses upon which everything depends."

A new era was born, since autos and mechanical engines were more cost effective than the horse. This created new jobs and business opportunities as dung was replaced by smog. Horse power, saddle makers and vast businesses were replaced by the horsepower of engines. New opportunities were created such as by William Phelps Eno, who gave us the stop sign, yield sign, the crosswalk, the one-way street and the pedestrian islands. Today we are beginning the robotics revolution, which may be as great a change as the Industrial Revolution, which was accelerated with the technology that created the auto.



Today restaurants and factory workers are being gradually replaced by robot power. Today, there is a huge unmet need for robot and in general technology workers. The U.S. lacks STEM (Science, Technology, Engineering, and Math) trained workers. Foreign students, especially from China and India, are flocking to our top Universities and becoming STEM-trained, only to have to leave after their student visas expire to go back home and compete against U.S. companies.

In restaurants, the push for higher minimum wages is accelerating automation, which is just starting in the U.S. but widespread in Asia.

An example of such robotization: At the Toronto airport I recently encountered automated ordering, where a small kitchen pod efficiently prepared food from table ordering devices with few kitchen workers. A human was still needed to deliver the food to the tables, which also had

individual phone charges and Internet access on a pop-up screen also used to order.

The automation of factories has just begun. In the meantime, the Wall Street Journal on 9/27/2016 reports that two million U.S. manufacturing jobs will remain vacant due to a shortage of skilled workers.

The article points out how U.S. companies are looking to Germany, with its vocational school solution where students both study and apprentice with top German industrial companies.



Cleaning crews are being replaced in airports at Toronto, Singapore, Queensland, and Auckland, etc. Intelibot "Hands-Free Cleaning" machines clean concourses. They even detect motion and immediately stop to let people pass.

Robots could be the next trillion-dollar business opportunity/job creator for skilled technology folks.

Innovations in robotics have come quickly and have become very cost effective. The biggest improvement in robotics has come from smartphone technology, with mass production drastically reducing component costs which are also used in robots. Building and modifying prototypes have been made

much quicker and less costly with the advances in 3D printers and software.

Costs have become very affordable. For example, Double Robotics Telepresence where you have a video connection with another person anywhere in the world costs \$2500 vs. \$70,000 when first introduced. For example, these are useful in hospitals or emergency rooms for a specialist consultation.

A small number of engineers can build something with massive appeal. Instagram had only 16 employees when it was sold to Facebook for \$1 billion. Hardware companies no longer need multi-millions of initial investments to become successful start-ups. This opportunity is attracting the brightest young talent. A recent news report showcased young engineers who decided to skip college and develop their own hardware or software startups with little capital compared to a few years ago.

Robots connected to the cloud can access huge amounts of computer power at very low cost without having to put the computer power into the robot itself. Robots can learn from and teach each other. For example, iRobot's Roomba vacuum cleaner isn't very sharp on its own. Networked with millions of other Roomba's, however, iRobot can examine all the situations others have collectively encountered and use the data to re-program them to be more effective.

Financing is flowing from incubators and accelerators designed to launch startups. For example, alphalab.com provides early-stage technology companies with an extensive mentor network, educational sessions with industry leaders, and a rich entrepreneurial work environment within a nationally ranked accelerator program. An example on the hardware side is bolt.io out of San Francisco.

China's Leadership

Much of the technology leadership has been foreign, especially based in China and India. In China, the education system has a complicated history. Since the 1980's more emphasis has been given math and science. A project for creating 100 world-class universities began in 1993, which has merged 708 schools of higher learning into 302 universities. More than 30 universities have received help from a special national fund to support their attainment of world elite class. Recently national university sci-tech parks have resulted in many new hi-tech enterprises and important innovations. On-line adult education is also rapidly growing to meet the growing need for high-tech skills.

Chinese have begun to place a high value on overseas education, especially at top American and European institutions. Outside of its elite domestic universities, Chinese training isn't as good, and many middle-income families want their children to go to foreign universities. In China, schools are required to have a Communist Party committee, which is charged with helping direct the ideological, political and moral education of students. Such pressures have intensified under President Xi Jinping, who has stressed the need to deepen education in so-called "core socialist values." Students and teachers are denied access to websites such as Facebook and Google Scholar, a mainstay for many academics.

In China, most schoolchildren are taught their first English lesson at the age of 10. Asian students are flocking to the best U.S. universities after studying hard to get good grades on the U.S. SAT test. Many

of these highly skilled students would like to join U.S. innovation firms after graduation, but we send them back to compete against us in China when their student visas expire.

The visa options for foreign skilled STEM U.S. graduates is very limited. Few student families can afford to pay the required \$500,000 for the only 10,000 EB-5 U.S. Investor Visas available. These are usually obtained by wealthy Chinese. In 2015, 8,156 of them went to Chinese as the easiest path to U.S. citizenship.

There is a limited number of H-1B visa's given by a lottery each year in a very complex, messy application process. The April 2016 annual lottery had 236,000 applications for the about 85,000 visas available This is only for temporary workers for 3-6 years, so they can't develop deep roots in the U.S.

Donald Trump has proposed reforms to HB-1 or its suspension in his fight against immigrants, along with his promised deportation squads and restrictions on Muslims. To get elected with his great sales techniques, saying whatever the crowds want to hear, he reversed an earlier immigration position: Trump tweeted in August 2015, "When foreigners attend our great colleges & want to stay in the U.S., they should not be thrown out of our country."

Clinton had proposed creating "start up" visa's for entrepreneurs in the tech sector; and giving a green card to foreign students with advanced degrees in science, technology, engineering and math (STEM). A similar approach was advocated by President Obama in his first term and Republican candidate Mitt Romney in the 2012 presidential campaign.

A tech employer said: "We still can't find any quality programmers in the U.S. with the latest skill sets...Why is that? Last couple of years an iOS programmer cost nearly 120-150\$/Hr, regardless of foreign (H1B) or American. There is a big shortage of programmers worldwide. That's the truth. If anyone knows a small colony of unemployed programmers in the U.S., please let me know ASAP !!"

Senator Orrin Hatch (R., Utah), claims that "foreign-born STEM workers complement the American workforce, they don't take American jobs." Bill Gates testified before Congress that "a recent study shows for every H-1B holder that technology companies hire, five additional jobs are created around that person." However, Trump now claims that foreign students would take U.S. jobs at lower wages.

Lack of U.S. Math Skills of 15-Year-Olds is a Looming Problem

The Program for International Student Assessment; OECD: Organisation for Economic Co-operation and Development (PISA) test scores measure math knowledge of 15-year-olds which is critical for STEM. PISA found that among the 34 OECD countries, the U.S. ranked 27th (near the bottom) The top-performer was Shanghai-China. "While the U.S. spends more per student than most countries, this does not translate into better performance. For example, the Slovak Republic, which spends around US\$53,000 per student performs at the same level as the U.S., which spends over US\$115,000 per student." Top-scoring countries included Korea, Japan, Switzerland, and Netherlands.

"Students in the United States have particular weaknesses in performing mathematics tasks with higher cognitive demands, such as taking real-world situations, translating them into mathematical terms, and interpreting mathematical aspects in real-world problems," the study concluded.

Investment Opportunities - I started researching robomation after reading some of our recommended managers' quarterly commentaries about robotic related companies. I see the potential opportunities.

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