

A Fascinating Intersection

As you know, North Sky Capital invests across a multitude of private equity and infrastructure sectors, including tech, healthcare, consumer, business services, social media and industrial technologies (i.e., tech that improves the manufacturing, energy, food, water, transportation and construction sectors). We do this as both a direct investor and as a fund of funds. Our role as a fund of funds affords us a very broad and deep view of the universe of venture capital, buyout, cleantech, mezzanine, distressed, infrastructure, secondary and even real estate portfolio companies. Our role as a direct investor allows us to apply all that we learn from the metadata we gather from our fund of funds duties. In essence, we sit at the crossroads where existing markets meet technological advancements, and it is often a fascinating intersection.

Since our inception in 2000, we have witnessed (to name just a few):

- the conversion of our entire world from analog to digital,
- the rise of smartphones, which now provide nearly limitless data, news, weather, entertainment, navigation, location and shopping power in the palm of your hand,
- social media's transformation of how we communicate with our friends, find new ones and provide news and other info to the world (YouTube, Twitter, Facebook, eHarmony, etc.)
- Netflix's destruction of the video rental industry (and maybe soon the cable oligopoly),
- Amazon's transformation of the retail industry, including the opening of niche markets and long tails (e.g., sales of George Orwell's 1984 book were up 6000% after the government's domestic spying programs were revealed earlier this month),
- tremendous strides in healthcare: improved diagnostic tests; new treatments for cancer, heart disease, ALS, MS, glaucoma, diabetes and other diseases; long-lasting joint and limb replacements; huge advancements in the drug discovery / efficacy process through automation and computational power; the decoding of the human genome; and driving down the cost of sequencing and analyzing your personal DNA from roughly \$1 million in 2001 (Craig Venter's own DNA in the Human Genome Project) to just \$99 today (23andme.com),
- the re-introduction of the electric car to the mass market and to critical acclaim (Tesla), and
- radical cost reductions and efficiency improvements in solar photovoltaics (PV), leading to vastly accelerated installation of solar panels worldwide. Note that in 2008 the International Energy Agency (IEA) forecasted that 72 GW of solar capacity would be installed worldwide by 2020. Critics of cleantech had a field day and chastised the IEA for being far too optimistic. But it turns out that forecast was not rosy enough! During 2012, 32 GW of solar panels were installed, bringing total installed solar capacity to more than 100 GW globally. At the 2012 pace, total global solar capacity will reach 356 GW by 2020, nearly 5x the original IEA projection.

Along these lines, we wanted to briefly discuss two important trends we are watching unfold right now in LED lighting and robotics / automation.

LED Lighting Megatrend

The size of the global general lighting market is about \$75 billion today and is expected to grow to \$100 billion by 2020. Currently, LED lighting makes up a small fraction of that market—certainly less than 10% of the overall market. LED penetration is expected to grow at a 30+% CAGR and reach 67% market penetration by 2020. The rapid transition is expected due to sharp cost declines and improvements in light quality and form-factor in the last three years. Furthermore, LEDs last 20-25x longer than incandescent bulbs and use just 20% of the electricity to produce the same amount of light. The tipping point has been reached where it makes sense for businesses and consumers to begin to replace burned out bulbs with new LED ones (which is exactly what we are doing in our homes). The LED industry is highly fragmented and there are 5-10 major players and 1,000 or more smaller players. We expect there will be multiple winners in this fast-moving market, including several of our own companies.

Robotics / Automation Megatrend

Robots have come a long way in the last 15 years but have made giant leaps forward recently thanks to steep cost-declines in computing power, batteries and sensors (optical, tactile and voice, facial and character recognition).

- For most of us, the first real working robot we encountered was the Roomba vacuum cleaner, which was introduced by [iRobot](#) (Nasdaq: IRBT) in 2002. iRobot has now produced more than 8 million robots, including ones that clean gutters and pools and those used for search & rescue missions (e.g., in collapsed buildings) and for military and police applications (e.g., the PackBot seen searching the car of the Boston Bombers). One of iRobot's next projects is a robot with video conferencing capability that would allow doctors to treat patients remotely yet do so in a very personal way.
- Many of us have also seen [ASIMO](#), the humanoid robot from Honda that is a precursor to what could become personal care robots for the elderly. ASIMO can walk, talk, recognize and distinguish among different voices, assist humans with walking, communicate in sign language and perform simple household tasks like opening, pouring and serving drinks.
- One of the founders of iRobot started a new company, [Rethink Robotics](#), in 2008 to create “smarter, more adaptable, low-cost robotic solutions that can help manufacturers to improve efficiency, increase productivity and reduce their need for offshoring.” Baxter is the name of the company's flagship product and is designed to work alongside humans to increase overall productivity. Baxter is taught to perform tasks by a human moving its arms and using other very simple programming methods. Immediate applications are packing / shipping, sorting, quality assurance, and assembly line manufacturing steps. There are 500 steps to assembling an iPhone that are performed by humans at Foxconn in China. Baxter could do many of those steps. His price tag is just \$22,000.



iRobot PackBot



ASIMO humanoid robot



Baxter by Rethink Robotics

- [Liquid Robotics](#) leads the way for marine robotics, with autonomous devices that can be used for defense, as well as data gathering for applications such as ocean floor mapping or resource exploration. Specifically designed to meet the strict requirements for defense and national security, the SHARC is equipped for harbor security and anti-submarine duties. This fish-like robot generates its own power from ocean currents and the sun. Liquid Robotics is in our VC II fund.



SHARC Wave Glider by Liquid Robotics

- Another area where robots could have a big impact today is in agriculture. [Harvest Automation](#) makes tough, smart, simple robots that attend to ornamental plants grown in nurseries, a \$17 billion annual market just in the USA. The company is working on next gen robots that will work in farm fields to perform harvesting, monitoring, watering, pruning and herbicide / pesticide delivery duties. The robots work safely alongside humans, are impervious to hot or cold weather conditions, work 24 / 7 without breaks and apply technology where it is sorely needed.



Harvest Automation's HV-100 robot

- [eCullet](#) offers another example of industrial automation. The company uses optical sensors and a mechanical sorting process at recycling centers to separate glass by color and eliminate non-glass residue. This process allows communities to switch to a single-stream recycling program (metal, paper and glass do not need to be separated into separate bins by the homeowner).



Glass sorting process at eCullet

This significantly increases overall participation and volume levels in such recycling programs. eCullet dramatically lowers the overall cost of producing recycled glass, which is then sold to glass container manufacturers to be re-used. eCullet is in our CleanTech Ventures I portfolio.

- Finally, a company that embodies the technological changes that enable all of the foregoing is [Heptagon](#), a portfolio company in our VC III and VC IV funds. Heptagon makes micro sensors and micro cameras that can be used in smartphones, robots and automated manufacturing lines. Heptagon is very good at miniaturizing these functions at the wafer-level and doing so in very large volumes and at very low cost. Its products enable features such as camera flash systems, room-brightness sensors for displays to reduce battery drain, 3-D vision, night vision, bar code readers, gesture recognition for human interaction (manufacturing or gaming) and optical interconnects for faster data transfers.



Imaging optics systems by Heptagon

On a serious note, the artificial intelligence, sensor and camera technology described above is the kind of technology that can be used in military and surveillance efforts—ranging from drones (armed and unarmed) to public and private security cameras in a big city to your smartphone or webcam in your own home to real spycraft stuff like miniature cameras in shirt buttons or micro drones made to look like birds and insects (and so realistic that both have been attacked as prey by actual birds).



Micro drones designed to look like hummingbirds and mosquitos

This technology is powerful and can be used to do tremendous good as shown above. It can also be used improperly, even for evil as we have seen in Iran, Egypt, Libya and Syria where their governments used the technology to spy on phone and internet activity and ultimately to target groups and individuals. We are hopeful for the future; but we are reminded by headlines at home and abroad that we must remain vigilant if we are to keep our wonderful technology from being turned against us.

On a lighter note, the science fiction of yesterday has become reality today. The intelligent Q&A interaction between human and computer on Star Trek 20-30 years ago is not only possible today but an everyday occurrence—just ask Siri on your iPhone for “directions home” as you leave work today or for suggestions for “restaurants nearby.” While the Holodeck and the food replicator of Star Trek and the flying cars of the Jetsons are still in prototype stages today, consumer versions are on the horizon. 3D printers are another example of [science fiction](#). These printers deposit layers upon layers of material to produce three dimensional objects. Such printers are still expensive but are becoming cheaper and more capable each year. Using blueprints downloaded over the internet, you already can print out a toy, a board game, jewelry, a replacement part for your broken lawn mower or even a gun today. Tomorrow, you may be able to “print” an iPhone and eventually food at home or, on an industrial scale, “print” cars or buildings.

All of this is to say that technology is advancing at an astonishing rate. Our machines—computers, phones, cars, trains, planes, buses, thermostats, washers & dryers, lights, online banking, supply chain logistics, reservation systems, healthcare diagnostic tools, etc.—are increasingly connected to each other and to us in both our work and personal lives. We are so intertwined with these technological wonders that we have grown dependent on them. Perhaps the singularity (where humans merge with machines) is approaching faster than Ray Kurzweil predicted (2045). Hmm, now where did I put my Google glasses...? Must have left them in my driverless car.

Upcoming Events

We are regular speakers and attendees at key industry conferences. We hope to see you at these upcoming conferences:

September 30- October 2 **NCCMP Annual Conference, Hollywood Florida**
www.nccmp.org

October 18-22 **59th Annual Employee Benefits Conference, Las Vegas**
www.ifebp.org

October 28-30 **SRI Conference, Colorado Springs**
www.SRIconference.com

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