



Managing a Human/Robotic Workforce – *It's Closer than You Think!*

Although the title of this article conjures up images of people and robots working side-by-side on a futuristic factory floor, it's really about how to manage rapidly advancing technology. We currently manage people, both employees and contingent workers, and technology and the vendors that provide it. But, there is a significant difference now: artificial intelligence (AI) pertains to systems that learn based on experience, rather than being programmed to perform specific tasks. This requires a different kind of management. Technology is advancing at exponential rates, and very powerful technologies will be available in a relatively short time frame. By being at the forefront of cultural, business, and technology trends, we can prepare ourselves for the challenges that lie ahead.

By robots, I mean any intelligent machines, not just robots that move. Although robots that move are important in many applications such as manufacturing, mining, or vacuuming, the great majority of intelligent machines will be those that “think,” either to assist people or autonomously make decisions.

Managing People

Let's start this exploration with the assets we're most used to managing: people. Although people management is as old as work itself, relatively recent changes in the business environment are necessitating re-examination of our organizational structures.

As managers, we're used to managing in a hierarchical organizational model, which means that every level of supervisor is responsible for directing and monitoring the work of those below on the org chart. But the nature of the organization is changing due to the dynamic needs of business. Contingent workers, consultants, and contractors are playing a vital role in the workforce, providing special expertise and additional worker power on specific projects while allowing the company

to retain staffing flexibility. In the early 2000s, HR systems began to reflect that trend with the “people” model, whereby employees and contingents can intermingle in HR systems.

We are trending toward a gig economy whereby non-employees will perform more and more functions. The numbers of actual employees will shrink as the pool and accessibility of a skilled temporary labor force grows. Relationships with contingent workers will be critical to the strategic plans of companies looking to optimize the new model.

Aspects of HR, talent acquisition, vendor management and customer relationship management systems will merge into one, as all worker relationships need to be managed from one centralized repository, both inside and outside the organization. As we'll see in the next section, managing relationships with vendors will play a crucial role and automation will perform more tasks.

Managing Technology

With the move to the cloud, your vendor is replacing the functionality of your IT staff; being responsible for keeping the software available, performing, and secure while applying more frequent updates. This trend is likely to continue as more of the systems we use move to the cloud. Therefore, the relationship with the software vendor should be baked into your management structures.

As machine-learning systems rise in capabilities and are more widely used, there will be a great demand for highly skilled workers, such as data scientists. It will be difficult and expensive for each company to acquire their own data scientists and develop their own systems. This expertise will be embedded in the software we use. The trend toward cloud vendors will continue, as companies with economies of scale can provide the most and quickest innovation.

Relationships with vendors will take on an even greater role in the organizational structure as they become integral partners in our business automation strategy.

Therefore, not only is our approach to managing people changing, but our method of managing technology, including the vendor relationship as a critical aspect of the workforce, is changing as well. This will prepare us for the powerful technologies of the present or near future.

Types of Automation

- **Administrative** – The systems of the last 30 years or so have been primarily focused on automating repetitive tasks and transaction processing, which is just the thing computers are good at.
- **Decision-support systems** – Some systems these days contain knowledge bases to provide needed and timely information to assist in decision-making. These tools are more oriented as an aid to knowledge-workers, as opposed to operational processing.
- **Intelligent** – Decision-support systems are evolving into intelligent assistants, which use voice recognition to interact with people. Siri and Alexa are early examples of this. However, they will increase in sophistication rapidly, to the point where they anticipate our needs and provide them proactively.
- **Autonomous** – Artificial intelligence, until now, has focused on aiding humans in their business, but we are developing automated capabilities where the machines can manage the work without human intervention, and with greater accuracy.
- **Sentient** – In the not-too-distant future, computing capability will rival humans. Systems will progress to have semantic understanding, which will appear as if approaching consciousness.

Evolution of Technology

Artificial intelligence can be broadly defined as any system that makes decisions. It has been around in concept for decades. Back in the 1980s, we saw what was then called “expert systems,” which consisted of relatively complex decision trees. For you programmer types out there, it amounted to many “if...then...else” statements.

The early promise of AI went unfulfilled, which initially gave AI a bad name. But over the decades, AI has crept into many of the systems and processes we now take for granted. This has come about through a few computing trends:

- **Rapid advances in computing power** – Moore’s Law observed that computing power roughly doubles every two years. This has held true throughout several decades of the computing age. Advanced technology requires a great deal of computing power that wasn’t available a few decades ago.
- **A preponderance of data** – The web has increased the amount of data available at an exponential rate. In subsequent paragraphs we’ll see why this is significant in the creation of intelligent systems.
- **Advances in programming techniques and advanced analytics** – Machine-Learning algorithms are moving away from transactional processing and more towards pattern-recognition.

Up until recently, software focused on automating administrative, repetitive tasks. Just as mechanized tools of the industrial age automated manual labor, the early part of the computing age did the “heavy lifting” of calculations and predictable tasks. To get a better sense of this, it’s helpful to understand a bit about computers, and how they differ from the way humans think.

Almost all computers we use are designed using what’s become known as the “Von Neumann” architecture (named after computing pioneer John Von Neumann). The central processing unit (CPU), which is often referred to as the “brain” of the computer, essentially does one thing at a time very quickly. This differs greatly from the architecture of the human brain, which consists of about 100 billion interconnected neurons. Each neuron can be thought of as an individual CPU – *but there are 100 billion of them!* Since neural connections are biological, they work at a much slower speed than electronics. So, as opposed to computers that do one thing at a time very fast, the human brain does billions of things at once very slowly. This is called a “massively parallel” architecture, and is more geared toward pattern recognition, which is something humans do well, but computers haven’t excelled at...yet.

While we still don’t know the “software” of

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the brain, for decades there has been a vision to model computers after its workings. People learn by forming neural connections that are reinforced when a desired result is reached, and diminished when the desired result is not attained. Programming techniques have evolved to mirror this situation: using feedback loops, software is able to teach itself by seeking a goal and reinforcing desired results. We learn from our experiences; the analog to experience in the digital world is data. And, since we have so much of it, machines are able to learn quickly. This is a departure from past programming techniques, whereby the computer was programmed to do specific tasks. Now, a computer is programmed to learn on its own based on the data available to it. This technique is called “machine learning.”

Organizational Impacts

We saw earlier that we need to include contingent workers and even vendors in our workflows. We will need to account for both human and non-human workers in our organizational structures (by non-human, I’m including the possibility of animals: the police, search and rescue teams, and health-care facilities have employed dogs, which are, indeed, knowledge-workers). Non-human assets will encompass automated agents of varying sophistication.

Flatter organizations, with fewer hierarchical structures, will be needed. In the past, line level managers would supervise individual contributors, and each subsequent level involves the management of managers. That won’t be needed in a highly automated workforce, as automated agents will require a different sort of supervision than the traditional approach. More responsibility will fall on the vendors that provide the bots. Fewer people, and certainly fewer levels, will be needed to manage a human/robotic workforce.

In his book from 1950, *The Human Use of Human Beings*,¹ Norbert Wiener coined the term *Cybernetics*, pertaining to systems that self-regulate due to feedback loops, and also the interaction between humans and machines. Machine-learning algorithms use feedback loops to learn. The impact of cybernetics will play an increased role, as machines become a more integral part of our lives and our work.

As humans, both employees and contractors will play a smaller role, and that role will

change. Whereas managing people is primarily about getting them to do things they are disinclined to do, then making sure that they do them; managing a mix of humans, people enhanced by intelligent automation, and autonomous systems will require a more strategic mindset as to how to fit the assets together to optimize their effectiveness. There will be more emphasis on what humans do well that machines don’t. There will be more focus on how to include the people who fit together well personality-wise as well as skill-wise, determined by analytics. Human workers will be more empowered to make decisions and take ownership of their work. Thus, advancing technology will result in a change to how we manage people, as well as machines.

Legal and Social Impacts

There will be much scrutiny as advanced technology encroaches on the workplace. Legal considerations have always lagged behind the technology. As John Sumser noted in “Artificial Intelligence: Ethics, Liability, Ownership and HR” in this issue, if a machine makes a recommendation for action, does the machine incur any liability if the likely result doesn’t transpire? Just as licensing and regulation is par for the course with other knowledge-based services, the AI field should be proactive and provide full transparency and audit trail of all data pertaining to each recommendation, as well as the thought process used in evaluating that data.

We must take into account the social implications of interacting in a deeper way with advanced technology. Technology has historically netted the same or more jobs. There is great debate over whether it’s different this time. Previously, machines replaced physical labor or repetitive administrative tasks. Now machines can perform knowledge work, which will make large sectors of the economy redundant. Not everyone will make the transition through the disrupted economy. We need to consider the social impact of many people being unemployable. There has been talk of the government providing universal minimum income. Some have suggested that robots pay taxes, in some form. Whatever the best solutions are, we need to be proactive in planning for conditions that may cause great social upheaval.

Endnotes

¹ Norbert Wiener, *The Human Use of Human Beings*, Houghton Mifflin Harcourt (US), Eyre & Spottiswoode (UK), 1950.

² Frank Levy and Richard Murnane, *The New Division of Labor: How Computers Are Creating the Next Job Market*, Princeton University Press, 2004.

Learning and Development

An important aspect of managing a workforce is the learning and development initiative. This is key to ensuring productive and fulfilled workers. However, as we saw earlier, machine learning systems are not programmed to do specific tasks; they are taught how to achieve desired outcomes based on their experience, which takes the form of massive amounts of data. Thus, machines need learning and development, just as human workers do. But, machines learn in a different way than humans do, and at different rates.

People learn from their experiences, which unfold over a lifetime. Machines learn from data, which can be fed in at tremendous rates. Therefore, machines can have a lifetime of experience in a short time frame. As we saw in “Trading Cancer for Data: Machine-Learning for Cancer Diagnosis” in this issue, machines can be trained to diagnose cancer, or recognize a stop sign by being shown many examples, which are labeled “Yes” or “No.” As we develop personal assistants, it will be important that they be trained to have pleasant dispositions – so important in their interactions with their human counterparts. It will be like teaching a super intelligent child that has absolutely no common sense. Try teaching common sense – it’s no so easy.

The way we educate humans will change also. As machines handle more and more tasks currently associated with knowledge workers, it will be important that we emphasize skills which humans have, but are still a challenge to automate. MIT’s Frank Levy and Harvard’s Richard Murnane argue that the automation of business processes has heightened the value of two categories of human skills: “expert thinking – solving new problems for which there are no routine solutions, and complex communication – persuading, explaining, and, in other ways, conveying a particular interpretation of information.”²

Our education is geared toward convergent learning – whereby there is one right answer, and our thought process is focused on attaining that answer. We should emphasize divergent learning – where there are a number of possible solutions, and we can imagine multiple options. Creative thought will be more highly valued. Artists develop the skills to perceive their environment differently. Although the goal of art is to realize one’s aesthetic vision, the process of creating art can be applied to solving business

problems. For instance, there are similarities between the process of composing a piece of music and creating software. The worker and manager will switch roles. It makes more sense for the machine to be the manager, freeing the person to be creative. I’ve known many artists and managers, and to my anecdotal observation, there is very little commonality among the skillsets. Effective managers must learn to get in touch with their inner muses.

Parting Thoughts

We need to change our philosophy as to how we manage organizations, encompassing human workers, business partners and technology, in preparation for a rapidly changing business environment. Beginning early to accommodate the current trends and technology will prepare us for the dramatic shifts in management that will be required in the not-too-distant future.

Looking further down the road, opinions differ as to if, or when, machines will achieve consciousness. Regardless, we can expect rapidly increasing sophistication in machines. There has been much discussion (and some consternation) about when the robots no longer need us. At the hands of our much more advanced creations, are we in danger as a species? Anyone who’s heard Hal’s iconic, “I’m sorry Dave, I can’t do that,” from *2001 – A Space Odyssey*, knows to always ensure that we have the off switch: ultimate discretion in an emergency situation. The industry must widely accept a set of principles for governing long-term advanced technology.

This article covered a relatively wide range of time, wherein the way we work will dramatically change. The nature of what it is to be human will change as well.

Although technology advances at revolutionary rates, human nature progresses at glacial, evolutionary rates. Many of humanity’s problems won’t be solved by advanced technology. Technology is a tool, which can be used to make life better or to manipulate and oppress others. We’re heading toward either Utopia or Dystopia (or maybe even both at once) as we weigh the cost-benefit of relinquishing privacy for convenience. Managing advanced technology is a tremendous burden; it is, in effect, managing the future of humankind. It may be a while before technology is as advanced as described in this article...but it’s closer than you think!

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