Combining Humans and Machines in an Emerging Form of Enterprise: the Humachine

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PREVIEW *Nada Sanders and John Wood, authors of* The Humachine*, believe that business leaders would be wise to resist the temptation to replace traditional business processes entirely with artificial intelligence (AI). Instead, they propose that a synthesis of human and machine will provide benefits beyond those achieved by humans or machines alone.*

INTRODUCTION: LINKING HUMAN AND MACHINE INTELLIGENCE

Research shows that over one third of companies are taking a passive approach to AI, looking at the field from the sidelines and studying the competition. Others believe that using algorithmic-based automation is all that is needed to be competitive (Ransbotham and colleagues, 2018).

Business leaders can be forgiven for thinking that competing in the age of AI is about implementing machine intelligence to displace human workers. In a recent *HBR* article, Marco Iansiti and Karim Lakhani (2020) claim that, "Rather than relying on traditional business processes operated by workers, managers, process engineers, supervisors, or customer services representatives, the value we get is served up by algorithms." (p. 62)

We contend this view may be shortsighted, mistakenly characterizing the emerging green shoots of AI for the fruit itself. Rather than viewing AI as the main source of value creation, we consider it to be an intermediate step, a necessary condition for achieving competitive advantage but not sufficient in itself.

Integrating AI into Operations

This is the caveat to the hype around AI. The popular press is inundated with examples of business innovation characterized by machine learning (ML), robotic process automation, digital networks, and the Internet of Things (IoT), triggering that powerful fear of missing out while also raising the cost of trying to keep up with the hype. As Khari Johnson (2020) recently noted, "Business executives are rushing to implement the technology into their operations and gain a competitive advantage, but it's not as simple as creating a data lake and crafting AI models."

Technologies associated with AI—autonomous devices, ML algorithms, neural nets, and more—are being built on digital infrastructures from Customer Relationship Management (CRM) platforms to IoT-connected systems. The emergence of these technologies has shifted the competitive landscape decisively in favor of companies that are seeking to stack AI capabilities atop a digital platform. While there is little or no question that AI is introducing revolutionary impacts to operations, strategy, and competition, it does not fit the plug-and-play model of technology adaptation that has driven innovation over the last several decades. Integrating AI into a firm's strategy is not like updating workforce laptops or installing a new CRM platform: it is unlike any technological change that has ever occurred in recorded human history.

Despite the surge of interest in adopting the latest "smart" technology, it would be a mistake to look at AI as yet another incremental technological investment like the latest personal computer. Competing in the age of AI is not about acquiring better technology per se. It's about properly integrating technology with human resources to leverage the virtues of each while avoiding their limitations. The future will belong to those companies

that are implementing AI at the enterprise level, mutating into a new form of enterprise entirely—not one that simply jettisons the human workforce and replaces them with algorithms, but rather one that combines the highest capabilities that humankind has to offer with the newfound and continually emerging powers of AI. Companies that mistakenly treat AI as another piece of technology to tack on to their company will go the way of Blockbuster Video.

Rethinking the Enterprise

The reason old business models will not succeed in the age of AI is that what is needed of the human element at all levels of the organization is dramatically changing. This requires a new way of thinking about the role of humans in an enterprise while rethinking the enterprise itself. There are already a number of leading companies, such as Google and Haier, that are changing the boundaries and activities of their firms. They are redefining processes, functions, and their interactions, representing a paradigm shift in business models.

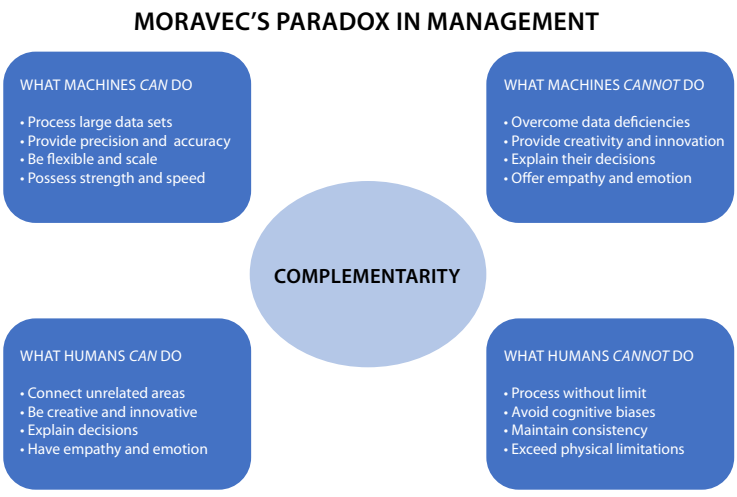
Adopting the latest AI technology is without doubt important, and most companies have been hesitant to fully embrace "digital transformation." While there has long been a carrot to adopt technology to gain competitive advantage, the COVID-19 pandemic has become a stick, forcing leaders to lean on technology without the needed runway to fully understand the organizational transformation required for successful implementation. The belief that competing in the age of AI is about acquiring "smart" technologies like in-store sensors is an outdated paradigm. It didn't work before the pandemic when many brick-and-mortar retailers were already beginning to slide into bankruptcy. And it's not enough now.

Using algorithms instead of traditional business processes is merely the order qualifier, not the order winner. Human integration with technology is the key to thriving in the age of AI; it can unlock organizational network superintelligence, resulting in a type of enterprise we call the humachine, one that vastly outperforms any competing company governed by mere human intelligence. It is an enterprise that creates synergies between human talent and AI, where the whole is far greater than the sum of the parts.

Key Points

- While humans may never attain machinelike capabilities, Moravec's Paradox (where humans are naturally gifted, machines struggle, and where machines excel, humans find difficulty) asserts that certain human skills are virtually impossible to replace with automation. Instead of "botsourcing" human capital, business leaders should follow Kasparov's Law, which documents that superior performance can be achieved by combining humans and machines.
- Our research leads us to forecast the emergence of a new form of enterprise that harnesses the strengths of humans and machines in a symbiotic relationship, which can achieve a "superintelligence" that outstrips performance achieved by either humans or machines alone.
- We call this enterprise form the *humachine*—and it is not science fiction. A number of leading firms are already exhibiting traits of the humachine, which we explain here.
- In this new enterprise form, organizational functions are fundamentally different, but few are impacted as much as the forecasting function. The humachine uses a forecasting process that optimizes the combination of human judgment and statistical forecasts generated via algorithms.
- Although a great deal of research has already been done to identify the mechanisms for combining human judgment with statistical methods, the age of AI offers new uncertainties, different types of models, and an unprecedented amount of data, all of which enable new thinking on the optimal manner of combining statistical and judgmental forecasts.

Figure 1. Complementary Strengths of Humans and Machines



The Survey

We conducted a survey of senior managers and executives over a five-year period, as well as performing in-depth studies of four leading organizations. Our objective was to identify how companies use AI technology and what traits are key to successful leadership.

We found that these leading firms differ in many aspects beyond technology. We were then able to identify that it is the integration of humans and technology within the enterprise that is most important, allowing us to coin the term "humachine" and identify the characteristics of this new form of enterprise.

We found that what differentiates the leading companies in the age of AI is actually a business model with a greater focus on acquiring and accommodating talent, rather than a sole focus on technology. Further proof comes from Kasparov's Law, which shows that the combination of ordinary humans and ordinary machines using the right process leads to superior performance. Kasparov's Law leverages the innate strengths of humans and machines, recognized by AI and robotics researchers and known as Moravec's Paradox.

WHY HUMACHINE WORKS: MORAVEC'S PARADOX

We are in an age of infatuation with evolving technological capability. However, it is still humans—executives, managers, and other decision makers—who use the output of algorithms to make decisions within an organizational context. These decision makers bring their human judgment, individual personalities, opinions, and expertise to the process, deciding how to use the analytically generated output. Even UPS truck drivers are authorized to override the route-optimization algorithm.

Some forecasts suggest up to 25% of the U.S. labor force will be displaced by automation by 2030 (Harris and colleagues, 2017). Humans and technology are increasingly viewed as competitors for jobs. We see this as a failure to think creatively about the future. When the steam engine came along, people who worked in horse stables may have panicked over job losses, too. For each previously human job description lost to robotic process automation—we call this phenomenon "*botsourcing*"—there could be several new jobs created involving co-bots, robot interpreters and human handlers.

Humans and machines have a paradoxical relationship, described by *Moravec's Paradox*: where humans are naturally gifted, machines struggle, and where machines excel, humans find difficulty (Moravec, 1988). This relationship between humans and machines is complementary, as shown in **Figure 1**. For example, while AI can now do many mental tasks that require "thinking" (such as mathematics), AI has a hard time doing what biological beings easily do without thinking (such as navigating a dynamic physical environment).

Machines are just tools. They cannot fix bad processes, poor management practices, or failing employee morale. It takes the human touch to do that. Moravec's Paradox is why companies cannot simply botsource their way to success. We can't take humans out of the equation. Even today, in a world dominated by technology, the key to success is to adapt humans to this new work environment—not to replace, but to enhance, not to train humans to think like computers, but to think *with* computers.

This human-centric approach of technology-focused firms is exemplified by the likes of Google and Haier. These companies understand that they must transform the way they do business to remain competitive. It is not about changing technologies to get the latest and greatest systems, but rather changing the business model itself. The issue is not how to replace humans with free robot labor—which myopically accounts for human resources as a cost instead of an asset. The issue is how to create a business model where machines and humans complement each other, unlocking the highest potential value of each. Machines will do repetitive and automated tasks. They will even do complex cognitive tasks and make semiautomated movements. However, those uniquely human skills of creativity, innovation, adaptability, empathy, integrity, playfulness, emotional intelligence, care, and imagination will become increasingly imperative to success.

We doubt that AI will ever attain the general intelligence needed to exemplify those uniquely human skills, at least not on relevant time horizons for corporate leaders to seriously consider turning over the reins of a company to AI. It is precisely these human skills that are needed to bridge the gap between technology and people and utilize machines in the best way to serve people—customers, coworkers, suppliers, and all other stakeholders. Leading AI companies know this and focus more on building work systems to fit human ergonomics rather than training humans to fit the demands of work. Indeed, there is proof that this works. Kasparov's Law proves that we do not need the greatest technology—or even the smartest people—to achieve superior performance. We need the best process of human-machine integration.

USING AI TO PLAY TO OUR STRENGTHS: KASPAROV'S LAW

In 1997 the stakes were high when then-greatest-of-all-time chess champion Garry Kasparov was defeated by IBM's Deep Blue chess-playing computer engine. The loss to Deep Blue sent shockwaves through the competitive chess community and all the computer scientists following the advances of IBM's computing innovations. This was the first time Kasparov had ever lost a chess match and his first loss ever was to a machine. ***https://open.spotify.com/episode/6JRpPEFhkd9qNjUAwxmYCS?si=y0tHC4ZYRd2V3U2JfD8BIQ***

The loss put him in a reflective mood and drove him to stage an experiment to test whether humans can attain mastery to beat machines (Kasparov, 2017). He designed the Ultimate Chess Tournament to function as an experiment. Prevailing in a chess tournament could perhaps be considered a stand-in to test the superiority of the intellects competing therein, at least to the limited extent that chess is a valid test of intelligence. It seems intuitive to use chess in this manner. Playing requires logical reasoning and tests the strength of the player's ability to reason through implications, to entertain and evaluate counterfactual scenarios, and to pursue tactics that are rational in decision making under constraints in a competitive environment. Unlike standard chess tournaments, Kasparov designed the tournament entry rules to allow multiple chess players per team and allowed for teams of chess players to also use computer programs. The tournament drew world-class chess engines and grand-master chess players as competitors—and the outcome was surprising.

Neither the smartest computer algorithms nor the most accomplished chess players won the Ultimate Chess Tournament. Rather, the championship went to a team of two amateur chess players who were virtual unknowns in the competitive chess-playing world. Using a custom homegrown computer algorithm that they trained on data from prior games, they learned which of the two of them tended to make better moves, depending on how the board was arranged. The algorithm would let the humans play to their strengths.

The key to victory was *a better decision-making process*, one that used deep analysis by the algorithm to tap into the best

Figure 2.

judgment of the human players—a simple yet elegant way of leveraging Moravec's Paradox. The fact that the amateurs prevailed in this experiment is just one result, but it may have proven *Kasparov's Law*—that the combination of ordinary humans and ordinary machines using the right process can lead to superior performance, even triumphing over human genius or powerful computers alone. Following Kasparov's Law, we can build organizations of superior intelligence, using ordinary human resources and clever algorithms—no geniuses or supercomputers needed. **Figure 2** shows a conceptual map of this development. Moravec's Paradox offers the foundation for Kasparov's Law, and the latter offers proof of the success of the human and machine partnership.

We believe that in the age of AI, using algorithms will help gather up the low-hanging fruit. However, eventually these technologies will be standard practice across all industries. Using algorithms instead of traditional business practices will no longer provide a competitive advantage once the transition into the age of AI has permeated the market. That will take a new form of enterprise—a superintelligent enterprise. As described next, achieving organizational network superintelligence is the strategy that we believe will provide a dominant competitive position for companies in the age of AI.

ATTAINING SUPERINTELLIGENCE

We use "superintelligence" as the term is defined by Nick Bostrom, Oxford University professor, founder of the Future of Humanity Institute, and author of *Superintelligence: Paths, Dangers, Strategies* (2020). Superintelligence is a form of intelligence that vastly outstrips human cognitive performance across all relevant domains of interest. Bostrom persuasively argues that creating superintelligence is the biggest challenge humanity will ever face. Suffice it to say this concept is relevant for business leaders eager for their organizations to remain competitive in the long run.

Bostrom outlines several distinct pathways that might lead researchers to creating superintelligence, including biological cognitive enhancement, whole-brain emulation, neural lace, and collective superintelligence. While these pathways may be thought provoking, our research shows only the latter pathway is realistically feasible in the immediate term and is attainable by business leaders. Neural lace, for example, requires implanting electrodes into the human skull and we certainly don't know any business leader eager to succumb to that procedure. Collective superintelligence, however, is immediately attainable, and we call this "organizational network superintelligence." According to Bostrom, this kind of superintelligence is not only possible, but would emerge "through the gradual enhancement of networks and organizations that link individual human minds with one another and with various artifacts and bots," (p.58-59) saturated with big data, and organized around the principles we outline here.

Although superintelligence sounds like a futuristic concept, this pathway is not dependent upon a breakthrough in technology. Companies can create superintelligence in an enterprise using the human and technological resources available by developing human-centric processes through an entirely different business model, combining the three variables of Kasparov's Law needed to create superhuman capabilities: *people*, *machines*, and *processes*. "People" includes everyone from company leaders and coaches to analysts and designers, as well as customers

and suppliers. Machines are the technologies from AI and IoT, to platforms, network links, and cloud computing. There are a number of features we observed that are common to these organizations, as we next discuss.

HUMACHINE TRAITS

Companies such as Google and Haier exemplify features of the humachine business model we have observed in a number of other companies. The success of these companies comes not only from better technology but because they have transformed the way they do business so that human resources can be augmented with machine powers. The secret is the business model itself, where machines and humans are integrated in a process designed to complement each other as noted by Kasparov's Law. Success comes from harnessing this combined power of technology and human resources.

The list of features is outlined in **Figure 3**. The first feature is selection of *technology that supports human needs*. Organizational goals are outlined and technology is chosen targeted to support those goals, not just following the latest technological advancements. Second, the humachine business model is driven by a *shared vision and purpose* that ties humans to the organization. Humans are emotional and thrive on meaningful relationships in an organization that has a greater purpose. Research shows that organizations can get the best out of their talent by leveraging these emotions. Having a purpose in society beyond mere profit capture is a critical element of success. It is hard to inspire innovation, creativity, and engagement with purely a profit motive, and this will not suffice in an era where greater human capabilities are needed.

Another observed feature is *flexible organizational structures*. Agility and flexibility are increasingly required as machines and humans work to adapt in real time to customer and environmental demands. This requires a shift from rigid functional procedures to systems thinking; away from silos and rigid hierarchies to cross-functional integrated teams and flatter organizations. The key is to play to individual strengths, responding and communicating with one another in real time and fostering innovation and adaptability.

Figure 3.

HUMACHINE TRAITS

- Technology supporting human needs
- Technology adopted to support a shared vision
- Meaningful relationships
- Flexible organizational structures
- Integrated work teams
- Combined physical and virtual work environments
- Aspirational and measurable metrics

At Google, structure and culture interact to influence the capabilities of the organization as one unit. Innovation is at the heart of Google culture, and Google uses a matrix organizational structure enabling cross-functional groups to work across traditional vertical silos. The same is true with Haier, where cross-functional teams are formed as needed, then dissolved and reformed as a new need arises. While each of these companies has its own unique organizational structure, the common elements are a flat structure that enables flexibility and rapid response to changing environments.

Lastly, we find that humachine companies combine the best of the *physical* and *virtual environments*, focusing on *metrics that motivate performance and innovation*. Workers are flexible to move from one work environment to the other with a focus on performance and results.

To take advantage of a flexible structure, a company needs a culture of freedom to create and innovate, regardless of where workers are located. Haier, for example, pushes entrepreneurship and innovation, recognizing that the digital era has reshaped customer expectations and that as a company it has to disrupt the status quo. To this end, Haier created an organizational structure and culture that is extremely responsive to customer needs,

constantly cultivating new ideas and innovating quickly. Haier has turned itself into several microenterprises and the focus is on performance outcomes, not micromanagement. The idea is to turn Haier employees into micro-entrepreneurs who run their own microenterprises centered around an innovative idea or a product. They are responsible for their own performance, budgets, profit and loss, and will behave as independent business units under the Haier umbrella. Technology is used to support workers in their endeavors.

Collectively these traits form an enterprise that is not centered on technology but rather uses technology to support the organizational strategy and is integrated with the human workforce. The humachine has a shared vision, fluid and flexible structures, a culture that allows risk taking, innovation and creativity, and a technology that supports human needs.

IMPACT ON THE FORECASTING PROCESS

In this new enterprise form, organizational functions are fundamentally different, but few are impacted as much as the forecasting function. The humachine uses a forecasting process that optimizes the combination of human judgment and statistical forecasts generated via algorithms.

Forecasters have expressed various preferences for the use of human judgmental versus statistical methods. Some feel that judgment should not be given credibility due to high subjectivity. Others point to the restrictions of human cognitive abilities such as limited processing ability, short-term memory, overconfidence bias, and difficulties in understanding functional forms.

On the other hand, we have forecasters who support the use of judgment in forecasting, and we know that practitioners rely heavily on judgmental forecasting methods. The primary reason for this practice is that judgment is privy to the latest information on markets, competition, and changes in the environment, called "soft" information. For example, marketing may become aware of rumors of a competitor launching a promotion, a planned consolidation between competitors, or a sudden shift in consumer preferences due to changes in technology. Other information may be causal in nature, such as the relationship between sales of snow shovels and snowfall, or temperature and ice cream sales. There are few better examples than the surge in sales of hand sanitizer during the pandemic, which historical data could not have predicted.

Statistical methods have the advantage of being objective, consistent, capable of processing large amounts of data, and considering relationships between numerous variables. However, statistical models are only as good as the data upon which they are based. When changes occur in the data that are not incorporated in the model, the forecasts cannot be accurate. Even with all the AI capability, it was impossible to predict the onset, magnitude, and duration of the pandemic.

In the COVID era, rather, the process of forecasting has been a combination of human judgment—in this case, epidemiologists and physicians—with mathematical algorithms that forecast propagation of disease under various scenarios. The flat and fluid organizational structures in a humachine allow constant communication across functions and sharing of information, from marketing to operations and sourcing. This enables pooling of soft information with stable, quantitatively derived data. Consider that prior to the 2020 holiday season, the CFO of Walmart said the company's executives were judgmentally adjusting their analytics algorithms for quantities of food items to stock. Why? The reason was the acknowledgment that algorithms were based on historical data and the COVID-19 pandemic had created very different consumer behavior expectations. The algorithms could serve as a baseline. However, it was up to executives—knowing what was happening in the environment—to add their judgment to the final forecast.

Following Moravec's Paradox, the ideal forecasting methodology is one that incorporates the advantages of both human judgment and statistical forecasting and is something we are witnessing in humachine organizations. How precisely to do this is an evolving question, which provides a tremendous opportunity and need for researchers to identify the best conditions for using judgment, when to rely exclusively on statistical models, and when and how to combine them. Although a great deal of research has already been done to identify the mechanisms for combining human judgment with statistical methods, the age of AI offers new uncertainties, different types of models, and an unprecedented amount of data. This is an important opportunity for researchers to delve into, rethinking the best approaches to combine judgmental and statistical methods and offer guidance to this emerging enterprise form.

CONCLUSION

We set out on a journey to identify the transformative power of technology, only to discover that the key to corporate success rests with human talent and the firm's ability to integrate it with technology in a symbiotic way. Kasparov's Law tells us that the right combination of ordinary humans and ordinary machines can yield superior performance, even outcompeting human genius and specialized computers. For an enterprise to succeed in the age of AI, it must break free from old business paradigms and embrace a human-centric business model that actively leverages human strengths. It is the human-centric AI strategy that can lead to a superintelligent organization that outperforms firms governed by human intelligence alone, and which enjoys a sustainable competitive advantage by getting the most out of humans and machines.

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