I. SCIENCE AND TECHNOLOGY

A) GENERAL OVERVIEW - THE BIG PICTURE

1. Which 5 scientific and/or technological inventions from 1920 to now are the most relevant for you? Why? How have they altered our daily lives?
2. Your opinion: What is the role of science in our society?
3. Your opinion: What is the role of technology in our society?
4. Present one event or situation which shows the misuse of science and/or technology and comment on it.
5. Name two prominent scientists.
6. Choose one prominent figure and determine why this person is relevant in relation to the topic. Maximum 120 words.
7. Should there be limits to the research done in the fields of science and/or technology? Which ones? Why? Why not?
8. If you had an unlimited budget at your disposal, what would you try to invent or what would you do research on?
9. Can you explain the recent trend of mistrust in science and scientific experts?

Concept: the mad scientist

Mad scientist (also mad doctor or mad professor) is a stock character of a scientist who is described as "mad" or "insane" owing to a combination of unusual or unsettling personality traits and the unabashedly ambitious, taboo or hubristic nature of their experiments. As a motif in fiction, the mad scientist may be villainous (evil genius) or antagonistic, benign or neutral; may be insane, eccentric, or clumsy; and often works with fictional technology or fails to recognize or value common human objections to attempting to play God. Some may have benevolent or good-spirited intentions, even if their actions are dangerous or questionable, which can make them accidental villains. (wikipedia.org)

10. Do you know any famous mad scientists from the world of fiction?

II. TECHNOLOGY AND THE MILITARY

28 ways military tech changed our lives

www.pocket-lint.com - by Adrian Willings, Contributing editor

(Pocket-lint) - War isn't exactly a topic to be gleeful over, but technology has always played its part. When countries go to war, it's the one with the best technology who's most likely to win. That's always been the case, whether talking about weapons used hundreds of years ago or tech used in more recent conflicts.

What we're focusing on here though is how military technologies in the 20th and 21st centuries found their way into civilian life and have improved the world as a whole.

Let's check out all the ways that we use original military tech in our everyday lives.

The internet

The World Wide Web that we know and love originally started life back in 1977 in the form of its forefather the Advanced Research Projects Agency Network (ARPANET). This network technology, along with TCP/IP became the technical foundation of the Internet as we know it today.

Before this time, development of computer technologies were advancing to a point where in the 1950s a concept was required for a wide area network to connect computers in science labs. It was the Cold War though that led to the need for ARPANET and the beginning of the modern internet.

GPS

After World War II and the space race that came shortly afterwards, it wasn't long before mankind started sending satellites into the atmosphere. In the 1990s, some of these satellites would be used for a space-based radio navigation system that was originally owned and operated by the United States government.

This system was perfect for keeping soldiers safe on the battlefield but also for identifying targets, improving mapping, tracking plane trajectories and more. As the technology expanded and improved it has moved into the civilian world too.

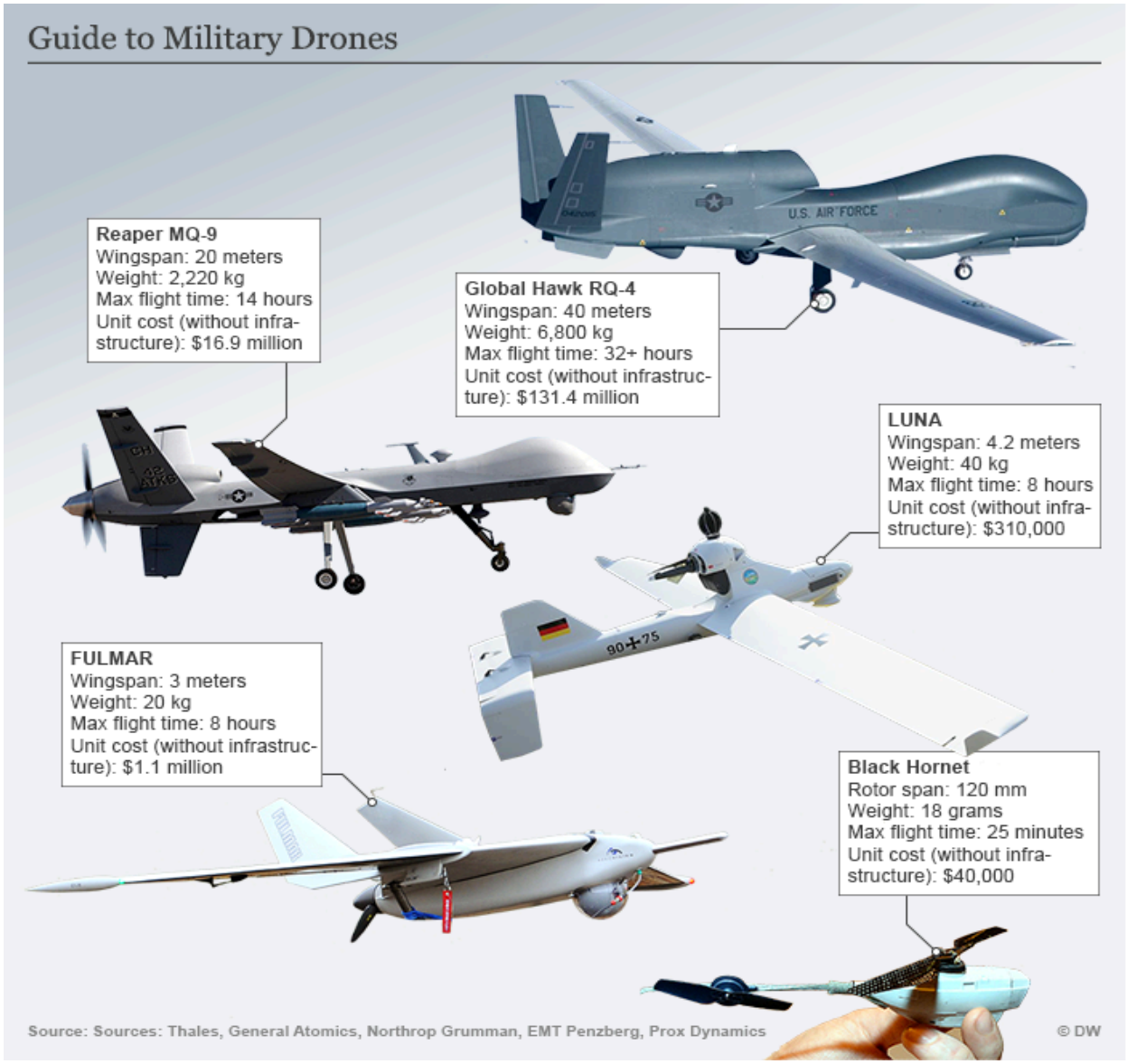
Now we're used to having GPS in our everyday lives - including navigation in our pocket thanks to the invention of GPS capable smartphones.

Drones

Nowadays drones are such a common sight that regulating them has become a headache for governments and there are all sorts of consumer drones available whether flying for fun or for professional photography and videography.

The humble drone began life as an unmanned aerial vehicle (UAV). These pilotless air vehicles were remotely controlled to survey battlefields or go on missions deemed too "dull, dirty or dangerous" for human beings. The idea for drones started well over a Century ago when Austria sent unmanned bomb-filled balloons to blow up Venice in 1849. Technology has progressed a lot since then. Nazi Germany pushed the technology forward during WWII with a number of UAVs aimed at dealing out death, but the US Military is perhaps most well-known for its drone use in more recent years.

Since the 1990s, UAVs have been used to launch Predator and Hellfire missiles to attack ground targets during a range of conflicts. It is now thought that over 50 countries have employed military drones in one form or another since 2013. Now the skies are full of drones, many with cameras for capturing leisure activities.



Microwave ovens

The radar technology developed during World War II was later adapted for different uses. One of these included the production of technology capable of creating electromagnetic waves on a tiny scale - hence "microwave". That technology could be used to rapidly heat and cook food by passing microwave radiation through it. This radiation causes the molecules in food to vibrate and heat quickly.

The original range of microwave ovens were named Radarange and sold in 1946. They were too large and expensive for most consumers. It wasn't until 1967 that they started to become commonplace in commercial and residential kitchens across the world.

Digital cameras

Digital camera technology originally started life in early spy satellites where they were used to capture high-resolution aerial images of enemy installations. The technology progressed in the military sphere, especially during the Cold War and in the 1970s the first self-contained digital camera was created. This early technology would take years to progress into the DSLRs we use today, now digital photography is everywhere, even in our pocket.

Computers

The original technology for computers was a lot more archaic than it is today. The original computers used punch cards and mechanical looms to solve problems. The technology improved at greater speed during World War II though, when an electronic digital programmable computer named Colossus was invented to help decipher messages sent by the Nazi encryption machines.

These computers were a small part of helping the Allies win the war and kick-started the age of the modern digital computer. In the decades that followed, technology has vastly improved and shrunk greatly, with computers even fitting in our pocket.

- Click here to read about the remaining 22 ways military tech changed our lives:

https://www.pocket-lint.com/gadgets/news/143526-how-military-tech-changed-our-lives

- Click here to get a glimpse of what the military is currently working on:

www.darpa.mil

Discussion points:

1. What are the advantages and disadvantages of removing the human element from warfare?

2. What do you make of the marriage between technology and the military?

3. Watch the video about technology and the military on our homepage.

Interesting fact:

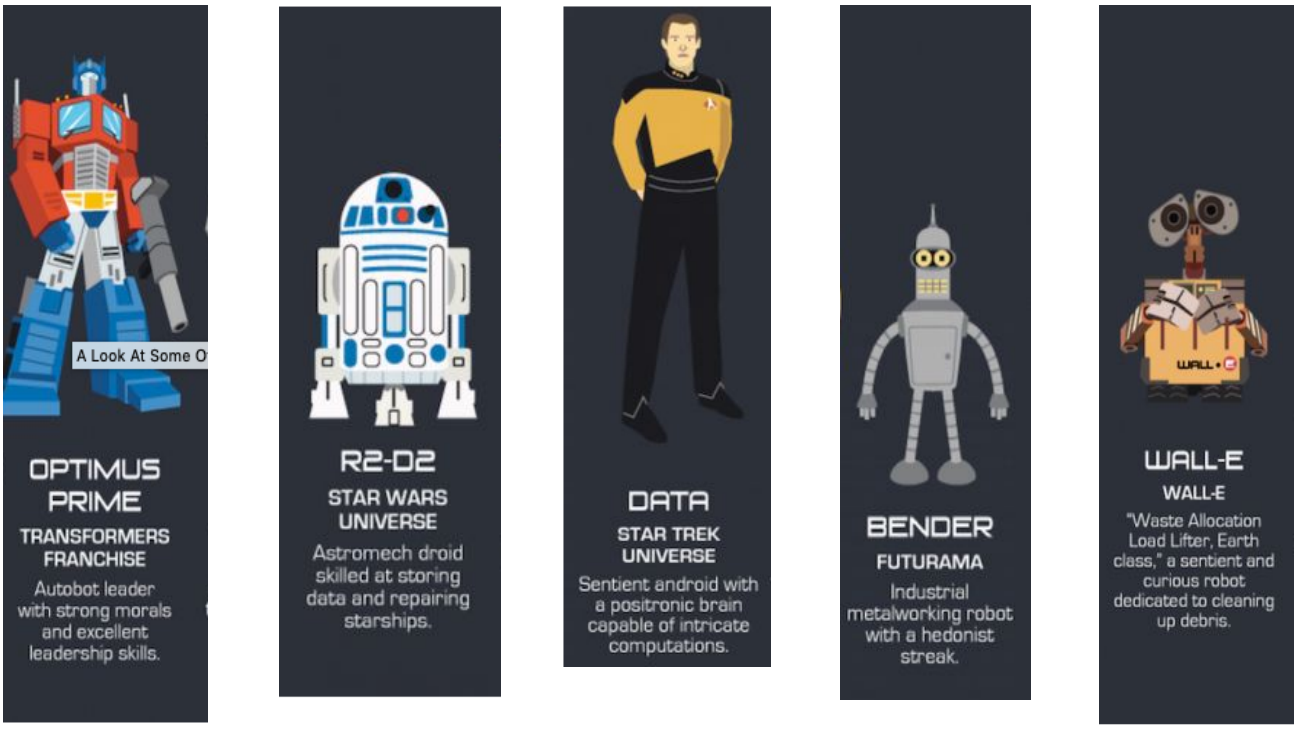
In 1962, Morton Heilig created a machine called the *Sensorama*. This machine is considered as one of the earliest Virtual Reality systems. However, Heilig did not get enough funding to develop his idea. He explains:

For the price of a couple of feature films, we could have created virtual reality decades ago. For far less than the price of a bomber, we could have distributed marvellous learning environments to our major universities. If I had written a proposal for a theatre that would kill people, I guess I might have done better with finding funding.[1]

Interesting fact: Centralization or decentralization?

According to philosopher Manuel DeLanda, centralization and decentralization are two trends in the "war machine": either military commanders try to centralize command and control of each event on the battlefield and get "human will out of the decision-making loop" or they delegate responsibility to individual soldiers. In terms of AI we have to decide: Should AI autonomously do what we told it to do, or should it act based on its own "will"? What do you think?

III. ROBOTICS



[1] Howard Rheingold, "Virtual Reality" (New York, 1991), p. 60

The Three Laws of Robotics (often shortened to The Three Laws or known as Asimov's Laws) are a set of rules devised by the science fiction author Isaac Asimov. The rules were introduced in his 1942 short story "Runaround" (included in the 1950 collection *I, Robot*), although they had been foreshadowed in a few earlier stories. The Three Laws, quoted as being from the "Handbook of Robotics, 56th Edition, 2058 A.D.", are:

First Law

A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Second Law

A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Third Law

A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

The original laws have been altered and elaborated on by Asimov and other authors. Asimov himself made slight modifications to the first three in various books and short stories to further develop how robots would interact with humans and each other. In later fiction where robots had taken responsibility for government of whole planets and human civilizations, Asimov also added a fourth, or zeroth law, to precede the others:

Zeroth Law

A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

The Three Laws, and the zeroth, have pervaded science fiction and are referred to in many books, films, and other media. They have impacted thought on ethics of artificial intelligence as well. - *www.wikipedia.com* -

Discussion points:

1. Do you think all the problems are covered with these laws? Which laws would you add?

2. "Instead of giving robots restrictions, they should be empowered." Comment on this quote.

3.Do humans suffer from the Frankenstein's complex? Why? Why not?

The 10 Grand Challenges Facing Robotics in the Next Decade

Edd Gent

Robotics research has been making great strides in recent years, but there are still many hurdles to the machines becoming a ubiquitous presence in our lives. The journal *Science Robotics* has now identified 10 grand challenges the field will have to grapple with to make that a reality. Editors conducted an online survey on unsolved challenges in robotics and assembled an expert panel of roboticists to shortlist the 30 most important topics, which were then grouped into 10 grand challenges that could have major impact in the next 5 to 10 years. Here's what they came up with.

1. New Materials and Fabrication Schemes

Roboticists are beginning to move beyond motors, gears, and sensors by experimenting with things like artificial muscles, soft robotics, and new fabrication methods that combine multiple functions in one material. But most of these advances have been "one-off" demonstrations, which are not easy to combine.

Multi-functional materials merging things like sensing, movement, energy harvesting, or energy storage could allow more efficient robot designs. But combining these various properties in a single machine will require new approaches that blend micro-scale and large-scale fabrication techniques. Another promising direction is materials that can change over time to adapt or heal, but this requires much more research.

2. Bioinspired and Bio-Hybrid Robots

Nature has already solved many of the problems roboticists are trying to tackle, so many are turning to biology for inspiration or even incorporating living systems into their robots. But there are still major bottlenecks in reproducing the mechanical performance of muscle and the ability of biological systems to power themselves.

There has been great progress in artificial muscles, but their robustness, efficiency, and energy and power density need to be improved. Embedding living cells into robots can overcome challenges of powering small robots, as well as exploit biological features like self-healing and embedded sensing, though how to integrate these components is still a major challenge. And while a growing "robo-zoo" is helping tease out nature's secrets, more work needs to be done on how animals transition between capabilities like flying and swimming to build multimodal platforms.

3. Power and Energy

Energy storage is a major bottleneck for mobile robotics. Rising demand from drones, electric vehicles, and renewable energy is driving progress in battery technology, but the fundamental challenges have remained largely unchanged for years.

That means that in parallel to battery development, there need to be efforts to minimize robots' power utilization and give them access to new sources of energy. Enabling

them to harvest energy from their environment and transmitting power to them wirelessly are two promising approaches worthy of investigation.

4. Robot Swarms

Swarms of simple robots that assemble into different configurations to tackle various tasks can be a cheaper, more flexible alternative to large, task-specific robots. Smaller, cheaper, more powerful hardware that lets simple robots sense their environment and communicate is combining with AI that can model the kind of behavior seen in nature's flocks.

But there needs to be more work on the most efficient forms of control at different scales—small swarms can be controlled centrally, but larger ones need to be more decentralized. They also need to be made robust and adaptable to the changing conditions of the real world and resilient to deliberate or accidental damage. There also needs to be more work on swarms of non-homogeneous robots with complementary capabilities.

5. Navigation and Exploration

A key use case for robots is exploring places where humans cannot go, such as the deep sea, space, or disaster zones. That means they need to become adept at exploring and navigating unmapped, often highly disordered and hostile environments.

The major challenges include creating systems that can adapt, learn, and recover from navigation failures and are able to make and recognize new discoveries. This will require high levels of autonomy that allow the robots to monitor and reconfigure themselves while being able to build a picture of the world from multiple data sources of varying reliability and accuracy.

6. AI for Robotics

Deep learning has revolutionized machines' ability to recognize patterns, but that needs to be combined with model-based reasoning to create adaptable robots that can learn on the fly.

Key to this will be creating AI that's aware of its own limitations and can learn how to learn new things. It will also be important to create systems that are able to learn quickly from limited data rather than the millions of examples used in deep learning. Further advances in our understanding of human intelligence will be essential to solving these problems.

7. Brain-Computer Interfaces

BCIs will enable seamless control of advanced robotic prosthetics but could also prove a faster, more natural way to communicate instructions to robots or simply help them understand human mental states.

Most current approaches to measuring brain activity are expensive and cumbersome, though, so work on compact, low-power, and wireless devices will be important. They

also tend to involve extended training, calibration, and adaptation due to the imprecise nature of reading brain activity. And it remains to be seen if they will outperform simpler techniques like eye tracking or reading muscle signals.

8. Social Interaction

If robots are to enter human environments, they will need to learn to deal with humans. But this will be difficult, as we have very few concrete models of human behavior and we are prone to underestimate the complexity of what comes naturally to us.

Social robots will need to be able to perceive minute social cues like facial expression or intonation, understand the cultural and social context they are operating in, and model the mental states of people they interact with to tailor their dealings with them, both in the short term and as they develop long-standing relationships with them.

9. Medical Robotics

Medicine is one of the areas where robots could have significant impact in the near future. Devices that augment a surgeon's capabilities are already in regular use, but the challenge will be to increase the autonomy of these systems in such a high-stakes environment.

Autonomous robot assistants will need to be able to recognize human anatomy in a variety of contexts and be able to use situational awareness and spoken commands to understand what's required of them. In surgery, autonomous robots could perform the routine steps of a procedure, giving way to the surgeon for more complicated patient-specific bits.

Micro-robots that operate inside the human body also hold promise, but there are still many roadblocks to their adoption.

10. Robot Ethics and Security

As the preceding challenges are overcome and robots are increasingly integrated into our lives, this progress will create new ethical conundrums. Most importantly, we may become over-reliant on robots.

That could lead to humans losing certain skills and capabilities, making us unable to take the reins in the case of failures. We may end up delegating tasks that should, for ethical reasons, have some human supervision, and allow people to pass the buck to autonomous systems in the case of failure. It could also reduce self-determination, as human behaviors change to accommodate the routines and restrictions required for robots and AI to work effectively.

Discussion points:

1. Which challenge would you tackle first? Why and how?

2. Are there challenges that should not be addressed in your opinion? Why?

IV. TECHNOLOGY AND ETHICS

As Technology Barrels Ahead—Will Ethics Get Left in the Dust?

Vivek Wadhwa

The battle between the FBI and Apple over the unlocking of a terrorist's iPhone will likely require Congress to create new legislation. That's because there really aren't any existing laws which encompass technologies such as these. The battle is between security and privacy, with Silicon Valley fighting for privacy. The debates in Congress will be ugly, uninformed, and emotional. Lawmakers won't know which side to pick and will flip flop between what lobbyists ask and the public's fear du jour. And because there is no consensus on what is right or wrong, any decision they make today will likely be changed tomorrow.

This is a prelude of things to come, not only with encryption technologies, but everything from artificial intelligence to drones, robotics, and synthetic biology. Technology is moving faster than our ability to understand it, and there is no consensus on what is ethical. It isn't just the lawmakers who are not well-informed, the originators of the technologies themselves don't understand the full ramifications of what they are creating. They may take strong positions today based on their emotions and financial interests, but as they learn more, they too will change their views.

Imagine if there was a terror attack in Silicon Valley — at the headquarters of Facebook or Apple. Do you think that Tim Cook or Mark Zuckerberg would continue to put privacy ahead of national security?

It takes decades, sometimes centuries, to reach the type of consensus that is needed to enact the far-reaching legislation that Congress will have to consider. Laws are essentially codified ethics, a consensus that is reached by society on what is right and wrong. This happens only after people understand the issues and have seen the pros and cons.

Consider our laws on privacy. These date back to the late 1800s, when newspapers first started publishing gossip. They wrote a series of intrusive stories about Boston lawyer Samuel Warren and his family. This led his law partner, future U.S. Supreme Court Justice Louis Brandeis, writing a Harvard Law Review article "The Right of Privacy" which argued for the right to be left alone. This essay laid the foundation of American privacy law, which evolved over 200 years. It also took centuries to create today's copyright laws, intangible property rights, and contract law. All of these followed the development of technologies such as the printing press and steam engine.

Today, technology is progressing on an exponential curve; advances that would take decades now happen in years, sometimes months. Consider that the first iPhone was released in June 2007. It was little more than an iPod with an embedded cell phone. This has evolved into a device which captures our deepest personal secrets, keeps track of our lifestyles and habits, and is becoming our health coach and mentor. It was

inconceivable just five years ago that there could be such debates about unlocking this device.

A greater privacy risk than the lock on the iPhone are the cameras and sensors that are being placed everywhere. There are cameras on our roads, in public areas and malls, and in office buildings. One company just announced that it is partnering with AT&T to track people's travel patterns and behaviors through their mobile phones so that its billboards can display personalized ads. Even billboards will also include cameras to watch the expressions of passersby.

Cameras often record everything that is happening. Soon there will be cameras looking down at us from drones and in privately owned microsatellites. Our TVs, household appliances, and self-driving cars will be watching us. The cars will also keep logs of where we have been and make it possible to piece together who we have met and what we have done — just as our smartphones can already do. These technologies have major security risks and are largely unregulated. Each has its nuances and will require different policy considerations.

The next technology which will surprise, shock, and scare the public is gene editing. CRISPR–Cas9 is a system for engineering genomes that was simultaneously developed by teams of scientists at different universities. This technology, which has become inexpensive enough for labs all over the world to use, allows the editing of genomes—the basic building blocks of life. It holds the promise of providing cures for genetic diseases, creating drought resistant and high-yield plants, and new sources of fuel. It can also be used to "edit" the genomes of animals and human beings.

China is leading the way in creating commercial applications for CRISPR, having edited goats, sheep, pigs, monkeys and dogs. It has given them larger muscles, more fur and meat, and altered their shapes and sizes. Scientists demonstrated that these traits can be passed to future generations, thereby creating a new species. China sees this as a way to feed its billion people and provide it a global advantage.

China has also made progress in creating designer babies. In April 2015, scientists in China revealed that they had tried using CRISPR to edit the genomes of human embryos. Although these embryos could not develop to term, viable embryos could one day be engineered to cure disease or provide desirable traits. The risk is that geneticists with good intentions could mistakenly engineer changes in DNA that generate dangerous mutations and cause painful deaths.

In December 2015, an international group of scientists gathered at the National Academy of Sciences to call for a moratorium on making inheritable changes to the human genome until there is a "broad societal consensus about the appropriateness" of any proposed change. But then, this February the British government announced that it has approved experiments by scientists at Francis Crick Institute to treat certain cases of infertility. I have little doubt that these scientists will not cross any ethical lines. But is there anything to stop governments themselves from surreptitiously working to develop a race of superhuman soldiers?

The creators of these technologies usually don't understand the long-term ramifications of what they are creating and when they do, it is often too late, as was

the case with CRISPR. One of its inventors, Jennifer Doudna wrote a touching essay in the December issue of Nature. “I was regularly lying awake at night wondering whether I could justifiably stay out of an ethical storm that was brewing around a technology I had helped to create,” she lamented. She has called for human genome editing to the “be on hold pending a broader societal discussion of the scientific and ethical issues surrounding such use.”

A technology that is far from being a threat is artificial intelligence. Yet it is stirring deep fears. AI is, today, nothing more than brute force computing, with superfast computers crunching massive amounts of data. Yet it is advancing so fast that tech luminaries such as Elon Musk, Bill Gates, and Stephen Hawking worry it will evolve beyond human capability and become an existential threat to mankind. Others fear that it will create wholesale unemployment. Scientists are trying to come to a consensus about how AI can be used in a benevolent way, but as with CRISPR, how can you regulate something that anyone, anywhere can develop?

And soon, we will have robots that serve us and become our companions. These too will watch everything that we do and raise new legal and ethical questions. They will evolve to the point that they seem human. What happens then, when a robot asks for the right to vote or kills a human in self-defense?

Thomas Jefferson said in 1816, “Laws and institutions must go hand in hand with the progress of the human mind. As that becomes more developed, more enlightened, as new discoveries are made, new truths disclosed, and manners and opinions change with the change of circumstances, institutions must advance also, and keep pace with the times.” But how can our policy makers and institutions keep up with the advances when the originators of the technologies themselves can’t?

There is no answer to this question.

Discussion points:

1. How much privacy are you willing to give up for safety?

2. Check the video on ethics and technology on our homepage.

3. In the realm of media and technology there are two major schools of thought:

a) Technological determinism
- The mere introduction of technology inevitably creates social change.
- This change will unavoidably happen beyond our control.

b) Technology is neutral
- Technology is neither good, nor bad. It's how we use it.
- Human agency and responsibility can control the impact of technology on society.

Find out more about these theories and decide which one you agree with. Why?

V. ARTIFICIAL INTELLIGENCE

Five AI fears and how to address them

By Kevin Casey | September 30, 2019

Artificial intelligence occupies the strange position of having a decades-long history while still feeling wholly futuristic to many people. It's not actually new, but it remains an eternally "new" frontier. No one can honestly claim to know precisely where it will lead. Any change produces fear. AI-related fears are of a different order, though.

So if it's true that we fear what we don't understand, then it makes sense that the future of AI keeps people up at night, especially when considering the more ominous possible outcomes. You could reasonably assume this is true of any major technological developments: They generate change, which produces fear, et cetera. AI-related fears are of a different order, though.

Most people don't know what microservices architecture is, for example, even if some of the apps they use every day were built in decoupled fashion. But technical evolutions like microservices don't tend to cause the kinds of emotional responses that AI does around potential social and economic impacts. Nor have microservices haven't been immortalized in popular culture: No one is lining up at the box office for "Terminator: Rise of the Cloud-Native Apps."

This speaks mainly to fears about AI's nebulous future, and it can be tough to evaluate their validity when our imaginations run wild. That's not particularly useful for IT leaders and other execs trying to build a practical AI strategy today. Yet you will encounter fears – many of them well-founded. The trick is to focus on these real-world concerns, not the time-traveling robot assassins. For starters, they're much easier to defeat – er, address – because they're often based in current reality, not futuristic speculation.

"The types of fears [people have about AI] depend on the type of AI that we are talking about," says Keiland Cooper, a neuroscience research associate at the University of California Irvine and co-director of ContinualAI. "The more theoretical and far off 'general AI' – a computer that can do all the things that humans can do – will raise more fears than those from a more realistic AI algorithm like we see being commonly used today."

Let's look at five legitimate concerns about AI today – and expert advice for addressing them so that they don't derail your AI plans.

1. Fear: AI will produce biased outcomes

There is growing focus on the possibility – though probability is likely the better term – of bias and other ills in AI systems and the decisions or outcomes they lead to. Unlike some of the more imaginative Hollywood narratives about AI, you *should* be scared of AI bias.

Unlike some of the more imaginative Hollywood narratives about AI, you should be scared of AI bias.

“Algorithms are only as good as the data that they are trained on. So if a dataset includes the historical biases of an organization, then the predictions it makes will reflect that historical behavior,” Chris Nicholson, co-founder and CEO of Skymind. “For example, if a company spent decades promoting white males with Ivy League degrees into positions of authority, then an algorithm trained to identify future leadership talent might focus on that same type of individual, and ignore people who don’t belong to that group.”

How to address it:

You should embrace this fear and act on it. An absence of concern about AI bias improves the odds that it will proliferate unchecked.

Algorithms should not absolve individuals and organizations of responsibility for the results; human oversight and governance is absolutely necessary, and a good example of how another fear – that we’re no longer needed – may be a bit overblown.

“You can’t trust AI to know everything or to make perfect decisions. Algorithms are produced by people, and people make mistakes,” Nicholson says. “So the thing that every company has to do is have a system built to check its AI. Take a regular sample of the AI’s decisions and show them to experts and ask them: Does that look right? Because then, at least, you’re no worse than the experts, which is all you could have hoped for to begin with.”

This may be especially important in sectors like healthcare, insurance, banking, government, and more. But really there’s nowhere where this won’t be an important issue.

“AI practitioners and machine learning engineers have to ensure they are holding themselves to a degree of algorithmic accountability, and IT leaders should have dedicated data teams building de-biasing programs for their existing data sets,” says Iba Masood, co-founder and CEO of Tara AI. “This would help deploy a level of fairness and equity in utilizing systems for decision-making processes, especially where end consumers are involved.”

It’s a matter of being ethical and equitable. AI ethics may also become a competitive differentiator, according to Masood.

“I believe that the next five years is going to see a conscious consumer who is looking to transact business with companies deploying fairness mechanisms in their decision making processes assisted by AI,” Masood says. “IT can have a significant impact in this consumer behavioral shift, by working to mitigate bias in data sets used for decision-based systems.”

2. Fear: We (will) have no idea why AI does what it does

Here’s another natural fear of the unknown: Many AI outcomes are difficult to explain.

“The most advanced forms of AI, which produce the most accurate predictions about data, are also the least able to explain why they made that prediction,” Nicholson says.

This is sometimes referred to as the "black box" of AI, referring to a lack of visibility into a system’s decisions.

This is sometimes referred to as the “black box” of AI, referring to a lack of visibility into a system’s decisions – something that could be problematic for a variety of organizations.

“In many cases and in many companies, people need to know why something was done,” Nicholson says. “That is especially true in highly regulated industries. Take healthcare. You don’t want an algorithm making decisions about a patient’s diagnosis or treatment without knowing why that decision was made.”

Cooper offers another scenario, noting that the black box model becomes particularly concerning when something goes wrong.

“Say I train an algorithm to pick the best stocks, and say it does a pretty good job, maybe making a nine percent profit,” Cooper says.

If you’re getting an adequate or better return on your financial investments, as in Cooper’s hypothetical (and plausible) scenario, you might not much care about why. You’re making money, after all. But what if you lost nine percent? What if you lost everything? You’ll probably care a whole lot more about why.

“The problem is that in many cases, we don’t know why it is choosing what is it choosing,” Cooper sats. “This is scary, as it not only makes us less involved with the system we are working with, but also doesn’t give us many insights should it do something wrong.”

How to address it:

One of the best means of addressing this fear is to ensure that human intelligence and decision-making is still a vital – and in some contexts, the ultimate – part of any process, even if that process is improved by AI. In other words, this fear can be mitigated by ensuring that people retain proper control of processes and decisions, even as the role of AI in those processes and decisions expands.

“In cases like [healthcare], AI is best employed as a form of decision support for human experts,” Nicholson says. “That is, you don’t let AI operate alone and without oversight. You integrate AI into an existing decision-making process, where it can make suggestions to a human expert, but the expert will be the one to make a final decision, and they will be able to explain why they made it.

3. Fear: AI will make bad decisions

Again, this is a perfectly sensible concern. How do we evaluate the accuracy and efficacy of AI’s results? What happens if it makes poor choices? (You can see how certain combinations of these fears have a compounding effect: What happens if AI

makes bad decisions and we can't explain why?) Assuming any and all AI-generated outcomes will automatically be "good" should make even the most optimistic people among us uncomfortable.

Bias can lead to bad decisions. This is actually a more sweeping fear, though, one that could – among other negative impacts – lead a team to mistrust any and every AI result. This can become more likely when the people outside of the AI team (or IT altogether) analyze the results. It can also lead to organizational stasis.

"This can be very tricky to nail down, particularly if a quantitative definition of a 'good' decision cannot be produced."

"Many people fear that AI will make poor decisions. This fear is often very broad from a technical perspective, but it always boils down to people thinking the decision 'just isn't right,'" says Jeff McGehee, director of engineering at Very. "For practitioners, this can be very tricky to nail down, particularly if a quantitative definition of a 'good' decision cannot be produced."

How to address it:

Once again, the importance of the human element reigns. If you can't quantify what constitutes a positive result, you'll need to come up with a qualitative framework for doing so, while ensuring you're relying on the right mix of people and information to combat real problems like bias.

"In order to identify such a definition, stakeholders must think critically about all possible definitions of good/bad with respect to the decision," McGehee says. "Exact correctness may be ideal, but often, certain types of errors are more acceptable or more 'human.' In addition, 'correctness' may refer to whether or not you meet some standard list of predictions, but if this list holds inherent human bias, it may be a bad target. All of these factors can come into play when non-technical stakeholders are evaluating the quality of AI decisions."

4. Fear: AI will lead to a loss of anonymity

McGehee points to a lesser-known concern, one that could become a higher-profile area of AI security: A loss of anonymity, or privacy, when that anonymity had been assumed as a given.

"It was previously a widely held belief among AI practitioners that once a machine learning model has been trained, its weights – the parameters that enable it to make predictions – do not contain any traceable representation of the training data," McGehee says. "However, recent techniques have emerged that would enable nefarious actors to inspect a trained machine learning model and make meaningful deductions about individual data points used for training. This is concerning if an individual data point was a person, who wishes to remain anonymous."

How to address it:

Again, by recognizing the legitimate issue underlying the fear, you can take steps to address it. Protecting the privacy or anonymity of data when necessary is an area where organizations can take proactive steps as part of their overall security strategy. It's also an area of ongoing research and development in machine learning.

"While this is a valid fear, proper protection and encryption of the model weights can reduce the likelihood of them falling in the wrong hands, and creating new machine learning techniques that are not susceptible to this threat is an active area of research," McGehee says.

5. Fear: AI will put me out of a job

We close with probably the most visible AI-related fear out there, one that bridges both present reality and more speculative scenarios. Most experts agree AI will impact a wide range of jobs, if it hasn't already. In some cases, that will mean job loss. Pretending otherwise isn't a strategy for mitigating fear.

But neither is embracing the doom-and-gloom scenarios. In the foreseeable future, increasing adoption of AI (and automation more broadly) is better compared to rise of the PC era, which came with similar worries. Research has found that the PC, while certainly impacting the workforce, created millions of jobs more than the number it displaced.

How to address it:

"Historically, new technologies don't just automate jobs, but they make new jobs possible," Nicholson says. "Think of all the jobs that are possible because of computers. New technologies usually need people to master them, support them and maintain them, and AI is no different."

Proactively addressing this fear will be key to AI success in the business world, because otherwise people won't get on board. And you'll notice just about all of the above requires people not just getting on board but actively managing AI in their organizations.

"The crucial thing to understand is that work in the future will be a collaborative effort between people and machines," Nicholson says. "Think about heavy machinery. It does a lot of labor that people used to do with, say, shovels. But that machinery still needs people to operate and maintain it. AI will be like that."

Discussion points:

1. Which fear is the one that makes you most afraid? Why?

2. Are you optimistic or pessimistic regarding the future of AI?

3. Watch the video on the challenges of AI and IOT on our homepage.

VI. DIGGING DEEPER - CASE STUDIES

1. Who or what is/was *Agent Orange*?
2. Why is *Dolly the Sheep* famous?
3. Why do many scientists criticise the Creation Museum in Petersburg?
4. Why did the Church Of England apologise to Darwin 200 years after his birth?
5. Why does Kasparov not like *Deep Blue*?
6. Why is the *Little Boy* not so innocent?
7. Explain the phenomenon of the so-called *social media echo chamber*.

VII. CONTROVERSIAL ISSUES - WHAT DO YOU THINK?

1. To what extent are patents a problem in the realm of science and technology?
2. Where do you stand on the issue of animal testing? Explain.
3. Where do you stand on the issue of GMOs? Explain.
4. What is the internet of things? Comment on this concept.
5. Can science and technology save humanity? Why? Why not?

VIII. OTHER PROJECTS

1. Make a keynote speech about one of the topics touched upon.
2. You are an alien from the future. You've come to planet earth in 2020. Hold a speech in which you comment on the human race and what they need to do to prevent their own extinction.
3. Describe and comment on these pictures (// Task 1 - Oral Exam)

Science and technology

The energy dilemma

The world is **in need of** more energy than ever before. Ideally, energy should be clean, **sustainable** and cheap. However, our current dependence on **fossil fuels** and nuclear power **causes** serious problems. The nuclear catastrophes of Chernobyl and Fukushima have reminded us of the **vulnerability** of this technology and its **toxic waste**. Another concept that divides experts is the so-called **peak oil** theory, which talks about the end of the oil age. In addition, the burning of fossil fuels results in **CO2 emissions**, which are **harmful** to the environment. Finally, every person who uses a **petrol engine** or heats his house with **domestic fuel oil** depends heavily on the price of oil. Hence, lots of governments are trying to turn to alternative energies to gradually replace the old nuclear reactors or become less dependent on oil.

Renewable energies

The advantage of **renewable energies** is the fact that the energy is **generated** through the **exploitation** of natural energy resources that cannot be **exhausted**. According to some experts, this green energy is truly sustainable and has far less impact on the environment than the current generation from fossil fuels or **nuclear fission**.

Keywords

dilemma	- *Zwickmühle*
in need of	- *etwas brauchen*
sustainable	- *nachhaltig*
fossil fuels	- *fossile Brennstoffe*
to cause	- *etwas verursachen*
vulnerability	- *Verwundbarkeit*
toxic waste	- *Giftmüll*
peak oil	- *Ölfördermaximum*
CO2 emissions	- *CO2 Abgase*
harmful	- *schädlich*
petrol engine	- *Benzinmotor*
domestic fuel oil	- *Heizöl*
renewable energies	- *erneuerbare Energien*
to generate	- *erzeugen*
exploitation	- *here: Förderung*
exhausted	- *here: aufgebraucht*
nuclear fission	- *Kernspaltung*

Solar power

With the improvement of the **photovoltaic cell** technology, **solar power** has become the ultimate **clean energy source**. The solar cells in the solar panels **convert** light directly into electricity. Negative aspects might be the **efficiency** of this technology, which heavily relies on constant sunlight and the recycling of solar panels.

Wind farms

Wind farms promise **pollution-free** electricity without the **waste-disposal** problems of other technologies. The wind turns the **blades** of the turbine and the latter turns a generator, which produces electricity. The weather conditions are crucial for this type of energy. When there is no wind, the turbines do not produce electricity and too much wind may result in a shutdown of the turbines to prevent damage. Another disadvantage is that it would need a lot of wind farms to produce the amount of energy that a nuclear power plant can generate. Moreover, in **densely populated** areas there might not be enough space for wind farms. Locating them **offshore** might solve this problem. People often oppose wind farms in their local communities on the grounds of **noise pollution** and **visual intrusion**. Environmentalists have also proved that wind farms **pose a threat** to birds and kill thousands of them every year.

Hydroelectric power

Hydroelectric power is already **supplying** more than 20% of the world's electricity. Water flows through a turbine and produces cheap energy. However, the building of dams and the **interference** with the natural flow of streams and rivers poses environmental problems.

Keywords

photovoltaic cell	*- fotoelektrische Zelle*
solar power	*- Solarenergie*
clean energy source	*- saubere Energiequelle*
to convert	*- umwandeln*
wind farm	*- Windpark*
pollution-free	*- schmutzfrei*
waste-disposal	*- Abfallentsorgung*
blades	*- here: Turbinenschaufel*
densely populated	*- dicht bevölkert*
offshore	*- offene See*
noise pollution	*- Lärmbelästigung*
visual intrusion	*- das Landschaftsbild stören*
to pose a threat	*- eine Gefahr darstellen*
to supply	*- here: liefern*
interference	*- Eingriff*

Fracking

Hydraulic fracturing is the process of drilling and injecting fluid into the ground at high pressure in order **to fracture shale rocks** so that the latter release the natural gas inside. In last decade, the USA has witnessed a real fracking boom. However, lots of **hazards** are involved in this process. The fluid that is injected into the ground contains lots of poisonous chemicals that end up **contaminating** the ground water. Many chemicals out of the 600 used in fracking fluid are **carcinogenic**. Communities close to a fracking site often alarm the authorities about the **intoxication** of their **ground water**. Some citizens were even able to light their **tap water** on fire. Other critics claim that with the process of fracking wastes more energy than it generates. In Europe we are currently debating whether fracking should be allowed or not.

Alternatives to the petrol engine

The biofuel revolution ended in a fiasco. People in third world countries had to starve so that the rich could drive. The high demand for energy crops increased food prices in the poorest countries and caused **starvation** among the population.
The latest **salvation** seems to be the electric car. Electric cars or hybrid cars use a battery that runs an electric motor. These vehicles certainly solve the **underlying** problem of CO2 emissions. Nonetheless, it remains to be seen if this **eco-friendly** way of driving is **picked up on** by the consumer. Critics argue that the lithium-ion batteries that are used in these cars will create a lot of **hazardous high-tech trash** in the future. Furthermore, the electricity currently used to drive is not necessarily generated from clean energy.

Keywords

fracking	*- das Fracking*
to fracture	*- zerbrechen*
shale rocks	*- Schieferstein*
hazards	*- Gefahren, Risiken*
to contaminate	*- verunreinigen*
carcinogenic	*- krebserregend*
intoxication	*- Vergiftung*
ground water	*- Grundwasser*
tap water	*- Leitungswasser*
petrol engine	*- Benzinmotor*
starvation	*- das Verhungern*
salvation	*- Rettung*
underlying	*- grundlegend*
eco-friendly	*- umweltfreundlich*
to pick up on	*- etwas aufgreifen*
hazardous	*- gefährlich*
high-tech trash	*- Hightech Müll*

The morality of science and technology

Scientific development and **technological advance** are the **pillars** of human **progress**. Nevertheless, relevant questions in this domain remain hot topics of discussion. Should there be limits and **constraints** regarding scientific experiments? What are the **implications** of technological breakthroughs on society? What are the **moral obligations** of the players involved? If an idea is possible, does that automatically mean that it should be realised? History teaches us that science and technology can be misused to serve **malicious ends**. This **begs the question** if progress is **innately** positive? And what if, like Frankenstein's monster, the creation **overpowers** its creator?

GM technology

Genetic modification (**GM**) is the name given to techniques used to change the genetic composition of living organisms. Basically, you isolate a gene in one organism, extract it and insert it into another organism. This procedure of playing God still divides experts and scientists worldwide.

GM medicine

GM can be used to produce larger quantities of a medicine than could be produced from natural sources (for example: very rare plants). As a consequence, more people can be **treated** at less cost. Human cloning also gives doctors the possibility to grow GM organs. As a result more organs would be available and this would save the lives of many people who are currently on waiting lists.

Keywords

scientific development	- *wissenschaftl. Entwicklung*
technological advance	- *technologischer Fortschritt*
pillar	- *Säule, Stütze*
constraint	- *Einschränkung*
implication	- *Auswirkung, Folge*
moral obligation	- *moralische Pflicht*
malicious	- *bösartig*
ends	- *Ziele, Zwecke*
to beg the question	- *eine Frage aufwerfen*
innately	- *per se, von Haus aus*
to overpower	- *überwältigen*
GM	- *genetically modified*
to treat	- *behandeln*

GM agriculture

In agriculture, the benefits of genetically modified organisms (GMOs) seem endless. Farmers can buy **crops** with a higher resistance to **pests** and an advanced tolerance to extreme weather conditions. Consequently, they might not have to spray their fields with chemicals as often as in the past. This is good news for the environment. Moreover, due to these characteristics, GM crops produce greater **yields** and therewith increase the farmer's productivity. In addition, the FDA supports the theory of substantial equivalence, which basically proclaims that GM crops are similar to regular crops and not in any way harmful for the **consumers**. Finally, some corporations have announced that their GM crops **herald** the end of world hunger. In theory this sounds like **a** win-win situation.

On the other hand, many critics have argued that GMOs cannot be considered as **equivalent** to normal crops and they have accused the FDA of being **in the pocket of** big corporations. Experts claim that due to the pressure of big companies, the food market has been flooded with GMOs without the necessary safety and health **precautions**. According to them, no one can yet **foresee** the potential **repercussions** for consumers.

What is more, companies like Monsanto, which sell the apparently harmless GMOs, have been caught lying about the negative implications of their products in the past. Moreover, they are heavily criticised for their business strategy. Farmers who use their products have to sign a contract which forces them to only buy Monsanto products. Moreover, Monsanto's GMOs contain **a suicide gene** so

Keywords

crop	*- Ernte*
pest	*- Pflanzenschädling*
yield	*- here: Ergiebigkeit*
substantial equivalence	*- check internet*
to herald	*- einläuten, ankündigen*
consumer	*- Konsument*
equivalent	*- gleichwertig*
in the pocket of	*- unter dem Einfluss von*
precaution	*- Vorsichtsmaßnahme*
to foresee	*- voraussehen, vorhersehen*
repercussion	*- Auswirkung*
suicide gene	*- Suizid Gen*

that the crop only grows for one season. Since farmers have agreed the terms of Monsanto's contract, they are not allowed to use other **seeds** or keep seeds from previous **harvests**. So they have to buy new seeds every year. This pushes poor farmers in developing countries to their financial limits. Some experts claim that Monsanto is responsible for the fact that the **suicide rate** of Indian farmers who cannot earn enough to feed their families has **skyrocketed**. This **casts serious doubts on** the GMO's **noble quest** to end world hunger.

Keywords

seed	*- Samen, Saat*
harvest	*- Ernte*
suicide rate	*- Selbstmordrate*
to skyrocket	*- hochschnellen*
to cast doubts on	*- etwas in Zweifel ziehen*
noble quest	*- edle Mission*

CHECKPOINT

Can you answer these questions with adequate vocabulary?

1. Explain the energy dilemma we find ourselves in.
2. What are the disadvantages of our current energy policy?
3. What are the alternatives to our current energy policy?
4. Why do we not simply switch to alternative energies?
5. What is the problem with fracking?
6. Why is biofuel not a long-term solution?
7. Are electric cars long-term solutions? Why? Why not?
8. Give examples which show that science or/and technology have failed us.
9. Is science and technology living up to its moral responsibility? Why? Why not?
10. What are the advantages and disadvantages of GM technology?