

Report 1

The Ethics of Unmanned Warfare

Isaac Asimov, the science fiction author, is best known for his 'Three Laws of Robotics'. Hardwired into each robot's circuitry, the laws are immutable rules designed to ensure complete human control over our increasingly sentient creations. The First Law of Robotics states:

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

In June 2007, three SWORDS unit were deployed for active service in Iraq. SWORDS, which stands for Special Weapons Observation Reconnaissance Detection System, is a weaponised robot which can house a variety of weapons including a M249 machine gun, a M82 sniper rifle or a six-barrel 40mm grenade launcher. It is not fully autonomous, as a human controller is required to operate its fire controls, but it is equipped with state-of-the-art sensors and cameras which allow it to track and target potential threats. It is designed to act as a 'pointman' in close-quarter urban warfare situations, where other means of tactical support are not feasible. Col. Barry Shoop, deputy head of West Point's electrical engineering and computer science department, reflects on the versatility of weaponised robots: "Send a robotic platform into a room, and it might take some small arms fire. But it can be repaired fairly easily. A Marine is not as easily repaired."

It was rumoured that almost immediately after its deployment, and before any unit fired a shot, the SWORDS project was prematurely terminated. Qinetiq, the UK company which developed SWORDS, subsequently refuted this claim, stating that the SWORDS units in Iraq are still operational. However, they are no longer used in combat missions due to safety concerns by senior US army officials.

Although only a fictional literary device, at the core of Asimov's laws is the idea that robots should not ever harm humans. This presents a problem for military contractors like Qinetiq, which designs robots especially for warfare. The ethics concerning the use of robotics to kill enemy combatants is a tricky moral and legal issue, especially if technology advances to the point when robots are fully autonomous.

Already, we are seeing huge progress in the design of weaponised robotic systems, especially in the field of artificial intelligence. Currently, technical difficulties prevent weaponised robots from being fully autonomous, but it is only time before these issues are solved. According to Col. Shoop, "The technical challenges [of building an autonomous robot] are great. Think of the kind of image and graphics processing you need to make positive identification, to use lethal force. That's inhibiting."

Deploying armed, autonomous robot raises a lot of questions about its responsibilities and roles. If it mistakes a civilian for an enemy and opens fire, is the programmer of the robot responsible? The treaties of the Geneva Convention, which are concerned with inhumane acts against enemy combatants and civilians, are only defined for human participants. Robots such as SWORDS operate in a legal grey zone in which its actions are not easily categorised as acceptable or not.



A SWORDS unit, equipped with the M249 Squad Automatic Weapon.

For this reason, every major unmanned ground vehicle (UGV) manufacturer has stressed the importance of having a 'man in the loop' when operating armed robots. This way, incidents such as friendly fire can be attributed to human error rather than malfunction or programming error. US Army programs manager, Kevin Fahey, notes the sensitive nature of the robotics industry: 'Once you've done something that's really bad, it can take 10 or 20 years to try it again'

But it is the US army's intention to eventually introduce fully autonomous robots onto the battlefield, either as a replacement or a supplement to human combatants. According to Chief army scientist Thomas Killion, "The Future Combat Systems program is demonstrating semiautonomous vehicles where they can do a lot of planning and execution on their own and they really only have to essentially call home to a soldier that's controlling it when it needs additional guidance." The US National Research Council advises "aggressively exploiting the considerable warfighting benefits offered by autonomous vehicles"

ISA, a non-profit security think tank, predicts that weaponised robots in the near future will be equipped with a 'conscience' to force it to act humanely, in an attempt to solve some of the dilemmas of robotic ethics. The Georgia Institute of Technology's Ronald Arkin, goes as far as suggesting the possibility that a robot soldier may act more humanely than a human soldier, as it would not react to stress or fear, which can often cloud judgment.

According to Arkin, an approach to programming this 'conscience' into robots involves "assaying opinion on the use of this class of autonomous robots, while also investigating how to embed artificial consciences in these vehicles to ensure that the international laws of war, codes of conduct, and rules of engagement are strictly followed by machines, perhaps even more effectively than by humans"

A US navy report suggested that another possible solution to this ethical dilemma is to "let men target men" and "let machines target other machines". However, in reality, this is still technologically difficult and strategically ineffective, as enemy combatants without robot technology will be immune.

Another ethical hurdle for the development of autonomous weaponised robot is the risk of terrorist attacks using the robots. Once the technology is sufficiently well developed, terrorists may be able to reprogram stolen robots, or to manufacture their own. Noel Sharkey, professor of artificial intelligence and robotics at the University of Sheffield, believes that "once the new weapons are out there, they will be fairly easy to copy. With the current prices of robot construction falling dramatically and the availability of ready-made components for the amateur market, it wouldn't require a lot of skill to make autonomous robot weapons."

Regardless of the numerous hurdles in the future of battlefield robotics, it is clear that the strategic advantages of unmanned warfare will ensure its role in the future of global security. Whether the technological, ethical and legal barriers against such a fundamentally different type of warfare can be overcome before its proliferation in armed forces worldwide is another story.

Samuel Tam

Report 2

Simulating a Better Future

A man jumps out of a helicopter almost before it lands. He chokes on the stench of burning bodies, as he attempts to make sense of the chaos unfolding around him. While his comrades frantically strip away the remaining debris, he rushes to resuscitate those recovered from the rubble, but is too late. If only they had been better prepared, these deaths could have been prevented. The simulation ends. Next time the response will be perfect.

Imagine a time when emergency forces can coordinate a response to a disaster and be in place before it even occurs. Where a new product's societal and environmental impacts can be judged and perfected, risk free and without the need for expensive prototypes.

Picture a place where a tunnel's collapse can be predicted and stopped before any fatalities can occur.

Thanks to revolutionary computer modelling and simulation technologies, much of this is already possible.

Simulation involves imitating an object, process or state of affairs through representation of its key characteristics or behaviours. Modelling is the use of mathematical equations to imitate and predict real events and processes.

Simulation and modelling software are used together in order to allow a business unit to reduce production cost, refine designs, minimise flaws and train staff or clients. Engineers of all disciplines have increasingly begun to employ this technology to simplify every day tasks.

It is widely known that Aeronautical engineers not only use modelling software to design and model their planes but also use flight simulators to teach pilots how to fly these planes in a range of different conditions in a consequence free environment. This provides significant benefit to large commercial airlines as it enables the training of their crew in addition to their pilots, which may be needed in situations of emergency.

The Australian Government Department of Defence relies heavily on simulation and modelling technology to train their troops and act out tactical manoeuvres without injury or mortality. Simulators have also been included in pre deployment training for personnel sent to hazardous regions such as East Timor, Iraq and Afghanistan.

The mining industry has also benefited from the introduction of simulation and modelling technology. The Mining Industry Skills Centre was formed in 1996 by the mining industry and the government as a Centre of Excellence for the development and implementation of training plans in the mining industry. The centre offers mining companies the opportunity to use state-of-the-art underground and surface mining simulators to train their new and existing employees in a safe yet realistic environment.



CAE Full Flight Simulator

Simulation software enables engineers in the manufacturing industry to predict the stability of structures and materials and their ability to handle real world conditions as well as external load factors like stress, heat and vibration. By testing these scenarios and identifying and correcting sources of possible failure early on, engineers can optimise product design.

Simulation technology assists manufacturers to improve the overall quality, reliability and performance of a product while keeping design time and monetary costs low.

By shortening design cycles and reducing the number of prototypes, manufacturers are able to accelerate the time it takes for a product to be released, giving them a competitive advantage over rival products arriving later to market.

Where would our gaming industry be without modelling and simulation software? People of all ages spend countless amounts of their time and money on these realistic simulations. Whether we are flying a Boeing 747 or fighting the Roman Empire, the popularity and enjoyment of a game is due to the quality of modelling and simulation technology that exists and continues to be developed. Other industries leveraging Modelling and Simulation technology include construction, rail and Healthcare.

Every year the Simulation and Modelling industry come together at SimTecT, a Simulation Technology and Training Conference held annually by the Simulation Industry Association of Australia in conjunction with its many sponsors.

SimTecT sponsors include CAE Australia, Thales Australia, Cubic Defence Australia, Calytrix, Bohemia interactive Australia, Presagis, Raytheon, The Mining industry Skills Centre and The State Government of Victoria (Multimedia Victoria and the Defence industry Unit).



Simulated reality in a role playing game

This year SimTecT will be held in Melbourne from 12-15 May 2008 with the theme “Simulation – Maximising Organisational Benefits” specifically focusing on the advantages that simulation provides to better meet an organisation’s objectives.

Like the previous conferences, this year’s SimTecT provides an opportunity for the simulation community to discover the latest research and product advances, and to discuss applications with developers and users.

The conference will include workshops, keynote speakers, paper presentations and an exhibition hall filled with booths ranging from government organisations to private companies.

It is important that we remember that simulation, like all technology cannot be developed without standards. Some Standards organisations involved in simulation and Modelling include ISO, IEC, IEEE, Standards Australia, DIS, ITLA, RPR FOM, SISO and SEDRIS. The Simulation and Modelling industry are supportive of the need for standards in Modelling and Simulation. The Department of Defence, Boeing, CAE Australia, The Simulation Industry Association of Australia and Engineers Australia are just a few members actively participating in Australian and International standardisation.

Simulation and Modelling technology will continue to simplify tasks in business, government and our every day lives and has the potential to launch entirely new business disciplines as it endlessly advances and develops over time.

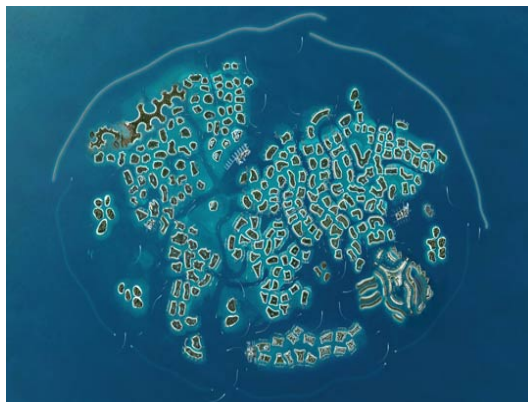
Jonathon Barel

“I saw The World!”

Smitha Viswanatha

My father came home from his business trip to Dubai sounding very excited. “I saw The World!”, he proclaimed. Seeing that I failed to reciprocate to his enthusiasm, he explained that The World is another one of Dubai’s extravagant dream projects made real. He continued talking about this for another week and told everyone and anyone who would listen. Seeing this immense excitement in my father I decided to do some research and get some “cyber experience”, if not real, of this new world!

The World- an archipelago of 300 islands constructed to take the shape of a world map. The project with its concept was first announced by Sheikh Mohammed bin Rashid Al Maktoum, Vice- President and Prime Minister of the UAE and Ruler of Dubai on the 6th of May, 2003. It is located 4.5 kilometers off the coast of Dubai, halfway between Port Rashid and The Palm, Jumeirah. Described as the ‘greatest engineering odyssey’, it is made up of a whopping 386 million tons of rock and 320 million cubic meters of sand is dredged from the sea for land reclamation. It forms 232 kilometers of new coastline and 27-km long breakwater. With the intention of putting it as one of the most exotic tourist attractions on, ironically, the bigger map of the world, every minutest detail has been carefully evaluated and executed. Be it the width of the canals, or the location of the transportation hubs and marinas, or the commercial centers of the project, everything is said to have been tailored to give the consumer the utmost satisfaction.



http://www.theworld.ae/mp_overview.html

Nakheel:

The engineering master mind behind this gigantic project is a Dubai's premier development company called Nakheel. It has to its credit many landmark projects in Dubai, such as The Palm, The Jumeirah Islands, The Gardens, Dubai Waterfront and the like, which have become icons of creativity, originality and sense of achieving the impossible. To summarize it in the words of Nakheel's chairman H.E Sultan Ahmed bin Sulayem- "Nakheel is more than a company-it is a belief that defies ordinary thinking...when conventional wisdom says no we say yes and make it happen."

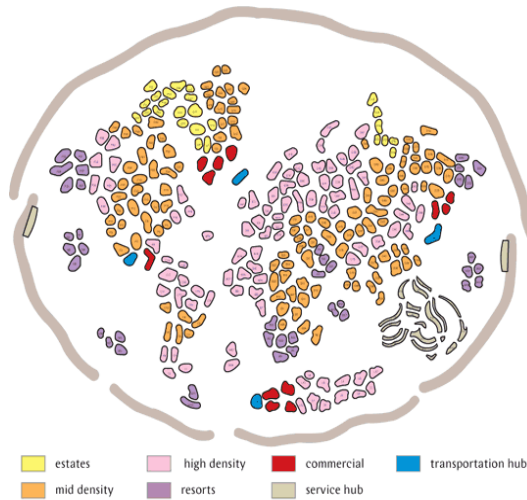
Construction:

The tender of marine and dredging contract was procured by Van Oord, also worked with Nakheel on projects such as The Palm Jumeirah. The early stages of the construction consisted of the deposition of sand in the sandbanks to 10 m below the sea level, which formed the foundation of the continents on the seabed. While medium-size dredgers were used to raise the sandbanks to 7m, smaller vessels were used to bring it to a height of 5m. Rainbowing technique was then used by the large-capacity trailing suction hopper dredgers to bring the sand above the water level. Cutter suction dredgers were then finally used to shape the islands, each rising above 3m above the sea.

Real Time Kinetic (RTK) Global Positioning System (GPS) technology was used to guide and track progress at all stages of construction. The accurate subcentimeter measurements provided by RTK and differential GPS (DPGS), were employed to guide the movements of a fleet of special-purpose construction vessels working on the project. RTK and GPS were also used to follow the daily advancement in the island construction and optimize work to keep the giant reclamation project on budget and on schedule. Every vessel was equipped with Pacific Crest and Trimble positioning technology, ranging from DGPS to RTK GPS. To obtain an accurate position each unit was then matched to the required position. This allowed easy and secure navigation through the continuously changing seabed. Similarly the hydraulic cranes operating on barges were also fitted with Trimble MS860 RTK GPS receivers and heading systems to control the construction of the protective backwaters (Hasse, 2006).

Islands:

On islands, which are sold as contiguous plots, terraforming is used to give the developers options to reshape the islands according to their needs and interest. The distance between islands is maintained between 50-100 meters, with an average depth of 11-16 meters around the islands. The islands are classified into four categories- low density, resort, mid and high density. The low density islands are designed to provide privacy to the residents and hence are located at the perimeter of The World. Resort islands mainly serve the commercial purposes of the project, which houses hotels, resorts and the like. The mid -high is a combination of the previously stated categories, making it both commercial and residential. It is surrounded by two protective breakwaters, made from 32 million tons of rocks, on the outer perimeters protecting the islands from long and cross-shore waves. While the outer breakwater is a submerged reef, the inner break water is above water. The average island measures 300000 square feet with islands sizes of islands varying between 100000 sq feet to 450000 sq. feet.



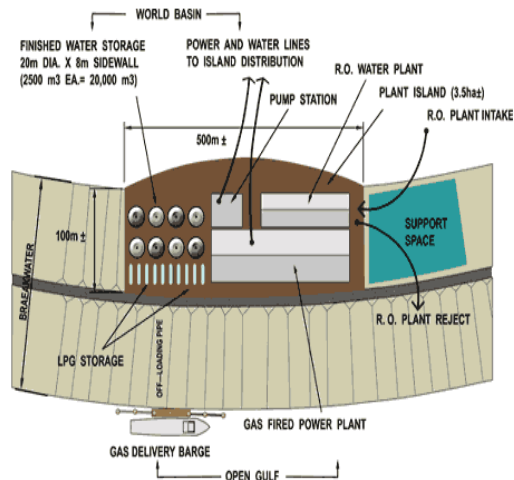
<http://www.theworld.ae/>

Transportation:

Since The World is seen as a 'boating paradise', an elaborate system of canals with a draught of four to five meters makes navigation to the different islands of The World possible at the same time also ensuring the privacy of the islands. Water taxis and ferries form the major share of the public transport. This is complimented by four marinas, island marinas, commercial

marinas, public transportation hub marinas, and mainland hub marinas along with the strategically placed hubs.

Centralized systems are used to provide the basic amenities to the residents. Power and water provision sites are located on the either side of The World along with the sewage systems and reuse systems.



(http://www.theworld.ae/mp_infrastructure.html)

Project completion:

The last rock was placed at 8:00 am on the 10th January, 2008, marking the completion of the first phase of one of the most extravagant project undertaken. The islands will be next handed over to the developers for the construction and building of infrastructure.

OQYANA:

Derived from the Arabic word “Oceanic”, OQYANA is a group of 21 islands which form the Australian and New Zealand islands of The World project. It is the foremost fully master-planned elite island community. Complete with spas, hotels and luxurious resorts it promises high level first class treatment. It covers an average of 20 million square feet and a total upland area of 4.5 million square feet. It contains 17 kilometers of inter-linked walkways, 15,000 meters of shore front and a marina with over 1,500 private yacht berths.

Reading about The World makes you wonder what the actual world will be like in a few years time. But then again there was a time when the world was considered flat and Pythagoras and Aristotle struggled hard to convince the society that it was indeed spherical. From then till now, we have come a long way. For one thing we know that the world is spherical, and that it can be conquered and now even replicated. Today one can dream beyond the norms and even dare to achieve it. However right now to me what matters is that my father has convinced me that The World is indeed a few kilometers away from Dubai and that he has seen it!

For further information, visit these websites which have also been the primary source of information of this article:

<http://www.theworld.ae/>

<http://www.nakheel.com/>

<http://www.vanoord.com/>

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Haase, P 2006, 'Ten quintillions grains of sand', The American Surveyor, July/August.

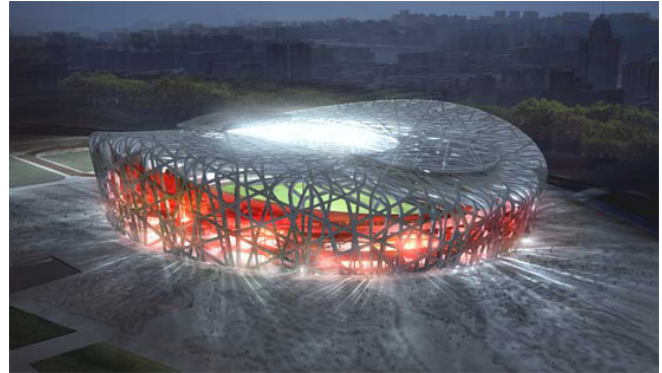
http://www.theamericansurveyor.com/PDF/TheAmericanSurveyor_Haase-CreatingIslands_Jul-Aug2006.pdf

Report 4

Gold, Silver Iodide, Bronze...How China hopes to engineer the weather for Beijing 2008

Peter DeNavi

On the 8th of August 2008 the forecast for Beijing is a 50% chance of showers, exactly what the organisers of the 2008 Summer Olympic games don't want to hear for the evening of their opening ceremony. If you don't like the forecast, why not simply change the weather?



As impossible as it seems this is exactly what the Chinese government are planning on doing, in fact it is what \$100 million of government money and 50,000 people have been researching since the mid 1950's.

For a games already marred by political protests and the international community casting a critical eye on the emerging powerhouse nothing can be left to chance when it comes to this monumental opportunity in the global spotlight. Hence the continuing implementation and development of the National Weather Modification Office and its aims of engineering the weather are paramount, in China's view, to a highly successful Olympics.

To achieve this China have been engineering a practice known as 'Cloud Seeding', although simple in design its effectiveness has been hotly debated amongst the wider scientific community.

The technique is initiated by firing canisters of Silver Iodide up into oncoming cloud formations. The Silver Iodide forms a chemical platform on which the water particles accumulate faster than by the normal cooling process. Thus the rain particles become prematurely heavy enough to fall to the ground and hence this creates rain before the clouds otherwise would have.

China claims that this process over the period of 1995 to 2003 was able to increase the rainfall by 210 billion cubic meters. Its practice has been utilised for over two decades in the northern arid parts of the country where drought and snow storms destroyed the farming plains. The areas which were subjected to cloud seeding techniques reported 470,000 ha of hail free land whose fertility would otherwise have been destroyed by viscous cold snaps.

The Chinese government initiative has also been focused on engineering the reverse practice by using a similar technique but rather than forcing the water to fall, the aim is keeping it cooled and suspended within the cloud. This is performed by firing a liquid nitrogen based chemical into the clouds forcing the water molecules to separate and decrease their size hence keeping them aloft for longer.

As China emerges on the world stage its ability to efficiently lead and run an effective operation with international links as large as the Olympics is crucial to securing a seat as equals at the international table. Consequently it comes as no surprise that they want to get things exactly right.

So by means of their weather army of 50,000 government trained rural farmers equipped with 7000 anti-aircraft artillery and 5000 rocket launches the Chinese government is endeavouring for perfection, even in terms of the weather.

Considering in China the month of August is typically the wettest of the year with on average 18 cm of rain and temperatures of 30°C meaning conditions will be much in the favour of precipitation and unfavourable to attempts to stave off rain over important venues.

The research on such a large scale has been pioneered by the Chinese whose investigations into this extreme engineering are viewed as too ambitious by some and contrary to a 2003 report from the National Academy of Sciences who concluded “there is still no convincing scientific proof of the efficacy of international weather modification efforts” China’s National Weather Modification Office claims that results have been highly successful and they are prepared for the challenge awaiting them.

The ability to increase rainfall is set to be utilised in the weeks leading up to the games in an attempt to artificially engineer a cleansing process for the smog which chokes the Beijing skyline.

This excessive pollution has been an issue raised by athletes of all nations as they fear for their wellbeing and performance as they inhale these dangerous levels of toxic smog before and during their events.

By inducing heavy rainfall in the weeks prior to the games the Chinese will attempt to naturally cleanse the air of the pollutants. Coupled with the shutting down of multiple large factories and a reduction in cars on the roads they hope to significantly reduce the levels of harmful pollutants in the air.

To calculate and organise the tactical approach needed to estimate when and where the artillery needs to be directed The Weather Office will utilise the latest IBM technology with the recent purchase of P575 supercomputer which has the ability to perform a staggering 10 trillion floating point calculations every second. The benefits of this technology enables the Chinese to accurately forecast cloud formation, temperatures and precipitation every hour for each individual kilometre of Beijing.

Thus oncoming showers to the Olympic venues, especially the opening and closing ceremonies can either be made to release their rain early in an attempt to dissipate the showers before they reach the venues, or if the cloud formation permits, the government trained farmers can cool the clouds with the liquid nitrogen chemical and stave off the rain until it has passed over the venues.

The preparation for the 2008 Olympics has been a testament to modern engineering practices and ability as deadlines for some of the most ambitious projects have been met and expectations exceeded. China has set a precedent for investment in the modern Olympics with it set to showcase not simply impressive sporting venues such as the aptly named 'birds nest' and 'water cube' but also the \$40 billion budget put towards engineering the worlds largest airport terminal or the dozens of newly constructed skyscrapers which have risen in Beijing since the announcement of their hosting the games in 2000.

It stands to reason that the best athletes in the world are converging on a city at the epitome of engineering brilliance and skill. Weather the determination of the Chinese government to enforce their slogan of "*One World, One Dream*" has been over ambitious is yet to be decided, but certainly at the present they are making these engineering dreams becoming innovative reality.

By Peter DeNavi