Engineering the Future

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Digital Design Weekend 2016

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Can we engineer the future?

What a ridiculously lovely notion – to engineer our future. As a young engineer, I was given the task of controlling the level of water in a water tank that was continually being topped up. I had to understand the rate of flow of current change, the amount of water stored and the history of change. Water, a simple molecule made of two basic elements, in a square predictable tank with a simple valve to release it – and I struggled. It was a fantastic way of teaching me about calculus in action. To engineer our future, we need to be able to predict it, to create feedback loops to the past and to design processes that interact between the past and the future to create useful and meaningful outputs. A tad more difficult than controlling the level of water in a tank. And while Newtonian mechanics were able to come to hand, I'm fairly sure we're entering the realms of science fiction when we start to think we can engineer the future.

Isn't it the history of science fiction that we turn to in order to say just how well we can imagine possible viable futures? Aren't we living in Gibson's Neuromancer? Wasn't the wonderful voyage of Tim Peake predicted by Arthur C Clarke? And didn't I just Skype colleagues on the other side of the planet in a world imagined in a short story by E M Forster? It is this collective imagining that can and has become the practical, engineered, exciting future that we now live in. Almost to the day, the 2016 Digital Design Weekend is happening 150 years after the birth of H G Wells, possibly the greatest imaginer of the future of all time, an author who 'predicted' multiple futures that have yet to happen. We have no Man In The Moon. Time travel is limited to a very few BBC hours of that chap in a police box. While we've come close to destroying this planet, the blame lies entirely within the confines of this globe and not that of another. It is this ability to predict a future that hasn't happened that I love – that someone living at the start of modernity was able to tell stories well beyond. Engineering, quite simply, is able to create reality feedback loops that transform the fictional stories of people in the past into possibilities for people in the future – that we need to have a social connection between creative imagining of what might happen next and the practical implementation of what can happen now. Engineers need to read what writers have written in a social connection between two different ways of thinking.

The social operational distance between writers, artists, designers and engineers is starting to change. People are working more closely together – beyond passive connections (reading, viewing, consuming) – and becoming far more participatory. People who might imagine a future unbound by current technical possibility are starting to work in sympathy, and in practical ways, to jointly create prototypes of possibilities. Artists and writers are forming and joining labs and workshops; engineers and scientists are starting to be found

in studios of practice. This is particularly true in Digital Design Weekend. It is a celebration of this emerging, shared, physical and philosophical space that we can inhabit. So it is apt that this is in the V&A – that a 'gallery' can be a lab, a studio, a workshop, in the same way that a workshop could be a gallery.

This narrowing of the distance between those who imagine the future and those who build the future has started to yield some distinct changes. The history of how we acquired our knowledge, our trade so to speak, is less important than the work we are doing. A creative technologist could have a PhD in engineering or a portfolio of digital art. A design agency can work with the materiality of artificial intelligence. The nature of privacy of global digital practice can be questioned by a jeweller.

Can we engineer our future? I don't know. I do know one thing, though – we're living in a future that we have already engineered. The challenges that face us now are not about the capability of what we can do; it's more about how we can do it. That sharing of knowledge leads to the creation of new knowledge; that there are futures that can only be engineered by collaboration across disciplines; that the future is coming is certain, but what that future is will largely be decided by the way in which we can work; that the biggest challenge facing engineering might come from the way we think about what engineering is, rather than what engineering does. Either way, I love the beautifully ridiculous challenge that a future is out there that we can engineer!

The philosophical engineer

Image: The workshop of James Watt (1736–1819), December 1924.
One of four photographs taken at Heathfield by J Willoughby Harr

The Scottish scientist, engineer and inventor James Watt (1736-1819), is remembered chiefly as a pioneer of steam power who improved the efficiency of steam engines by inventing a separate condenser, devised revolutionary steam-powered mechanical drives and introduced the concept that steam power could be measured by reference to the power of horses. Watt's achievements as 'The Great Steamer' were fundamental to the Industrial Revolution.

Watt had a restless curiosity that led him into all types of experiments and inventions. He invented a machine to make it easier to produce perspective drawings. At the time of his death, he was working on machines to copy sculptures that now seem like an analogue form of 3D printing. Watt developed and marketed the first apparatus to produce duplicate copies of handwritten documents using chemically impregnated paper. He made musical instruments and invented new types of clocks. A pioneering chemist, Watt experimented with processes to produce alkali from sea salt, and claimed to have been among the first to realise that water was a chemical compound.

Watt trained as a mathematical instrument maker. The hands-on process of making and the trial and error of experimenting with different materials was a constant source of fascination and inspiration to him. His friend at the University of Glasgow, the scientist John Robison (1739-1805) remembered how Watt could not resist playing with anything that came into his hands to see how it worked:

Every new thing that came into his hands became a subject of serious and systematical study, and terminated in some branch of Science ... A Mason Lodge in Glasgow wanted an Organ ... We imagined Mr Watt could do anything, and tho' we all knew that he did not know one musical note from another, he was asked if he could build this organ. He had repaired one and it had amused him. He said Yes – but he began by building a very small one for his friend Dr Black ... In doing this a thousand things occurred to him which no Organ builder ever dreamed of – nice indicators of the strength of the blast regulators of it, etc etc. He began to build the great one. He then began to study the philosophical theory of Music ... Before Mr Watt had half finished this Organ, he and I were completely masters of that most refined and beautiful Theory of the Beats of imperfect Consonances – He found that by these Beats it would be possible for him, totally ignorant of Music, to tune this Organ according to any System of temperament – and he did so, to the delight and astonishment of our best performers (E. Robinson and A. E. Musson, James Watt and the Steam Revolution, London, 1969, p.38).

Watt appreciated how every act of making is also a theoretical statement, and building and making machines was for him a stepping-off point for deeper intellectual exploration and investigation. His advances in steam power were partly inspired by his friendship with chemists at Glasgow University and their theoretical advances in areas such as latent heat. In the words of Ben Russell

of the Science Museum, Watt's steam engines combined in a tangible product: 'an astonishing concept, a feat of experimental science and precision engineering'. As Ben emphasises, it is only through considering Watt's diverse achievements as acts of making that we can draw together Watt as engineer, craftsman, chemist and philosopher.

Glasgow University (where I work) celebrates its connections with James Watt, naming its engineering school, two professorships and a prize after him. However, Watt was employed by Glasgow University not as a professor, but as a mathematical instrument maker, initially to repair some astronomical instruments left to the University that had been damaged in a sea voyage. Glasgow University in the 18th Century placed a great emphasis on practical knowledge, also employing a university type founder (who afterwards became Professor of 'Practical Astronomy'), while the Professor of Natural Philosophy, John Anderson, threw open his physics lectures to artisans and others who were not members of the University. Watt's workshop at Glasgow became an intellectual hub of the University, as John Robison recalled:

All the young Lads of our little place that were in any way remarkable for scientific predilection were Acquaintances of Mr Watt, and his parlour was a rendezvous for all of this description – Whenever any puzzle came in the way of any of us, we went to Mr Watt. He needed only to be prompted – everything became to him the beginning of a new and serious study, and we knew that he would not quit it till he had either discovered its insignificancy or made something of it ... Every thing became Science in his hands, and I took every opportunity of offering my feeble Aid by prosecuting systematically, and with the help of Mathematical discussion, thoughts which he was contented with having suggested or directed (Robinson and Musson, pp. 24-5).

Watt's work on steam engines was prompted by John Anderson, who asked him to make improvements on a model of the type of steam engine invented by Thomas Newcomen in the 17th Century. The liminal space of Watt's workshop was the home of a stream of innovations.

The story of Watt's life has been retold in many different ways to justify different social, cultural and political ends. But although Watt worked in a very different environment to the modern digital world, his story still seems to have many current resonances. Many of the greatest achievements of the Industrial Revolution were incremental improvements which took technologies to new levels, like the separate condenser. Progress in the digital world is often more incremental and less disruptive and transformational than we might think – it has been pointed out how Steve Jobs was a 'tinkerer' rather than an inventor of completely new concepts, and there are many parallels between the career of Jobs and those of industrial pioneers like Watt.

The nature of spaces of innovation is also significant. Innovation often takes place in liminal spaces outside the mainstream, in places like James Watt's workshop, where people with different types of background, interests and enthusiasms can meet together, talk and play and enjoy what Robison called 'an inexhaustible fund of instruction and entertainment'. After he settled in Birmingham, the meetings of the Lunar Society (so called because it met on nights with a full moon) provided Watt with a similar space for a mixture of scientific, philosophical and practical discussion. At the heart of this wide-ranging and often philosophical conversation was a constant concern with making – to quote Ben Russell again, 'Britain depended for its movers and shakers on its doers and makers, and Watt stands for all of them, regardless of their specific trade or profession'.

Watt was also creating a new type of profession – part scientist, part craftsman, part businessman. At the end of the 18th Century, the word 'engineer' was most frequently applied to military engineers (it was for this reason that the term 'civil engineer' later emerged). The assumption was that those who erected and operated machinery like the Newcomen steam pumps were just mechanical operatives. However, high-end mathematical instrument makers required a considerable amount of scientific knowledge. John Morgan, who Watt worked with in London, described himself as a 'philosophical instrument maker'.

James Watt proudly appropriated the word engineer to capture the distinctive mix of art, craft, science, making, serious play and philosophy that characterised his work. Watt described himself as 'James Watt, engineer' in his publications for the Royal Society at a time when the Royal Society was promoting the idea of the gentleman scientist. Watt sought to make the case for the philosophical engineer.

It is our feeling that one of the transformative and exciting aspects of digital technologies is its ability to support new types of interaction between artists, engineers, scientists, historians, writers and makers in a way that recaptures that idea of the philosophical engineer. In the activities of the 2016 Digital Design Weekend, you will see projects supported by the Arts and Humanities Research Council (the major funder of arts and humanities research in the United Kingdom), the Victoria and Albert Museum, the British Council, Mozilla Foundation and other bodies which explore the way in which these intersections are revivifying our engagement with the philosophical engineer.

Openness – Privacy

Image: Open Internet of Things Lab notes, Mozilla Open IoT, Anstruther Scotland Design Sprint, June 2016

A conversation between Jayne Wallace (Reader in Craft Futures at Northumbria University) and Michelle Thorne (Lead, Mozilla's Open Internet of Things Studio at Mozilla Foundation) following The UnBox LABS: Caravan, NID, Ahmedabad, India, February 2016 and The Mozilla Foundation: Open Internet of Things Lab, Anstruther, UK, June 2016.

J What kind of experiences did you have in India and Anstruther that made you reflect on what the IoT could be?

M I did like how over those two events there was an openness with knowledge... there was also a real willingness to share knowledge or support across multiple projects – so if someone was like 'I need someone who can programme code'... I thought it was quite fluid and supportive and I think that same openness with knowledge was also true in our interactions with all the crafts people we met in India. They were very generous with showing the process and showing what they made, even in Anstruther too. Your experiences on the boat it seemed that people were very forthcoming with just the knowledge of how a boat works and again, on the farm, it felt very generous with sharing how that process is. I think that openness to share knowledge wasn't in the way that, you know, we're trying to take that on as a profession, but rather, look into this world of mine, this is something I know a lot about and I see you are curious, so I'm gonna share – I think that spirit took shape in a lot of different forms in the events.

J Could you see, I'm trying to think how would IoT map onto that and where would the spaces for digital be in places like Indian craft? Because one of the tensions I felt was that with development, and with new ways of making and ways of living, a lot of things were being lost. It's a really tough question – how could the digital open up vistas for people who are in rural locations to have new channels to sell their work? That being one thing and thinking about the kinds of things that the craftspeople make – it's not a template, but definitely a series of designs that have been made for decades and patterns that are reproduced, meaning that there is a limited market for that if we're thinking about how this could be something to export for example, new ways for them to make money – Sean[1] and I have been thinking about pottery that feels quite western, but that has the traditional Indian oil lamps or diyas as part of them. And by sending these back to India we're starting a conversation about what this could mean and I can see there would be a place potentially for IoT there to aid communication and nuanced exchange of information about how things are being made, maybe.

[1] *Sean Kingsley, Potter and Collaborator, Duncan of Jordanstone College of Art and Design, University of Dundee.*

M Yeah, like what are the craftsman to craftsman exchanges that are there if you and Sean represent a different location? Maybe there are new ways for IoT to become a bridge to share that knowledge if it goes back to this idea of genuine interest and exchange of practice and approach and methods and all that. I can imagine it being a way to facilitate that, I don't know what shape that takes, but...

J That would be really nice in an educational setting as well, wouldn't it? You know, maybe the way that a craftsman works... For instance, when we watched the potters in India throw pots, they did it in a completely different way to the way that we're taught how to do it in the UK – we take it (clay) out and then up (when throwing pots) – they were taking it flat and then bringing it right up, which is one of the hardest things to do, but it means that by taking it flat first, it's not all full of water, making it a much more efficient process, and it worked with the clay that they had in a way that it might not work with the clay that we typically use, but it was different.

M Just to be able to exchange those practices! I'm always amazed by how many videos I can find on YouTube. If there is anything I want to learn how to do, be it how to chop an onion or fix this or that, apply make up, whatever, there's always a YouTube video for it and not only that, there are seven or more.

J It's amazing, but I can remember one evening I was looking up how you do makeup and trying to copy and I just looked like a mess afterwards – I just couldn't do it, which makes me think you can watch all of these videos, and lots of the way we learn is by observation, but could the IoT give us more multisensory ways of experiencing someone else's craft or knowledge base in some way, I wonder?

M That's a really nice question – multisensory and also interactive. I was also thinking, there is this video of an onion getting chopped, but you know I may not be aware enough of my technique. My knife-holding technique maybe is already so off that... So what are the ways that the knife or the object could guide me? Is there a way for technology to help with these other types of adjustments?

J Yeah, because if we think, taking the rural craftspeople as an example, how could they, because a lot of them are having to give up their crafts, as they're not making money out of it anymore, as what they make isn't wanted anymore by a population that wants to be more western – and you think 'OK, so how could we find other markets or how could they assimilate some of these western qualities while retaining some of the very Indian qualities?' But you're right, imagine if you had a learning situation where you could hook up with a master in India who could be getting feedback of what a child or adult learner was doing and be able to correct them – then that would be a direct way for them to use their craft in a different way.

M The knowledge and expertise in teaching becomes a form of service. It also makes me think of the things that I'm learning to do, I guess a clichéd example from India is yoga, but it's so interesting – there's this kind of yoga that I'm doing called Ashtanga in which you get a lot of adjustments. There's this one sequence (and you always have a sequence), but you have this teacher who is there adjusting you; they don't just give a command, they are always watching you and they adjust you and there's a parallel with crafts.

J It's really similar, it's that kind of embodiedness.

M Yeah and you can really 'feel'. I can see somebody doing these moves and I understand conceptually what the pose is supposed to be, but it's not until they push you or adjust you that you're like 'oh I get it!'

J You can then actually feel what that looks like! I think for a lot of making activities, it's really the same. When it starts to work, it's an embodied knowing that you can feel happening and can replicate.

M It's interesting the different ways of knowing, right? You have that embodied knowledge or the muscular knowledge even, right? I think it would be a really beautiful way or area of exploration of embodied craft learning.

J Completely. With things like wearables, you can imagine all kinds of ways that...

M That you could get adjustment or feel the feedback.

J Yeah.

M Even this might be an interesting space where VR or AR becomes an interesting technology. Not to overdo it, but there are already pretty rich and immersive environments where you can 'feel'.

J True, but it's difficult. I can't imagine what these things would be without them being really clunky.

M You know, you have these remote surgeries – that's at a very high end of technical possibility and robotics and really fast connections and stuff, but if technology follows the current trend, then technologies we have now (that are incredibly expensive – prohibitively expensive for a layperson to use) will, in 10, 15, 20 years, be the kind of robotic telepresence that might actually be much more commonplace – so that kind of precision and complexity of movements might mean we actually have something we're able to use in that kind of way. So today, what we could build might be quite clunky and imprecise, but it's also interesting to think about what's down the road where that might be more accessible.

J It would be a really beautiful project and having tangible outputs, like pots – what does the pot look like where you start to get this kind of feedback from a master in India? The story would be there in the pot. That's quite interesting because clay is such a fluid medium, such a plastic medium and it's just using your hands, that you know...

M These are the algorithmically assisted pots... these are the...

J That would be such a great project to do in India and see how the craftspeople would take to it, or not, and how they would bring their expertise to defining what the technology would be, what the wearables would be...

M I can imagine doing something cool with them where there are different modes, and I'm jumping to all these different technologies – it's interesting to see what would be available. We have this 360 degree recording, like Rory[2] was doing; we have 3D scanning and all the different haptic tools that seem to be coming together – actually there's quite a lot of accessible technologies that you can probably do in a low-cost way with the crafts people there.

J We should pursue this, it would be so exciting to have IoT that would do something in these spaces, where it isn't just an addition to all the tech that people have already got, but it would be something really different for people and could potentially make a real economic difference.

M And there was something I found interesting when we interviewed farmers on Tobie's estate[3] – it was like the thing they were looking for wasn't more efficiency or more technology to go with their farming equipment – they were already covered there; but they were really looking for genuine ways to connect to the sea-orientated village, and that I found quite interesting. I've seen that come up in other kinds of research and projects, where neighbourhoods have been asked to design smart solutions etc. And what often comes up is that we don't want more efficiency, we want more social connection or more social character.

J More poetics probably a lot of the time, too.

M I do think it would be great to think about IoT aesthetics – something that explores that.

[2] Rory Hamilton, Interaction & Service Designer at Copenhagen Institute of Interaction Design Consulting and our partner in crime at the Open Internet of Things Lab, Anstruther.

[3] Tobie Anstruther, Balcaskie Estate, East Neuk, Fife. Host during the Open Internet of Things Lab, Anstruther

J It's usually quite problem orientated, rather than human orientated. That makes me think of a submission we've just had to a journal I'm involved with, where one of the writers talks about Tim Ingold's work. The writer was proposing that we shouldn't just be designing for human centredness, but also thinking about how we extend to the animals around us and the environment around us and design for this...

M An ecosystem-centric thing.

J Yes – the writer had dedicated the paper to the family dog. But it's true, isn't it? And in Anstruther, we saw how people live with the sea and the land – that felt really tangible – and that was really tangible in India as well wasn't it?

M I was going to say: in India, remember how many dogs and cats were there and elephants and cows and the animal life was very present?

J It was amazing, and I guess we really miss out on a lot. I'd love to see elephants walk past and think nothing of it.

M And it's really nice to have an approach that's human-centric and India cow and elephant-centric! And in Anstruther, you also had cows and it's a really nice philosophy to say let's look more holistically at who were solving for or...

J It's making me think about risk and openness as well. Thinking about India: where we were, there was a lot of risk; monkeys, for example; people telling us they aren't very nice, they can be quite aggressive, keep away, but they were literally just across there, so there was a huge amount of risk in doing everything in India and in terms of thinking about open IoT and risk and being risk averse...

M Yeah, how do you do responsible risk-taking? I also think there's a responsibility on our end – if we're initiating a creation process, then there is a responsibility for us to not be disruptive or create failures for other people. What does the responsible creation process look like where there is maybe more informed consent around risks that are taken and awareness of the risks?

J Without it being stultifying.

M Without having to do ladder training!

J You were saying an interesting thing in Anstruther about how you were getting more into the understanding of how you orchestrate things like these events to facilitate people to be creative – and often to be creative in groups of people they didn't know beforehand.

M That's risky!

J But really fascinating.

M I think I learned so much from India, from that event, and I really have to thank Babitha[4] for being a really great role model in an approach that is like self-directed group creativity, because I came much more from this school of group facilitation where it's probably overly facilitated. And I think there's a time and place. There are groups where you need that level of coordination to get somewhere, and other groups that have a sense of purpose and agency and, more than anything, you want to get out of the way! And so how do you like help to create that space and get out of the way? What's the role to be supportive? Guidance where necessary, unblocking where necessary, but also out of the way for people to be full agents.

J Yes, I see that you need to look to the person organising to give some structure to begin with, because structure can be useful as a 'way in' and then it's how you facilitate people feeling like they have an ownership of what's happening, I guess.

M I'd love that feedback of where you've seen in other communities or events where you've seen that collective and individual ownership really come to bear – what are the indicators or conditions for that?

J It was interesting how that worked across generations, as well, in terms of that. If there were things that you can actually leave behind and things that people actually want to keep using, it shows you whether it was a genuine kind of ownership and value going on there – it could be genuine if it was fleeting and it only happened during that week of course, but...

M I guess that's an interesting question, let's say desirability of the outcomes, of preserving the outcomes is a potential indication of success or stakeholdership maybe...

J Is this part of your working practice going forward? To do these events?

M I'd like to do more. I'd like to think of it more as a very circuitous journey where hopefully everyone who participates in it can take different approaches back in their own space as well. I mean, I'm learning a ton, and hope to do more, and see where other people are adding, too.

J I think it's completely that, and I think people couldn't help but get something out of it. And it seems to be that thing of how much you put in seems to be proportionate to how much you get out of it as well, but I think again it's that openness – people have to be open, to give their time and openness, to see what happens without having any major agenda. I think it's a really healthy thing.

[1] *Babitha George, Quicksand Design Consultancy, India. Co-founder of Unbox and co-organiser of the Unbox Labs Caravan.*

M That openness to the unexpected, and trust as well, I think. Now, having participated in two of them and also having worked with Jon[5] for many years, do you have a sense of just personally where for you is an interesting place to explore next or try next broadly in these themes?

J The thing I'm trying to think about, personally, is this notion of ongoingness through the digital. So, rather than us having these kinds of pockets of periods of our life, or pockets where there are certain relationships with people – and this links to work I've been doing with people with dementia and people at end of life – thinking about how, rather then seeing experience as before, current and after, how the digital can kind of weave these things together. So that's definitely a lens that I'm looking at things through – so whether that's in India, thinking about the crafts communities... So, it's not about looking back, I'm trying to think how can the digital, I'm not making much sense Michelle, I'm sorry!

M No, it does make sense.

J For instance, I was thinking if you think about mortality and the finite nature of things, we have all of these digital trails that we are creating with all of our content, whether we're doing it purposefully or not, that we could do so much with. So imagine if there is a husband and wife who used to jokingly argue about which song is better this one or that one, and then one of them dies; then, whenever that person who is still alive plays one of these songs on Spotify, the other song immediately plays afterwards – you know there are just ways that things about our relationships and sense of self and place with other people could still be ongoing...

M That's really nice. It's also the affordances of digital to be atemporal almost, or like a continuous temporality where you can have, like, even if you just think about Facebook for example, it wants you to put your photos in this timeline, but actually all those photos are existing concurrently from ten years ago to now and you can access and experience them all in the same moment.

J Yeah. There is an artist called Moira Ricci, she's an Italian photographer primarily and she did a piece of work that took all these photos from her family archive when her mother had died.[6] She put herself at the age that she is now and dressed in the period of that photograph, but she appeared as an adult in the photographs when her mother was a child, and the same age as her mother at parties in the `60s and she did it really brilliantly and she really looks like she is there.

[5] *Jon Rogers, Professor of Creative Technology at Duncan of Jordanstone College of Art and Design, University of Dundee and Fellow at Mozilla Foundation.*

[6] *The work being referred to is '20.12.53 – 10.08.04' by Moira Ricci.*

M It really fits.

J And that just really made me think we could be doing things where we cross each other's timelines in ways that are meaningful for people, or how you visualise your own future. Whatever, I just think there's so much potential there. The notion of ongoingness is something that's been on my mind with all of these events and trying to look at what we did in the events through that particular lens.

M That's really nice, that's a beautiful way to think about it. Also, those things, like the event itself, often have their own sense of beginning middle and end, but often it's like as we're experiencing it now; as we talk, we're accessing memories and insights and stories from the past and projecting future ideas of things we could be doing with the crafts people and how to feel that the event isn't 'done'.

J Yeah.

M It's still vivid and still part of us, right? And it's really interesting also, I'm just thinking from a perspective of documenting, learning and documenting where this sense of continuity is also really interesting. How does it not feel that what you did a year ago is over and not relevant? Or that the connections made there have gone cold? We have all these expressions...

J Completely, and I guess there's all the etiquette around that and use of the digital and how, if you forget to email back, when is it still ok to do so? And when do you feel that you couldn't anymore?

M And how much social stress that causes!

J Completely.

M We also had an event in Berlin[7] and it was based on some research that one of Babitha's colleagues had done where she visited four or five different homes in Bangalore and had got some stories that we responded to. Two of the four projects were about memory and recording and accessing and engaging with memory that happens in the home. One of the objects that was kind of inspiration was one woman had talked about this baby book that she had from her firstborn and had really recorded all the details of first words and first steps and scraps; and then she had her second kid and had all this guilt for not archiving, but you could tell these books were some of her prized possessions. And her kids, now that they're older, really treasured them, which also makes you think 'yeah, as

[7] *ThingsCon, Berlin, 2016.*

a kind of object or inspiration, you know, I've really treasured the events in Anstruther and India and all those things'. How may we have ways to say that they (and Tommy's[8] book is one way), but how do we have other ways to say they were important? There's something nice there.

J It's harder to think how you create that embodiment of the value that you felt in something when it's transient, isn't it? But there's a lot that we might not be able to touch, but... yeah, interesting. I'm always keeping sketchbooks and notebooks where you finish them and move on to the next one – have you ever looked through old ones? These whole worlds open up in front of you of all the things you were thinking about and things that were happening and the things that you say, `oh, why didn't I do that idea?'

M I know, they come with their own set of, like, nostalgia and regrets.

J Like you were saying in a sense with the `digital notebooks', everything that we're doing, all the photographs, recordings all the rest of it, if we thought of that as the same kind of `being ongoing', then that could feel more like lots of layers rather than discrete events.

M There was a really nice project that Google did, actually, that was a physical notebook[9] that connected to the web and you could interact with the notebook and it would access different content on this site: videos and text and all that. I really liked it because you had the permanence of this one object, this little interface that felt very easy to use – it had a pen, this stylus, but then the content you saw was so layered. So you had the permanence of this one thing, but that let you easily go to see this richness of digital stuff. It made me think, for the next event as a complement or as a next version of having a book documentation, maybe there's a page in it that actually has a circuit in it.

J That's really nice.

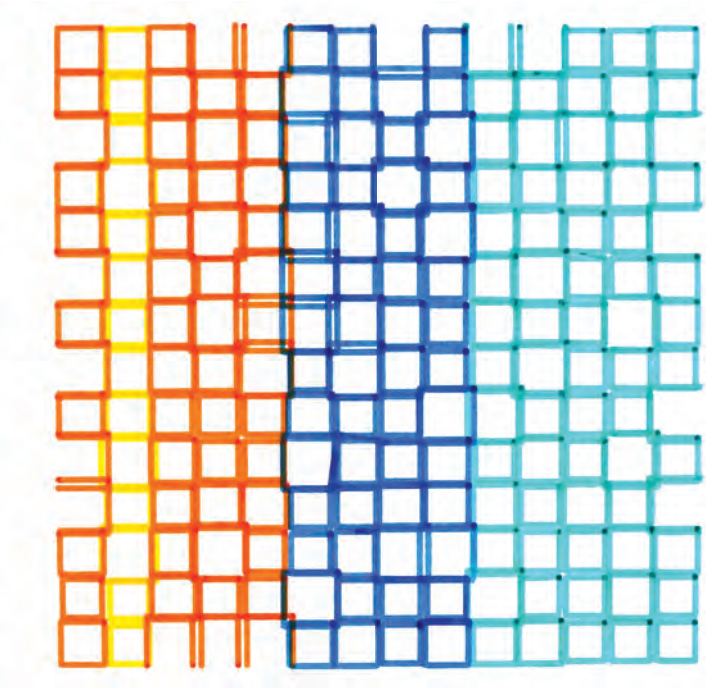
M A page that has a more dynamic archive or ongoing stuff with people still adding in stories as it continues.

J It would be lovely to have some of the pages that have got some audio, as well, from the week. We could have Mike[10] doing his conductive ink. `Could have a load of things being captured over the event and you don't know which one it is you're getting in your book...

[8] Artist and Designer Tommy Perman documented the Open Internet of Things Lab in a beautiful book.

[9] "Think with Google" http://rolandellis.uk/go.html

[10] Mike Shorter, Uniform Design. Currently completing a PhD exploring emergent technologies including printmaking with conductive ink.



Re verse engineering: poems on the turn

Image: Print from the Frieder Nake matrixmultiplikation portfolio published by edition hansjörg mayer, 1967

Researching a series of text-related events and exhibitions relating to the 1950s and 1960s has led me to recognise that the emergence of computers, or computational thinking,[11] had strong parallels and interconnections with the form and content of concrete poetry works. The form of the concrete poem was open to inventiveness, pliability and malleability, yet simultaneously encouraged intensive concentration by the viewer or listener. It allowed us to move in, contemplatively, as well as to look out at the white spaces between words and around them. Revisiting these sometimes overlooked poetic constructs can offer a space for considering an idea of the pre-digital after years of exposure to digital visual overload. If the idea of post-digital holds, then might not recognising the pre-digital also? This text begins to look back through the lens of interrelations between poetry and early computing. It interleaves some thoughts on discovering and inventing.

1. On discovering

'A particular convention or attitude in art has a strict analogy to the phenomena of organic life. It grows old and decays. It has a definite period of life and must die. All the possible tunes get played on it and then it is exhausted; moreover, its best period is its youngest. Take the case of the extraordinary efflorescence of verse in the Elizabethan period. All kinds of reasons have been given for this – the discovery of the new world and the rest of it. There is a much simpler one. A new medium had been given them to play with – namely blank verse. It was new and so it was easy to play new tunes on it'.[12]

2. On inventing

John Cage spoke in 1972 of the influence his father, an inventor of submarines, had on him. He also recounted how Schönberg, his music teacher, when asked who was his best pupil, had said, 'Cage' – then added, 'of course he's not a composer but he's an inventor – of genius'.[13] Schönberg believed that there was no technique without invention and that it was closely aligned with inspiration, otherwise it was imitation.

The etymological root of engineering, the Latin word ingeniare, means ingenious and clever thinking coming from within. Indeed much of the impact of engineering happens below the surface, at structural or sub-structural levels. We might think that poets are also subterranean diviners. But they can also affect perceptible surfaces. In 1964, Brazilian poet Décio Pignatari wrote that 'for me, poets are language designers'.[14] He expressed this at a point when the skills of graphic and industrial designers, typographers and poets were crossing over, evident among networks of people in Brazil,

[11] *Ernest Edmonds, "Moving Between Poetry and Code", in Visualise: MAKING ART IN CONTEXT, ed Bronac Ferran (Anglia Ruskin University 2013) pp64-71.*

[12] *T. E. Hulme, "Romanticism and Classicism", in Speculations, ed Herbert Read (New York: Harcourt, Brace 1924) pp121-122.*

[13] *John Cage, interview with Jeff Goldberg in Transatlantic Review, 55/56. Ed J.F. McCrindle (1972). pp103-110.*

Germany and UK in particular, resulting in the making of new types of poetry – variously called concrete, process based, visual, spatial or semiotic. Finding new ways to describe the movement itself occupied many pages and many manifestos. Linguistic inventiveness was at the heart of this development. In 1965, Haroldo de Campos coined the term 'typoetry'[15] to describe the work of one practitioner, Hansjörg Mayer, whose skills with language, type and form helped fit this new jigsaw – a typoetical revolution? – together.

3. Poets and revolutionaries

There are points in history when the runes and rules of poetry shift and seem to go head in hand with revolutionary turns. It is sometimes thought that many English poets, in the stormy period after the French revolution, turned their faces and their backs away from the emerging industrial revolution and took refuge in clouds, daffodils, Gothic storms and wilderness. They did this. But the truth is a little more complex. When we look at William Blake's depiction of Isaac Newton's powers of calculation, it helps to reinforce our belief that he was radically opposed to science. But though true on one level, this image could not have been so precisely and accurately realised had Blake himself not understood a lot about calculation. He knew, inside out, what he was drawing. Similarly, a little known fact is that Lord Byron was formally elected to the Royal Society, though only went there once. His friend Percy Bysshe Shelley was greatly influenced in his youth by James Lind, royal physician and close friend of James Watt who belonged to Erasmus Darwin's Lunar Society. Samuel Taylor Coleridge, who was an exemplary early inter-disciplinarian, declared that he wished to 'warm his mind with universal science' (Prescott, 2012) and was a close friend of Michael Faraday, inventor of electromagnetic induction.[16] He 'discovered'/was inspired to write the poem Kubla Khan, in an opium-influenced dream-state. Ada Lovelace, mathematician daughter of Lord Byron, who called her Princess of Parallelograms, showed her innate poetry when she wrote of how she saw the Analytical Engine as: 'a machine for weaving algebraic patterns just as the Jacquard loom weaves flowers and leaves'.[17]

The discovery of electricity was also food for a Gothic imaginary. The enduring imaginative power of Mary Shelley's Frankenstein reveals the capacity of the literary imagination to rapid-prototype future fictions.

[14] Décio Pignatari, "The Concrete Poets of Brazil" in Times Literary Supplement Any Advance? The Changing Guard 2, ed John Willett (Times Publishing 1964) and downloadable at: https://loriemersondotnet.files.wordpress.com/2011/10/astronautsofinnerspace.pdf (accessed 5.8.2016).

[15] Haroldo de Campos, contribution to catalogue of TYPOETRY exhibition of the work of Hansjörg Mayer, Studiengalerie, Stuttgart, ed Max Bense (1965).

[16] See http://journalofdigitalhumanities.org/1-2/an-electric-current-of-the-imagination-by-andrew-prescott/ (accessed 6.8.2016)

[17] Notes in Lovelace's hand with her translation from the French of article on the Analytical Engine by Luigi Menabrea (1843). See http://www.computerhistory.org/babbage/adalovelace/ (accessed 5.8.2016).

A remarkably prescient essay published in 1797, attributed to German idealistic poet Friedrich Hölderlin, expresses a poetic desire to `give wings to our slow physics which has been moving so laboriously by way of experimentation... Thus – when philosophy provides the ideas [and] experience the data we can finally achieve a physics on a large scale which I expect from future epochs. It does not seem that present physics can satisfy a creative spirit as ours is or should be'.[18]

In visionary poetry also from this period, Hölderlin began to fragment words and leave extended white spaces, which we might recognise as an important step towards the spatial poetics which Stéphane Mallarmé's Un Coup de Dés Jamais N'Abolira le Hasard brought fully to light in 1896. It has recently been argued that Mallarmé's poem was based on a numerological play with the number seven.[19] It is certainly a vital turning point between symbolism and serialism. Its conceptual abandonment of poetic control makes a leap through the gate out of the 19th Century and into the 20th.

A small network of writers, including T. E. Hulme and Ezra Pound, banded together in Soho in London in 1909 with the shared aim of writing a new form of poetry appropriate to a new century. The outcome was Imagism, which brought a new focus on precision of form and concision of statement and which drew, through Pound in particular, on Japanese and Chinese ideographic influences. Picture- and language-making were beginning to coalesce and combine.

4. Programming the poem

Interconnections between concrete and visual poetry forms and what we now think of as early computer art were initiated for the first time by Professor Max Bense at Stuttgart Technische Hochschule in the late 1950s. His expertise in mathematics and philosophy infused the experimentation which his publishing, teaching and exhibition activities facilitated. His influence was enormous on the development of concrete poetry internationally. It was on the large Zusse mainframe computer at the Technische Hochschule in Stuttgart that what is regarded as the first computer poem was created by Theo Lutz in 1959. It was through connections to Bense that, in 1965 in Stuttgart, Georg Nees and Frieder Nake (who had been a maths student at the Hochschule) had their (and the world's) first exhibition of computer plotter drawings.

Mayer, the poet and typographer who had studied informally with Bense in the late 1950s, contributed significantly to the development of an `international style' within concrete poetry design and typography, with

[18] *Friedrich Hölderlin, from The Oldest System-Program of German Idealism. http://ebooks.cambridge.org/chapter.jsf?bid=CBO9780511803734&cid=CBO9780511803734A013 (accessed 5.8.2016).*

[19] *Quentin Mellassoux, "The Number and the Siren: A Decipherment of Mallarmé's Coup de Dés". Trans. Robin McKay. (Falmouth Urbanomic 2012).*

his consistent use of lowercase and Futura typeface which, for a critical period in the mid-1960s, many other poets adopted. His first typoems and experimental typographies date from the very early 1960s. From 1964–1968, through his imprint, Edition Hansjörg Mayer, he published many early works revealing correspondences between concrete poems and early computations within the context of his three major concrete poetry portfolios as well as a series called futura. One of the contributors to the futura series was the Imagist poet, Louis Zukofsky. Mayer also published a rarely seen portfolio of prints made with computers by Frieder Nake in 1967. This portfolio, called Matrizenmultiplikationen, is currently on display at Tate Modern. Mayer's unique expertise and virtuosity with print technologies of the time allowed for the casting of works in various experimental formats which stretched, fragmented and expanded the concept of the poem. He combined an interest in chance and randomness with a mathematically precise attention to use of graphic space, which makes his works now seem anticipatory of networked systems whilst holding a more modernist purity of form. He typeset several issues in the early-mid-1960s of Bense and Walther's booklet, rot, a seminal platform for disseminating and circulating possibilities of concrete and computational convergence.

The work of both Bense and Mayer was referenced in a special edition of the Times Literary Supplement in 1964 focussing on literary avant-gardes internationally. Edited by John Willett and extremely wide-ranging in scope, it showed intersections and correspondences between concrete and visual poetry with ideas from semiotics and emerging information theory. Willett edited another special issue focussing on UK- and US-based writers and poets which included work by Dom Sylvester Houédard, a Benedictine monk who was particularly interested in connections between computational language and poetry. He was the first in England to give lectures about concrete poetry and links to machines. He recognised that the movement (the turns) which kinetic poetry offered were a further step into the post-authorial void which Mallarmé had first identified and which computers in potential offered a chance to take further. His own works, often called typestracts, were usually produced on an Olivetti typewriter in the small cell in the abbey where he lived in Gloucestershire. A prolific letter writer, he was often invited to provide introductory texts for concrete poetry festival catalogues, which he wrote in characteristically hyper-textual, inventive language that looks prescient of today's texting and Twitter. He sent typestracts out widely to friends and acquaintances. Prices for these works are rising posthumously.

Prompted by the TLS coverage of Bense and information aesthetics, Sylvester wrote a letter[20] to Margaret Masterman, who had founded the Computer Language Research Unit in Cambridge several years earlier, which Houédard considered the nearest equivalent in the UK to Bense's project in Stuttgart:[21]

[20] *Dom Sylvester Houédard, "Poetry Theory & Poetry Theoria", in THEORIA TO THEORY, Vol 1 First Quarter 1966 (The Epiphany Philosophers) pp6–9.*

[21] *Unpublished letter from dom Sylvester Houédard to Hansjörg Mayer, October 1965.*

--- I find all this area still unsatisfactorily mapped in British philosophy ----I mean---if language is THERE to use ok------but the need for new words is w / us all the time ----- they don't come by analysis------we can take the words & nonwords quark and antiquark & use them and make means things abt elementary properties------but I'm thinking about a deeper problem (I think) abt the originating of language and communicating signs-------- or does one just have to depend on the given & enlarge it?

Masterman had studied philosophy with Wittgenstein and with colleagues in the CLRU, and made a pioneering contribution to experimentation within the then emerging field of natural and machine language processing. In his letter, Sylvester also referred to the challenges of: '--- getting machines to write tolerable conceptual and semantic associations & language models &c.', linking this to his experiments at the time in making in kinetic poetry with poets Kenelm Cox, John Furnival and Richard Loncraine:

---- our own contribution --- here in the Cotswolds (furnival loncraine cox myself) has been (....) towards the possibility (via kinetic poetry) of machine semiotic poems in which NO lexical key is provided any more than when nice/nasty/white/&c clouds passes across ?yr sky (have the glostershire group ('gloop') poets here produced art? Poems? Or a language?...or is it that the poet constructs the MACHINE --- ie the machine IS the poem? --- cf pierre albertbirot on the POET as the poem machine in grabinoulor).

Houédard was here referring to Pierre Albert-Birot, a friend of Guillaume Apollinaire whose calligrammes from earlier in the century were important influences on later visual poets. Albert-Birot's lead printer had stayed up all night to typeset Apollinaire's hand-drawing of Il Pleut into the form which we recognise today, first published in Albert-Birot's journal SIC in 1916.[22]

5. "The difference between the concrete and the computer poet is"...

In a text published a year earlier in the journal From Theoria to Theory, McKinnon-Wood and Masterman had given an extended account of their hypothesis and experiments:[23]

(ii) Algorithms (mechanical tricks) can also be used to produce a fully computerised poem. For instance, in the output given immediately below the machine has been (a) only to chose words beginning with the letter 's' and, (b) when there is a choice among 'S' words, to take the one whose second letter is nearest the end of the alphabet (and so recursively, if there is still a choice of words).

[22] Il Pleut by Guillaume Apollinaire was typeset by M. Leve and first published in SIC (Son Idées Couleur) journal no 12, ed Pierre Albert-Birot (1916).

[23] Cambridge Language Research Unit, "Computerised Haiku", in THEORIA TO THEORY, Vol. 1 Fourth Quarter, 1967 (The Epiphany Philosophers) pp378-382.

The fact that some of these algorithms of tricks produce quite good output highlights the known fact that traditional poetry also uses tricks of rhythm, rhyme and alliteration to allow words to combine more freely (because more mechanistically) than would be permitted by the stereotypy of prose.

VII. The role of the poet in computer poetry
It will be evident from the above that the poet programming a computer must: (i) set up the frame, (ii) create the thesaurus, (iii) devise any mechanical tricks (e.g. rhyming) with which he may desire to operate. ....He can, of course, be vastly more sophisticated than we have in setting up and varying his frame (a sonnet, for instance, is a sophisticated frame).

But the ultimate creative act, for the computer poet, lies in writing the thesaurus.

They end with an amusing yet serious summary of differences between the concrete and the computer poet:

From the above it would provisionally appear that, whereas part of the motivation of the genuine concrete poet is to stream-line his own mind, so as to make his poem into something as like an algorithmically produced machine output as possible, the computer-poet on the contrary, tends to use the machine to create a profusion of new, surprising and unforeseen combinations of words which, without its help, he would not have thought of.

6. Revealed in the turn

In 2012, I had the opportunity to curate an exhibition to coincide with the centenary of Alan Turing's birthday, which I called Poetry, Language, Code. Amongst the works were several by Ernest Edmonds, including concrete poems from 1967 and a print-out of a computer programme he wrote using FORTRAN in 1968, juxtaposition of which demonstrated intriguing parallels and differences. Writing later about making 'concrete poem collages', Edmonds has described how his work evolved from making simple, constructive, rules-based poems on a typewriter to a more complex set of works using code from around 1968: 'the structure and the computation became all. The poetry was in the code'.[24]

The exhibition tried to reveal the important materiality of early code works and so also included a print-out of POEM FOR SPASMO composed in 1969 by the late Alan Sutcliffe, one of the founders of the Computer Arts Society, using an ICL 1904. At the top of what looks like a programme written for a computer is printed in tiny lettering:

WHEN YOU SEE THE MOON PLEASE SAY THIS POEM QUIETLY.

[24] Ernest Edmonds, "Moving Between Poetry and Code", in Visualise: MAKING ART IN CONTEXT, ed Bronac Ferran (Anglia Ruskin University 2013) pp64-71.

His text for the Visualise book concluded as follows:

Over the years, I have moved from wanting to specify every detail of a work, to wanting to leave everything to a computer programme, often using random values to take decisions, so that I was distanced from the process of composition. I would have liked to have no pre-mediated decisions but there must be at least some part to the process, to decide what programme to write.[25]

7. A poetic conclusion

In the arts and humanities, design and engineering fields, we're experiencing turn after turn. We've had the linguistic and the digital turns, and now the material and the spatial. But could there be one which would aggregate all the others into a potential revolution? Perhaps we need a poetic turn. It is not that difficult to argue for. Poets reverse-engineer facts and rapid-prototype future fictions. They have often been associated with revolutionary movements because they need to attenuate language, and so their work becomes meaningful – or should be – at points of dynamic shift or transformation. Despite themselves, they have been in the revolutionary vanguard of our current interdisciplinary preoccupations, bringing STEAM to the narrow STEM. Of course, their contributions can often be too early or too 'out there' to be understood, sometimes even by themselves. I think a poet-led turn would be nicely challenging. It can be about taking the can of worms and revelling in the escaping.

[25] *Alan Sutcliffe, "MAIN GROUNDS (anag, 5.2)" in Visualise: MAKING ART IN CONTEXT, ed Bronac Ferran (Anglia Ruskin University 2013) pp55-59.*

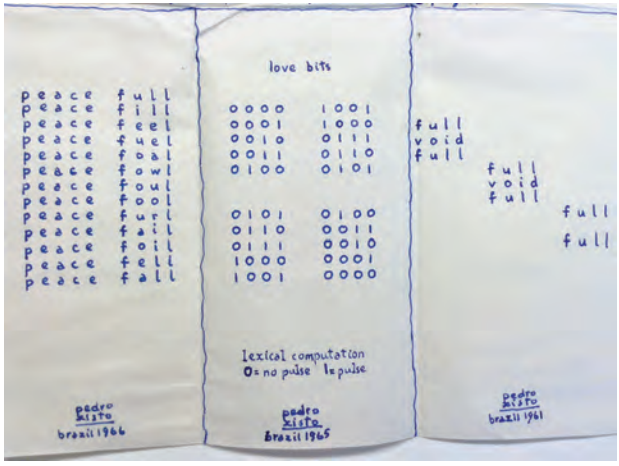
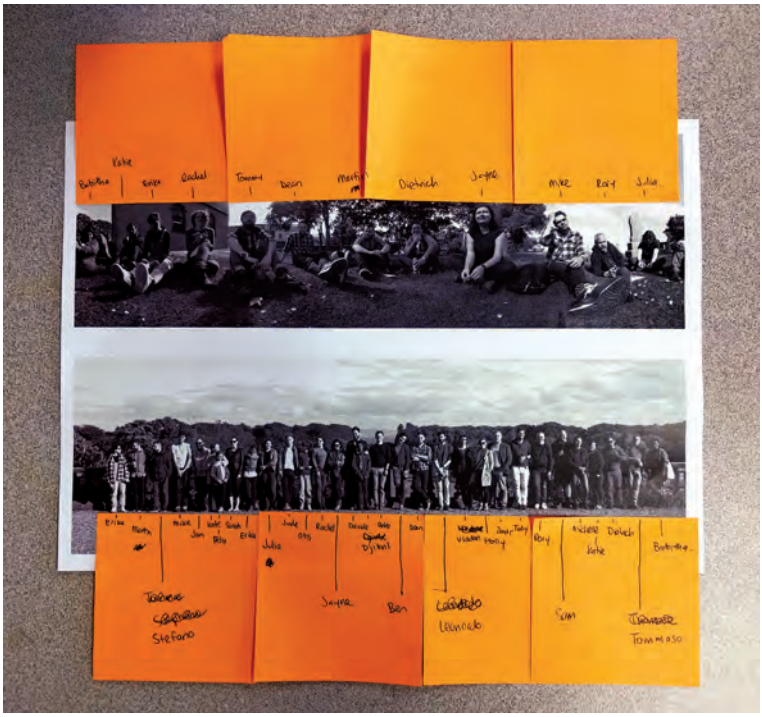


Image: Manuscript poem by Pedro Xisto, a Brazilian poet which was enclosed in a letter sent to Stephen Bann in 1966



Healthy Networks: The Future of IoT is Open

Image: Group photo, Mozilla Open IoT, Anstruther Scotland Design Sprint, June 2016

The internet is changing forms. Today we live in a network of physical objects and services that continuously gather data and exchange it over the internet. These connected systems are increasingly invisible, inaccessible and immutable to us.

We believe that, as the internet evolves, it must remain a global public resource that is open and accessible to all.

The Internet of Things (IoT) describes the trend of increasingly connected objects and environments. It's rapidly growing, although its professional practices and leading products are not yet fully established.

With the Mozilla Open IoT Studio, we're seeking to make IoT more open, accessible and empowering. We also strive to improve privacy and security in the field. To this end, we're convening a global network of professionals committed to open IoT.

Here we invite participants to collaborate on prototypes that serve local communities and celebrate the unique affordances of physical places. We test and critique best practices for embedding privacy, digital literacy and diversity & inclusion in IoT. We publish and exhibit our results as a way to reflect and advocate for these values as the internet evolves into more physical and ubiquitous forms.

We prioritise working with professionals who are currently active in IoT: product designers, web developers, hardware manufacturers, data scientists, user researchers and internet activists.

That's because the professional norms of IoT are not yet established. Through collaboration, we develop shared practices and understanding of what it looks like to better embed these values in the technology we build.

In this way, our work is all about learning-by-making. We want to build a healthy network through collaboration and making something meaningful together. By making a prototype together, or a project, you start to form bonds. These bonds form a network.

We strive to welcome diverse thinking, identities and experiences. We care about sustainable activities, meaningful contributions to local communities and a nurtured approach to innovation. We are committed to learning-by-making and to sharing what we know and create.

These formats are still unusual within Mozilla. That's because, historically, we're an organisation that has primarily defined itself in software and technology products. With software, especially when it's used by millions of people, there is almost a hubris in thinking that there is a universality in the world.

Particularly in Silicon Valley, there's an obsession with 'fail fast'. It uses hackathons and sprints in a way that's not necessarily a good thing. We are often failing fast with other people's lives. It seems reckless, especially if you are trying to do things for others. There's a need to be supportive and nurturing.

These sorts of events help Mozilla find its body and its voice. That practice has been growing in different forms with a lot with colleagues that have been doing similar work, particularly with the Mozilla Leadership Network.

We are here to learn by making and shaping professional practice, especially in technology, because we want IoT to be more open, more accessible. Therefore, we have to think about learning in more holistic and reflective ways. It's about taking the time to listen, observe, be in a place, be present in your practice. You can still be rapidly prototyping, but with a slow philosophy.

This requires meta-cognition. You have to realise the event isn't just about making a prototype, but about shaping your practice and contributing to a larger community. For that, reflection is vital.

Located thinking: the future of IoT is local

Image: Refurbing an old telephone box in Anstruther with a RPi-powered local information exchange for teenagers, Mozilla Open IoT, Anstruther Scotland Design Sprint, June 2016

We care about technology, but we care even more about people and places.

When Michelle and I started out thinking about how we could convene people around open Internet of Things, it was about understanding that it's a journey; about knowing that we are not 'getting' anywhere, and it is not going to be clear. Innovation is never clear. It is about the atmosphere, the environment and the attitude.

Our direction emerged from the following values:

- Diversity is key – diversity in people, in processes and technologies.
- Critically positive framework for reflection
- Not having a goal in sight – otherwise we would only deal with things for the now
- Celebration of individuality and personal expression, which also equals messiness
- Patience with this messiness and chaos
- Beauty and celebration
- Clever people who are also nice

We are attempting to break away from this business of Silicon Valley and their language of agile prototyping and failing fast. That doesn't mean anything in our contexts. It is instead about being flexible, adaptive and empathetic where you are working in tune with the people you are with.

Let's not forget that we are human! So much of the Silicon Valley approach attempts to remove the human, building a dirty culture of lack of respect for land, history, people. Everything is new and in the 'here and now', and we are all shiny and let's get on with it.

I have a problem with the word 'disruption'; no-one where I live wants to be disrupted. Yes, of course we need to work hard and work quickly, but the things we are dealing with can't happen quickly. We can have a hackathon for climate change, but these are complex problems, and nothing is going to change in a couple of days.

Which brings me to why we like to create in specific places.

For me, it is a very clear personal point of difference about 'innovation' and the way it is going right now. Globally, this trend of innovation labs is becoming characteristic of glossy places in posh parts of cities, giving visitors this 'amazing' experience of life that in reality is a sanitised version of real life. This is a pretty inhuman way of working. For example, town halls and village halls were built with this incredible purpose of public good, especially for times of extreme emergency.

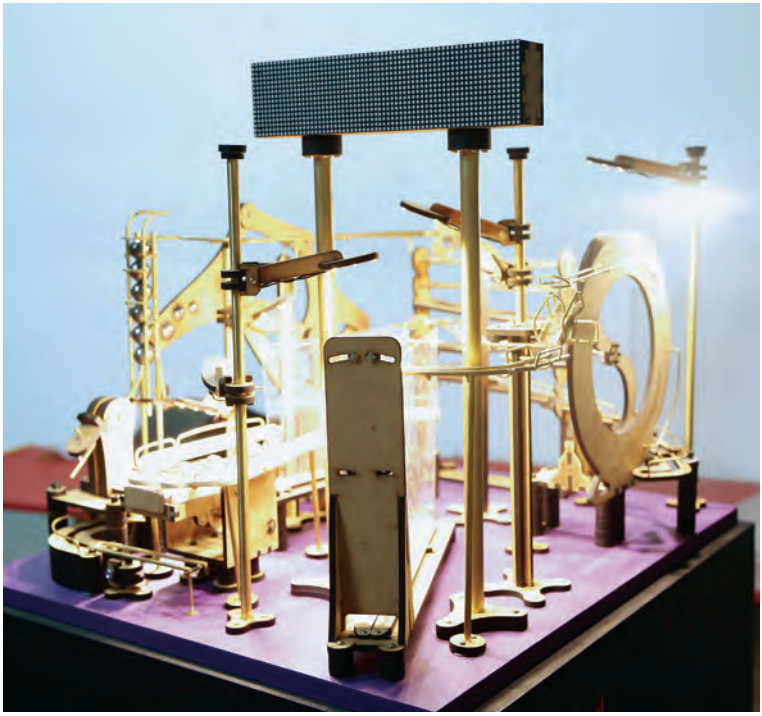
Nowadays, we all seem to think we are all fine, but we are actually going into real crises, whilst these civic places are now crumbling. We wanted to locate

us back in these real spaces. It immediately locates you in communities. All around in these places there's art, painting, photos, knotting and embroidery that has been done by the community over decades, possibly centuries, and not installations that have been produced by the latest, trendiest 'artists'. This helps us to not forget where we come from and connect to communities via these. The internet doesn't know how to do that, but village halls do.

In the design sprints we run, it's our intention to make it feel memorable and inspiring. People need great food; they need breaks; they need to not be working all the time; they need locally resourced forms of entertainment. People need nice places to stay in.

If I were to write some guiding principles for our design sprints, it might go something like this:

- You are here
- Be mindful and respectful
- Look around you
- You are passing through
- Stay in homes, not hotels
- Build the event from local resources
- You aren't anything special, you are part of the tide of life



Weapon of Choice

Image: Hola Goldberg (2016), Centro de Cultura Digital, Mexico City

You can go with this,
or you can go with that.
You can go with this,
or you can go with that.
You can go with this,
or you can go with that,
or you can throw with us.
Fatboy Slim, Weapon of Choice, 2001

When Google first launched the Google Maps API in 2005, I rushed to make a personal search. It was overwhelming to be able to locate my house, my neighbourhood, my school, and the park I used to play in when I was a child. But the amazement vanished when the API launched a pop-up saying something like, 'OK, now that you have searched for home, let's take a look into the real potential of the tool you are bursting into'. That was about the first time I felt a real, let's say, connection with an inanimate tool powered by the already-taken-for-granted tool called the internet. A little more than ten years from that afternoon, I stand upon the task of thinking about the future of the Internet of Things and actually writing something about it.

Far from the Matrix vision of communication among inanimate systems, I want to lead my argument towards a cultural lecture of IoT and the implications of process automation, specifically those referred to the still-pending subject for informatics: the awareness of existence and self-regulation in computerised systems. Hola Goldberg (2016) is a machine produced by the Free Technologies Lab of the Digital Culture Centre (Centro de Cultura Digital) in Mexico City. This machine executes a simple task in a complex process: a set of iron balls slip through a circuit in response to the use of these hashtags on Twitter: #Holagoldberg, #Tecnologíaslibres, and #elCCD. The system follows a given criteria which could also be set up to make choices. This faculty highlights the statement about awareness of existence and self-regulation I just mentioned above. In order to frame a brief archaeology to this realm, I plan to revise three figures that have anticipated the conceptual and operative basis upon which IoT has been built: robots, cyborgs, and artificial intelligence (as bold as it is now). I also want to emphasize the importance of bringing IoT development forward to discussions within the fields of humanities and cultural studies. Isaac Asimov's short story Runaround (1942) outlined The Three Laws of Robotics, which pointed out the lack of consciousness of robots since they needed to be programmed with instructions in order to perform a task. Later on, in 1962, Manfred E. Clynes and Nathan S. Kline proposed the figure of the cyborg as a cybernetic organism that would develop adaptive abilities in order to inhabit space. The authors enlisted a series of problems that cyborgs would face (let me be obvious about the fact that perception works differently in outer space than it does on Earth). Even though there are many cyborgs developing better prosthesis prototypes, there is still pending a labour of translation of the cybernetic impulse into human perception since technology is developed by humans and for human purposes. That is to say, there is no such a thing

as technology for technology's sake, as Edgar Allan Poe would state. This may be the reason for the third figure's problem: artificial intelligence. As much as humankind has led countless efforts towards this task, it seems that awareness of existence and self-regulation in computed systems will not be solved soon.

Let's just consider Tesla's autopilot crash, the first fatal crash in a self-driving car. The autopilot was driving over the speed limit. We can wonder whether the system was aware of its felony or not. According to Asimov's laws, the car shouldn't have put a human life at risk, but the facts say that the car's computed scenarios, in which a machine would consider its programmed options, had failed to succeed. The criteria considered during trials went short compared to the undetermined external factors that affected the scientific system. Does this event make science, engineering, robotics or informatics less reliable? Let's think not, but it does point out the urgency to incorporate philosophical concepts into account. Even more, it proves the importance of a philosophy of engineering, since the answers that science is looking for could find a path in cultural and philosophical theories. In the end, the questions about awareness of existence – the same awareness that the IoT fail to develop – may be easier to approach from the field of humanities.

There is a commonplace in social and cultural studies about how there cannot be a study of historical shifts without the study of technology. Let's take a second to think of the wheel, the vapour machine, electricity or even canned food and how those developments trace a breaking point in human history. These technologies change the way we constitute ourselves as human beings and our relationship with reality. Now let's take one more second to think of some philosophical developments. There is also a joke among philosophers that says, 'It is true that France made the revolution, but Germany invented the terms and concepts to think of the revolution'. In other words, there would have never been a French Revolution if the concepts had not been developed by philosophy.

As a term, IoT was first proposed by Kevin Asht in 1999. The concept was conceived as a network to set up interactions among different technologies. As for this very moment, almost 20 years after, it seems that there has not been a devolvement of IoT beyond Asht's concept. If we consider the extent to which technologies have been a breaking point in human history, and we add how the development of new concepts allow us to think ourselves in new terms, then it becomes clear that both technology and philosophy are social tools in terms of how we constitute ourselves as human beings.

Let's set up our current context towards a philosophy of engineering, and let's enunciate the bases upon which Internet of Things can be developed as a philosophical theory.

Image: Hola Goldberg (2016), Centro de Cultura Digital, Mexico City

The Good Home

Image: MozFest HomeLab Kitchen, 2015

The Good Home is a design exploration of better living for the 21st Century. Through a series of public installations, we explore life for a technologically-savvy household. We explore with artists, designers and technologists from around the world how flexible living interacts with the limitations of diminishing household budgets, limited global resources, evolving concepts of privacy, the sharing economy and global migration.

What might be unusual in the Good Home is that all work starts from values: future (connected) homes should be respectful and participatory, humble and hackable. Data, increasingly an element to actively design with and for, should be used primarily as an empowerment tool for residents.

During London Design Festival and the V&A`s Digital Design Weekend, we explore the theme of better, more humane 21st Century living as well as post-Brexit life in the UK through a number of design prototypes:

- Privacy Dimmer and the Wayback Machine are speculative designs – light dimmer-like devices which help residents control their privacy levels easily in their homes as easily as they can dim the lights. Wayback Machine is a collaboration of Peter Bihr, Rachel Uwa, Martin Skelly and Vladan Joler.

- In Tech Deities, Marta Monge addresses connected technology in the home and its totemic presence, as well as heirlooms and rituals in the connected home.

- With a charming connected toy, Kai Turner proposes an interactive kids' play experience.

- Brexit Bedroom Posters by James Bridle and various other artists ask what a teenager growing up in the next few years of post-Brexit life in the UK would put up on their walls.

In practice, the ways we live have been changing rapidly due to changing economic factors, global migration (both forced and voluntary, both permanent and temporary) and the dynamics of the so-called sharing economy, as well as digital connectedness. Yet our notions of living and housing are still deeply rooted in the concepts of 20th Century life and haven't yet adequately evolved. At the same time, we see a highly commercialised smart home industry emerge without sufficient debate around the implications of inviting potentially invasive technologies into our homes.

As a society, we need more experimentation and debate to shape these technologies as well as our larger concepts of better living for the 21st Century.

With the Good Home, we hope to make some small contributions to this debate.

How to Build Peace: Be Honest

Image: Build Peace 2015 conference. Photo by Claudia Meier

Six of us sit in a small room in Barcelona, discussing how to design tech tools for peace-building in Burundi, Colombia and Myanmar. This is the training for the Build Peace Fellowship, which brings new meaning to the idea of thinking global and acting local.

- Burundi, with a history of intermittent, violent, ethnic conflict from the legacy of European colonial rule, faces its first president ignoring the constitutional term limit. Youth under 24, who have been ruled by him for close to half their life, make up 65% of the population, and Jean Marie Ndihokubwayo and Centre d'Alerte et de Prévention des Conflits (CENAP) think they have something to say about the future of the country. Their goal is to amplify their voices in a participatory polling process.

- Colombia is working on a peace process to end decades of violent conflict, originally motivated by political disagreement and complicated by drug trade. Victims and former combatants rub shoulders in communities across the country. Diana Dajer thinks reconciliation can happen, in part, in local participatory budgeting processes required by the peace accords.

- Myanmar faces ethno-religious conflict perpetrated by a Buddhist majority on a Muslim minority with roots reaching back 200 or more years, but the military rule that mostly kept a lid on the violence just ended. Facebook is the primary connection to the internet for most people, which has created a self-selecting echo chamber for many users, making rumours and hate-speech much easier to spread. At the Centre for Diversity and National Harmony (CDNH), Maude Morrison thinks a tool that efficiently verifies or debunks rumours might be the first step to building a culture of scepticism and moderation.

Each of these projects is one piece of a much longer work to build social cohesion in places rocked by generations of violent conflict. In our hearts, we are dreamers and optimists – we believe peace is achievable, and we believe our tools make it possible for more voices to define that peace. It's so easy, so tempting, to think that if we simply connect everyone with an app, the world will be a better place. We are not techno-utopians, and if you thought, 'nothing is that simple', neither are you.

We worry: 'If people know the end goal is for peace, will they leave?'

We ask: 'What if government officials simply refuse to accept the results?'

We wonder: 'Are we creating a system that can be abused by the very actors we're hoping to reconcile?'

As designers and engineers focusing on what technology can do for social challenges, our task is to understand contextually and culturally, in a very critical way: how. For the past several years, our team at Build Up, and others working at the intersection of peace-building and technology represented in

the Build Peace community, have been coming to understand the processes needed to do this work well.

Here's an exercise. Take the tech you're working on right now and ask yourself these questions:
What change am I trying to initiate, and why do I think this tool will work?
Who is in the community that needs to own this tool for it to work, and what needs and assumptions do they bring as I build the tool with them? If I don't know, who can I ask to get more information?
With whom do I need to compromise, and where do I need to give up control?
In what ways could this disrupt the community, and do I put anyone at risk?
When I disrupt the community, how do I mitigate the harm and maximise the good?
How do I know I am achieving my goals, and how do I know when I'm not?

This is the foundation of a toolkit for any socially-focused technology, collaborative making or civic design process. It asks questions that drive at the heart of assumptions, ethics, participation and ownership. It is not a prescriptive formula, but guideposts or waypoints as we stake out uncharted territories in context-sensitive design. It's an iterative process built on a hybrid of the fundamental principles guiding work for social good and responsible design of hardware, software, and systems.

It's not easy, but it's necessary. It forces us to be more honest with ourselves about what we're making, whose input really matters in the making process, and how it might impact the world.

Women Who Code for Social Change

Image: Women Hack For Non-Profits. Photo by Elizabeth Chesters

Established in 2015, Women Hack For Non-Profits[26] (WHFNP) is a fast growing community of women who are looking to improve their coding, testing or design skills. What started out as a simple idea back in May 2015 by co-founders Nandhini Narasimhan and Vinita Rathi has been brought to life and has grown into the wonderful community we have today. We are over 200 coders, designers, writers, project managers and testers working on projects that are personally rewarding and contribute to the society at large.

The software engineering sector is one of the fastest growing in the world, but female representation is still rather low and there is an evident gender gap. With coding and design becoming necessary skills for shaping the future, it is important to encourage more women to enter the tech scene. By volunteering with Women Hack For Non-Profits, women can practice and grow the skills they require to help switch careers into the engineering sector, while working on real-life projects and communicating with clients. As a group, we help each other grow, boost self-confidence, share and exchange experiences, knowledge and best practices, and provide guidance at all levels. Starting from just a handful to over 200 volunteers, the group has grown in a very short period of time, which indicates the need for such a community.

Here at Women Hack For Non-Profits, we believe that open source is the way forward. Open source software comes with a licence for anyone to study, change and distribute it to anyone and for any purpose. Open source has been at the core of innovation and it has contributed greatly to the technology we use today. The web today would not be the same without it, and this makes it the main reason why we want to share the knowledge we have and will acquire as part of Women Hack For Non-Profits, to contribute to the innovations the future may bring. It is our requirement that all the projects we undertake are open source, with the code becoming available on Github for anyone to use, modify and contribute to.

We choose projects that are for a good cause. Volunteers can put project ideas forward to be worked on, but the majority of our projects are work that helps charities and non-profits. These range from simple websites, mobile apps, improving search engine optimisation, or a custom content management system that can help charities reach out to more people and promote their cause. Charities pitch these projects to volunteers during the monthly-organised events, after which volunteers self-organise into teams and start work on them. We usually collaborate on Slack, Google Hangouts and during project meet-ups in cafes around London. Everything is volunteer-led and none of this would be possible without the commitment, determination and time given by the volunteers. Organised by the volunteer board members of the organisation, we also have monthly workshops, talks, panels and project hack evenings. We have just begun work on two more projects, which bring us to ten on-going projects to this day.

[26] *http://www.womenhackfornonprofits.com*

Creating a community of interest

Together, we are working to create technology that can inform and educate, with a wide range of causes touching on issues such as living with a rare disease, overcoming OCD and acclimatising to foreign cultures and customs as a refugee. We hope to inspire many more women to come and join us so we can watch them grow, flourish and make a positive contribution to the community and non-profits that would otherwise not have the budget to create engaging and informative websites/content/apps that they so urgently require to reach more people, to further their cause. At the same time, we create an environment which constantly offers support and educates women in coding by holding workshops on learning coding languages such as Ruby and Python, as well as UX design, HTML, CSS and Github, to name but a few.

Our work has gained recognition amongst the non-profit sector and we have partnered with organisations such as Women Who Code, Code First Girls, AcornHack:Girls and Empowerhack, as well as many other, similar organisations. We hope to continue growing our outreach and impact on social/civic causes by organising hackathons and more panels similar to the Women's Day Parity panel organised by the volunteers this year. Panel for Parity touched on issues such as inequality, minority representation and challenges that many women face in the technology sector. With this outreach and the growing number of projects we undertake, we are beginning to gain momentum and starting to make a difference.

Project: Fashion Revolution Wall

Over two years ago, the garment factory Rana Plaza in Dhaka, Bangladesh, collapsed, taking the lives of over one thousand people and injuring over two thousand more. From this tragedy, the Fashion Revolution charity was born to raise awareness of workers' wellbeing and conditions in workplaces around the world. Every year, during Fashion Revolution Week in April, the charity urges their followers on social media to wear their clothes inside out and take pictures of their clothing labels. This is all in hope of raising awareness and understanding of where each garment is made and what kind of conditions the workers who make them may be working in. Women Hack for Non-Profits worked closely with Marianne Hughes to define requirements for a web app that would allow the charity to reach out to global followers and collect all submissions in one place. With a deadline only two weeks away this, has been an incredible and exciting challenge. We designed and developed a web app which aggregated all images of people's clothing labels, from their Twitter streams, and displayed them in real time on what is called a Twitter Wall. The app is live on www.fashrevwall.com and is still accepting submissions with the hashtag #fashrevwall. In such a short time, we designed, planned and built the full app with very little prior experience of the technology used for this and with only four volunteers.

Project: Erehwon

Erehwon project[27] is a collaborative research project started at Queen Mary University of London that investigates well-designed digital tools, free from corporate interests and social media noise, which assist those engaged in socio-political interventions in the public space (physical or digital) who, through their imaginative and creative practices, contribute to new narratives of change and help build a more fair, free and participatory society.

Mariza Dima, a WHFNP member and Human Computer Interaction designer, is a co-creator of the project. After almost two years of online research, guerrilla-ethnographic studies and many workshops across Europe, the project is currently at the first development stage of a prototype online tool. Together with three volunteers from the community (two front-end developers, one graphic designer), we created the alpha prototype over a hackathon during the last weekend of May 2016. The source code is available at Github and there is a list of the tasks needed to take the prototype to the second stage. The WHFNP community has been invited to work on a volunteering basis towards this next step. This would be an excellent example of community-driven change and support in collaboration with University research projects and in light of growing funding cuts for arts and humanities research.

Project: Collective creativity

We like to view WHFNP as an ecosystem that is driven by creative collaborations, collective creativity and diverse approaches to engineering and project management combined with a strong wish for social change. New members who join WHFNP encounter a lively, non-hierarchical community which warmly welcomes new members, aspires to connect with each other, works with and learns from different disciplines, is enthusiastic about creating tools and often inventing new concepts, and has a vision to help drive social change. Collaboration, creativity, and self-motivation are the pillars of how we work. These characteristics are partly the reason for the fast growth of the group whose members proudly promote the work they do and the community ethos. We have women applying daily to become volunteers, and it is with this vision and these tools that we hope to make our contribution towards minimising the gender gap whilst, at the same time, helping to shape a better society.

[27] *https://github.com/marizoldi/Erehwon*

RE:FORM – Reimagining Education for the Future of Redistributed Manufacturing

Image: RE:FORM project

Manufacturing supply chains are being reshaped and redistributed by the internet. Designers in Delhi are working with makers in Manchester, transporting bits over networks rather than boxes by container ship. We are moving to a world where software files rather than physical products are posted, with makers local to consumers fabricating products designed and developed globally.

How do we educate future makers and designers for this new industrial reality of networked prototyping and manufacturing? The Open University (OU) and MAKLab have been exploring this challenge as part of the Royal College of Art's Future Makespaces in Redistributed Manufacturing project.
The OU is a distance learning institution. Providing hands-on making experience for our design students is difficult, as we cannot assume our students have access to any equipment or materials; yet we recognise the importance of materiality in design education: not just understanding the theories, but also how materials and tools perform. MAKLab specialise in providing individualised training pathways in design and digital fabrication, but are interested in exploring how to scale up that individualised educational model in partnership with educational institutions.

Partnering allowed us to explore what benefits learners might gain from being involved in an online collaborative design-and-making process, from sketches to software models through to full-scale prototypes: not only learning technical expertise, but also the soft skills of negotiation, collaboration and project management. As educators, we were interested to find out how universities and makerspaces might work together to set learners a challenge that more closely resembled what they might experience in their professional lives.

To address these questions, our project was underpinned by a number of research workshops and interviews to establish the context and potential challenges to be addressed; but we were agreed that our project wouldn't stop at the theoretical stage. We would test our ideas by running a live study with participants, aiming at real, measurable outcomes.

What did we do?

We ran a summer school: a 12 week design-make project, pairing Open University design students around the UK with maker trainees based at MAKLab Glasgow.

Each pair had to work together to design and make a flat-pack chair, CNC-cut and assembled from plywood using no mechanical fixings. The OU 'designers' imagined initial concepts and worked these up into sketches and 2D CAD models. They then had to communicate and negotiate their ideas with their 'maker' partner at MAKLab, who would advise on material and equipment constraints, helping their designer-partner move their ideas to a software model suitable for cutting. The maker would then fabricate the design and

Image: RE:FORM project chair

offer feedback. Once each chair was made and tested, it was flat-packed and shipped back to the designer for review and revisions. The pairs would reflect on the process, and how the prototype might be improved. Each pair went through this process three times. Communication was solely through a web-based workspace: we wanted to create a collaborative learning experience that could function no matter where the participants were in the world. Our engineering tutor advised us that, in an industrial setting, key decisions would always be committed to in writing, so this was not only a constraint that allowed us as researchers to capture all communications, but also simulated a process similar to that which our learners might experience professionally.

What happened?

Our seven teams of designers and makers engaged enthusiastically with the task at hand. With over 750 forum posts, many design concept battles were fought, lost and won. 18 full-size prototypes were successfully completed. As they mastered the use of the CNC router, the makers had to negotiate questions of how to communicate design issues that were incompatible with the medium, where their responsibility lay in relation to the design and how much scope they had to make adaptations to the design in order to suit the needs of the CNC router.

For the designers, the challenge was to understand the potential and limitations of the CNC router process without having experienced it first hand, communicating their concept and design choices with their maker partner and learning from their mistakes throughout the iterative process. 'Words are a horrible way to express design concepts'. Many of the participants struggled against the restrictions of communicating only via the forum and we saw our teams develop a number of innovative ways of communicating via sketches, notes and photographs – and we hope to better facilitate that in future.

What did we learn?

Two cultures met and negotiated: formal, structured, university distance teaching at scale, and face-to-face, personalised, community-based makerspace learning. We succeeded – chairs were made, collaborations happened, and participants were positive, contributing well-considered reflections on how we might improve the process for the future.
The design of the online space was critical: rich functionalities were required to enable satisfactory interactions around ideas and sketches, as well as 2D and 3D models. We're looking to further develop the shared online workspace.

Guidance is a balance: Were we offering an authentic professional experience, or a supported learning environment? One maker suggested that if a designer sent a poor-quality software file, the maker should send back exactly what was requested, even if it resulted in a blank sheet of timber. While

participants were learning new skills, we had to consider at what point we should step in to offer support, and to what extent we should let them make their own mistakes. As educators, we benefitted from learning about each other's approaches (the university and the makerspace).

Materiality is central: A key aspect was finding ways to support conversations around the material aspects of the designing and making. There is immense richness to be explored around how educators can support distributed learners to explore collaborative designing and making, focussed around physical artefacts: 'sociomateriality'.

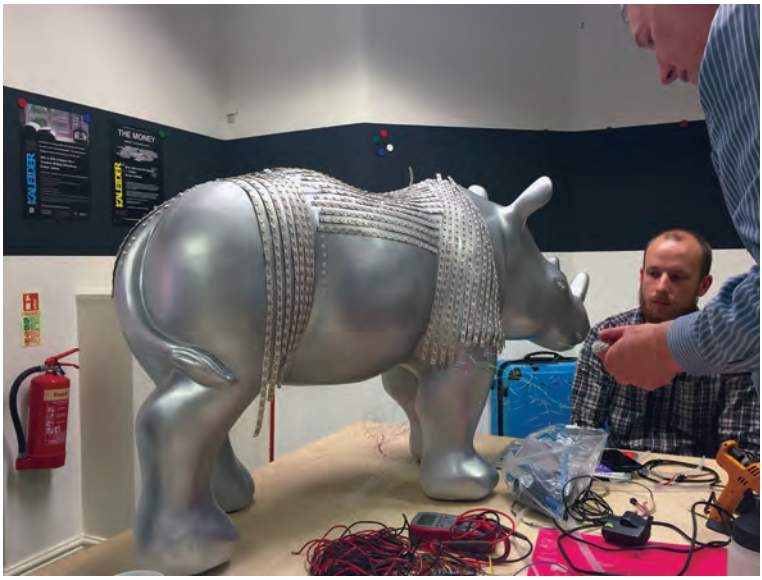
Where next?

The success of this first project has confirmed that this is a worthwhile area of research and development, which we intend to continue exploring. For future iterations, we wish to investigate the possibility of bringing on board an industry partner to set the brief and act as the client in the hope of replicating real-life scenarios with industry relevance. There are also issues around scalability to be addressed: how do you keep the individualised learning experience of a makerspace environment with the number of students from a university design course?; how do you assure a comparable experience if you grow to a network of collaborating makerspaces and universities?

Project team: *Mark Craig, Delphine Dallison, Gary Elliott-Cirigottis, Mark Gaved, Lestyn Jowers, Alan Rochead*

Project website: *www.open.ac.uk/blogs/reform*

RE:FORM was funded as part of the Future Makespaces in Redistributed Manufacturing Network, a two-year project managed by the Royal College of Art and funded by the Engineering and Physical Sciences Research Council (EP/M017591/1).



#TechnoRhino

Image: Positioning the LEDs

Recently, things I have separated throughout my life are merging; science and technology are colliding with art and creativity. Experiencing the collaborative blending of skills during my time at the Met Office has made me question the way society often separates science and technology from the arts, and whether this might be changing.

Science or art?

As a summer placement student at the Met Office, I've been unable to predict my daily duties from one day to the next. I couldn't have known, for example, that when working with the Met Office's Informatics Lab on Friday I would spend the day sticking LED strip lights onto a fake rhino's arse.

I've spent most of my time on this planet making choices: what to do next, where to go, how to better my experience in order to prepare myself for life. I now find myself in the peculiar position of actually doing 'that life thing' that I've been working towards all this time. A significant choice I had to make was between my two passions: science and art. It was never an option to pursue both subjects. I chose science with the idea in mind that I would still 'do art' in my spare time.

Despite my intentions, I realised how unrealistic this was. Deadlines and revision always demanded my attention and energy. The quick bit of painting I would squeeze in every now and again didn't satisfy my yearning for a creative outlet. It soon came to light that it was not the physical act of 'doing art' that I loved so much, it was the entire creative process. It was starting with just a word or an idea and researching, sketching, trialling and perfecting before finally producing an outcome. Simply picking up a brush and painting an object is a different subject entirely.

A collaborative way of thinking

On starting at the Met Office, I glimpsed a world where my dreams of combining creativity with science may be closer to reality. The Met Office's Informatics Lab is a collection of scientists, coders and designers who work on projects collaboratively. This merging of disciplines and skill sets results in the rapid-fire production of ideas, prototypes and new technologies. Making data more manageable and accessible to people is a creative process, requiring idea generation as well as trial and error. It's a form of creativity I had never come across before.

The #TechnoRhino was a small scale version of the type of projects the Informatics Lab undertake. The hundreds of LED lights covering the rhino's body are controlled by the public, who choose what will be displayed using the internet. The displays are of the weather under various conditions. The science is communicated using technology, design and public engagement.

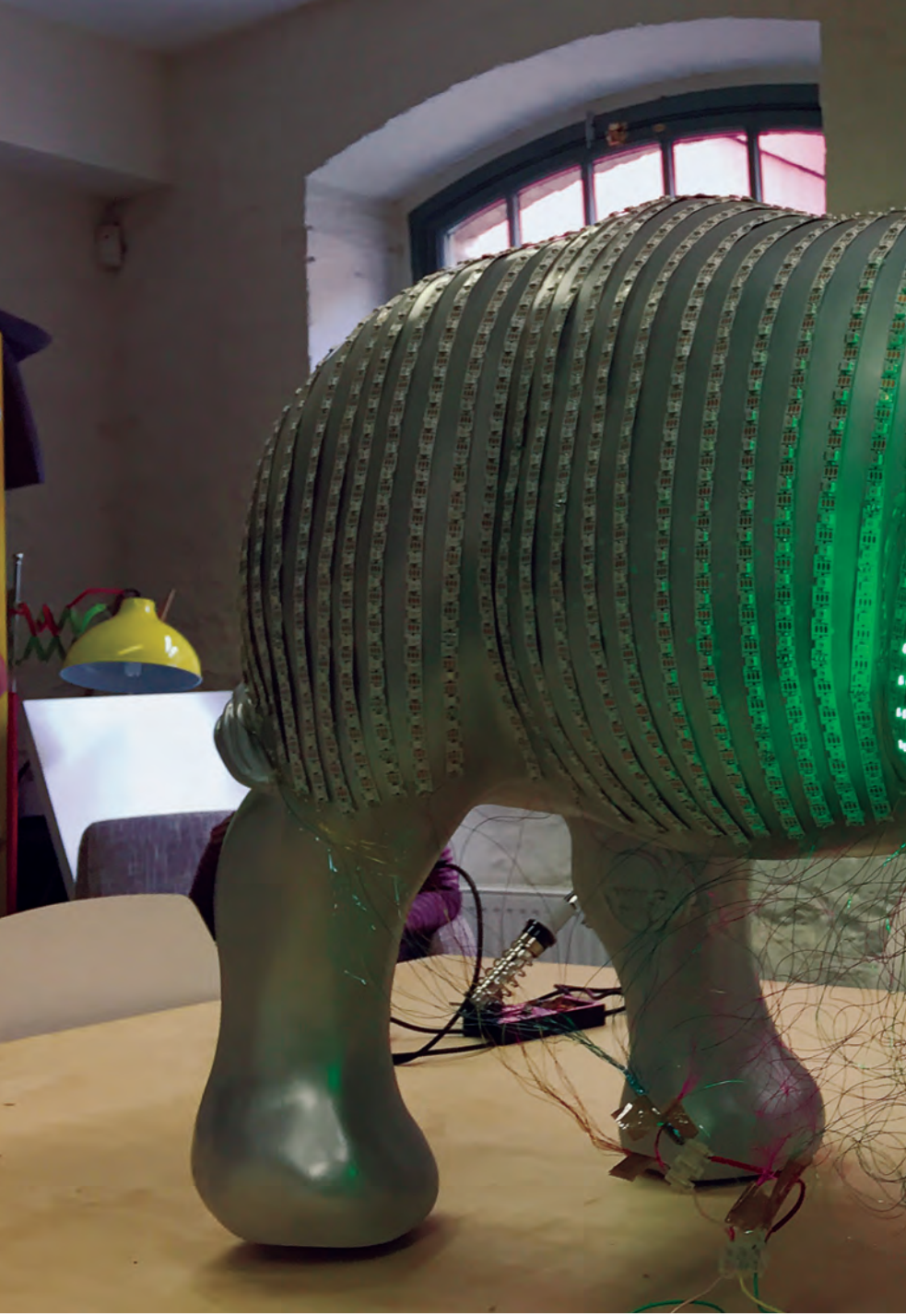
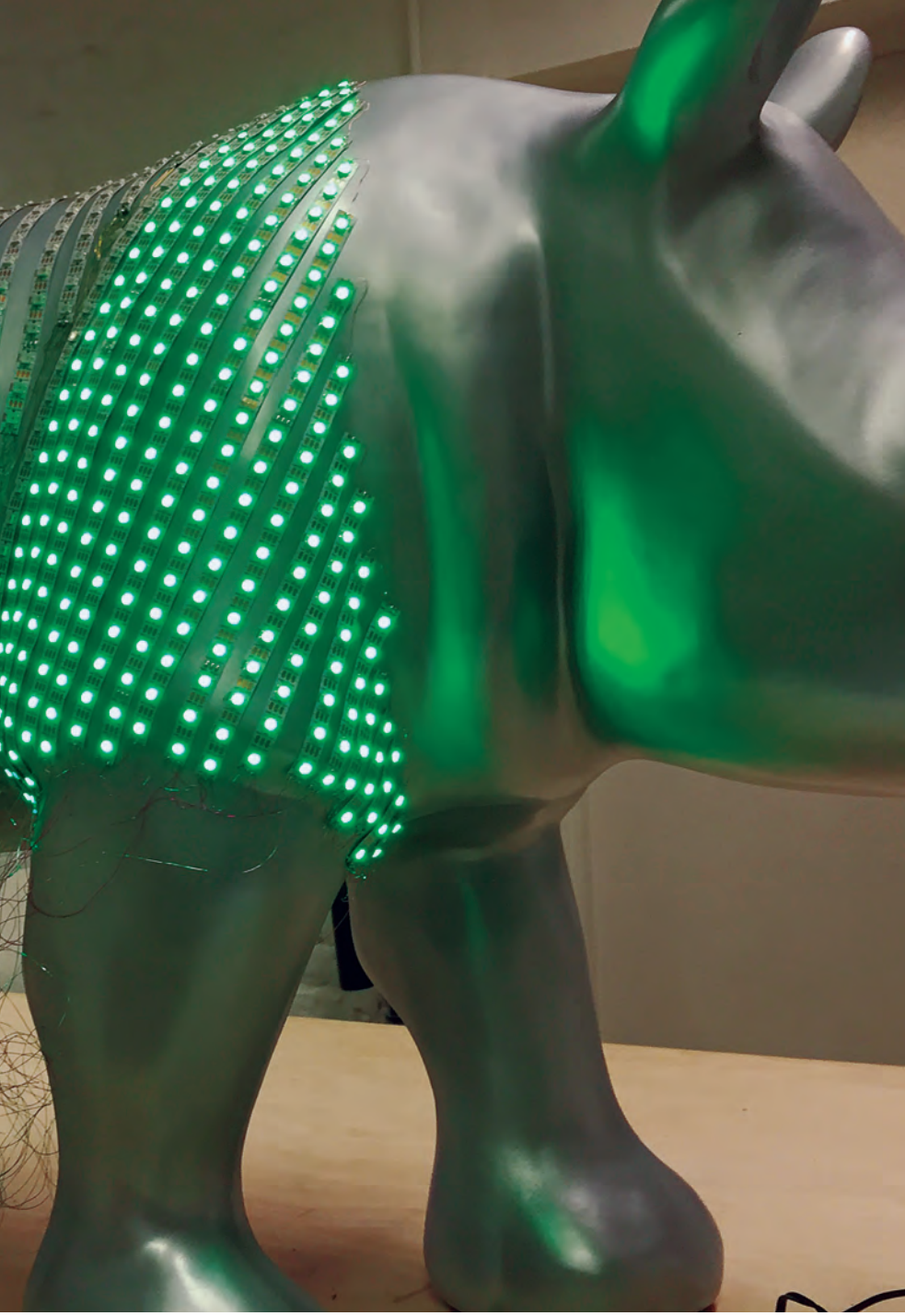


Image: Testing LEDs on the body of the rhino



CAKE, Tellybox and Radiodan

Part of our job in BBC R&D is to get a deep and broad understanding of a product space. 'Deep' in the sense of gaining a fundamental understanding of the technology landscape; 'broad' in the sense of discovering what something could become by understanding the user needs underlying people's behaviour in a particular sphere.

As technology rapidly opens up new possibilities, making it feasible for a spatula to know where you are in a recipe, or a TV to provide you with any piece of video ever made, or an advertising system to be able to predict what you will buy, there's an urgent need to explore possible futures with people, so that we get the future we want.

Here are three practical things we do to make sure this happens, illustrated by three of our recent projects:

The Cook-Along Kitchen Experience (CAKE) is a real-time, interactive cookery programme that changes as you cook with it. It customises recipes based on your familiarity with ingredients and methods, your tastes or dietary preferences, and how many people you're inviting round for dinner. The experience reacts 'in the moment' to your progress, allowing you to create new dishes at your own pace. Novices can level-up and experts can cut to the chase, supported by an evolving dialogue between audience and presenter.

CAKE explores the rituals of recipes, so we started with a questionnaire to broaden our initial thinking beyond our own experiences. We then studied fifteen people in their own kitchens following an early stop-start video prototype to prepare a chocolate dessert. We observed them and listened to their conversation with Bella our presenter, enabling us to iterate the prototype at an early stage and get valuable early feedback on appropriate interaction modes.

Tellybox is a project to prototype future TV experiences in the home, with a ten- to fifteen-year time horizon. Initial interviews led us unexpectedly to 'watching together' as a need that the current technology trajectory is failing to meet. In this subtle and complex area of decision-making in groups, in-depth ethnographic interviews were the most suitable next step. Using this information, we have developed a card-based tool that investigates viewers' decision-making behaviour in groups and paper prototypes to broaden our understanding of user needs before we settle on any particular technical approach.

Radio is listened to by 89% of the UK population, so for Radiodan – a project to explore the future of radio – we had many potential users with diverse and

varied behaviours. We designed a set of postcards and stickers for having structured conversations with people about what they want. Using these, we generated physical prototypes to investigate the 'how': what the architecture would look like, how it might be controlled, whether it would work, and how much it would cost to make.

This process eventually led us to the creation of a kit of parts for building your own radio. A kit of parts facilitates conversations and criticism of the current approach to building software apps and closed-devices. Building your own device lets you 'see inside' the design-and-build process for a connected device, and from there we can explore issues of data privacy, functionality and connectedness.

By talking to a broad range of people about what they want, we expand our own frame of reference about what something might become. By grounding the work in physical prototypes, we gain a deep understanding of how new devices might be made with modern technologies. By showing people those prototypes and encouraging them to interact with them, we expand their frame of reference, too, and gain insight into whether the functionalities we have provided from a technical perspective are the right ones from a human perspective.

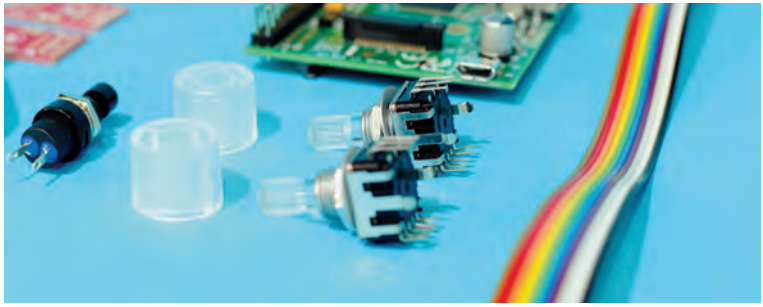


Image: BBC R&D

The Buddy, the Butler and the Police: AI Personas and the Myth of Frictionless Functionality

AI is fast becoming a new material for interaction designers. We developed three AI 'personas' to help us better design intelligent products.

AI has finally crept out of science fiction and into products and services we use everyday. It is fast becoming an exciting new material for interaction designers, and companies such as Google, Microsoft, Amazon and IBM are making their AI technology available to use. The use of AI in objects will lead to new kinds of relationships between products and humans. With these new relationships come new challenges (and responsibilities) for designers and technologists.

An AI – or 'Smart' object – is, at its worst, a one-size-fits-all attribute that steers away from actually considering the advantages of the upgrade. We challenged ourselves to find a way to design better intelligent products, a way that accounts for variances in functional preference.

To help us more fully understand the different ways AI can behave, we developed different AI 'personas': the Butler, the Police and the Buddy. These personas demonstrate three different ways of employing smartness to help us better design AI powered products. By no means a rigid set of rules, these personas are more of a vocabulary to help start thinking and designing with artificial intelligence.

The Butler

The Butler in AI is what we would refer to as 'seamless' in UX: a system that knows what you might need and does it, requiring little or no explicit interaction. There are cases in which this is a desirable capability, for instance a robot vacuum cleaner. The Roomba 980 robot vacuum cleaner uses computer vision to map your house to know where it has already been. We are fine with it doing this autonomously, and not asking for permission to go in one room or another. But if there are hardly any risks in letting technology take care of such an underwhelming task, there are cases where this approach would be problematic.

Firstly, such a model requires the designer either to consider all kinds of users and design for each, or (a more common scenario) design a standard default behaviour supposedly apt for the great majority – an approach that can lead to problems designing for diversity. The second issue centres on legibility. Seamless interactions and invisible interfaces might lead us to become even more disconnected from the technologies we rely on. As these become more complex, and the effect of their actions more important, the risk of being alienated from such an important infrastructure becomes fraught with threatening implications.

The Police

The Police describes a smart system that prevents some choices and enforces others, following some 'higher good' that might go against the user's intentions. A banal example is a smart alarm clock. We can enhance it by making it aware of sleep cycles, syncing with our calendar and learning our routines; but eventually it will need to enforce a certain action to perform its core function. The alarm clock is inherently, even before any technological upgrade, a 'police' device, while there are other products where smartness introduces a novel functionality.

Consider the learning function in the Nest thermostat. The first version of the algorithm set the temperature to a value that users never set, in order to help them save energy. This might be fine with some who accept the inconvenience for the perspective of a higher good (environmental or a cheaper bill), but eventually user reactions against feeling a lack of control led the company to change their algorithm to eliminate this behaviour. It's easy to see the benefit in enforcing certain widely beneficial choices, but the problem here is to decide who's in charge of those decisions, and to what extent they should be enforced. The implication of those decisions might turn out to be highly critical and range from design for good to designing dystopia.

The Buddy

The last persona is the Buddy: AI that supports the user without substituting them. The machine here is a friend. You ask it for help, and it won't judge or serve you predictably. The crucial aspect here, and what distinguishes this persona from the previous two, is that the final choice is the user's. Options are not enforced or implied, but rather suggested.

A good example of this type of AI relationship is an historical one. Chessmaster Garry Kasparov was famously beaten by Deep Blue, IBM's supercomputer, in 1997. What's less well known is what happened after. Kasparov didn't resign in desolation, hailing the new robot lord of the game; he instead theorised and instituted what goes by the name of Centaur Chess. This follows the same rules of traditional chess, except players can use specific computer programmes to predict all possible moves at each stage of the game. Most importantly, this human-machine team has proven to be

superior to both humans and machines alone. It's easy to see the appeal of such a reference. Here we have a human-computer entity where the human is empowered rather than replaced. The machine does what it is best at: precise data crunching. The human is left to apply those skills which he or she excels at: creativity and intuition.

Drawing from the AI personas framework, we set out to build a prototype that would express one of those characteristics. This would serve as a sort of archetypical product that, when deployed in the real world and used by real people, would allow us to gather insight and feedback. We began by applying the AI personas to many different everyday products. For each, we decided the particular behaviours assigned to an AI Buddy, Butler or Police. Some objects had a natural persona; for example, a car fits well with the Police (if you were intoxicated, it would not let you drive). We eventually decided that a radio was an interesting product to explore, as it could take on any one of the three personas, with different, equally arresting results.

The resulting project, The Emotional Radio, works by playing content depending on your emotion. As you approach, a metronome-style feature starts moving, letting you know it sees you. As you stand in front of the radio, your eyes appear on the screen as two circles. The circles track your eyes; as you move, so do they. When they recognise your emotion, the eyes spin round, suggesting something is playing. A track begins that is reflective of your emotions. As you walk away, the eyes fade and the metronome slows, then stops.

If The Emotional Radio embodied the Buddy, it would give you options – friendly recommendations – but would ultimately let you decide. If it embodied the Butler, it would give you what it thinks you want. If you are sad, it would allow you to wallow, rather than suggesting you cheer up. If the radio embodied the Police, it would turn the volume down late at night, or refuse to play explicit tracks before the watershed.

We chose the Butler as the AI persona to explore with The Emotional Radio as it raises questions of obedience. Do we want what we think we want? What AI characteristics should products take? How do design decisions impact our relationship with the eventual AI? Each persona has distinct challenges and benefits.

One such challenge was navigating a visual language still in its nascency. How do we know when an object is scanning for emotion, age or sex? Does a screen make this explicit, or can there be a more subtly designed interface? Interestingly, we found that when the radio was in debugging mode, users were more inquisitive. They could see it was watching them, and were drawn in to explore.

Another complexity is one that will likely improve as AI algorithms increase in sophistication: the issue of generic features. Why does The Emotional Radio

always think one user is angry? A monobrow fools the AI. And another, why is he always so sad? His beard makes the AI see him as perpetually glum. AI has much to learn about navigating physical individuality. Or we could all start grooming ourselves to look the same, and train our smiles and frowns into the perfect shapes for AI to recognise.

We believe designing AI through personas introduces a shift in how we understand and interact with smart products as they take increasingly important roles in our environments. Sticking to constructs of magic or 'perfect robots' for products whose behaviours are complex and nuanced is misleading. It encourages 'faith' in the infallibility of the product, making the consequences of an unexpected action deceiving and, in the worst case, even dangerous.

The use of human-like characteristics implicit in personas leaves room for forgiveness. You don't expect a robot to make mistakes, but you do expect them from your buddy, butler or police. Designing for AI through characters – roles the algorithm takes on rather than settings that precisely define its behaviour – created a constructed human identity for AI that fostered a healthier relationship with technology.

Image: Jonathan Formento

Interface

Technology is a vital and ever-present part of our daily lives. Yet despite this, we often don't recognise the subtle and growing impact it has on our relationship with our physical environment.

Human-computer interactions have so far been predominantly screen-based. But this is changing. Our first experience of digital began with desktop computing, which then expanded with the evolution of the web, And then became mobile – which has led us to the fascinating intersection we find ourselves at today.

User interfaces consist of voice and gesture. Devices and products that were once analogue are now connected and equipped with sensors that share data about user behaviour. Creative technology is at the heart of this transition, where tangible inputs and mechanical outputs reign supreme.

Knit create projects within this space. We are a new breed of technicians, combining practices and techniques from traditional engineering such as software, electrical and mechanical, to merge technologies in bespoke ways, making them work together to create interactive and immersive experiences.

For the V&A Digital Design Weekend 2016, Knit have created a Rube Goldberg-inspired sequence of interactions that represents the convergence of our physical and digital worlds. The installation will use a variety of technologies to create an interactive experience which explores how these technologies can be engineered to work in harmony through a sequential chain reaction of digital and physical elements.

Join us in the exploration of just some of these technologies, where we will reveal the inner workings at play, the input data we use, the environmental factors and also the data that we collect.

Image: Knit

Machine Wilderness

Image: Machine Wilderness, Danger squirrel nutkin, Ian Ingram

Machine Wilderness is a speculative arts and science programme which explores what our machines could look like, now that they are becoming permanent inhabitants of our landscapes, part of material flows, foodchains and layers of communication. In particular, it looks at environmental robotics, designing 'pseudo-organisms' as agents in their own right that inhabit and participate in specific habitats and ecosystems.

The challenges associated with the Anthropocene make evident that the earth's systems are not separable from human activity, and really never have been. For centuries, civilisation meant separateness from nature, while connectedness to nature was deemed as primitive. Our modern sense of emancipation and freedom is caught in this opposition to nature. Now that it has become clear that our cultures and technological innovations are destroying the very earth that supports our existence, we need to find a new meaning for emancipation and rationality coming from a new sense of connectedness and cohabitation.

The responses to the current ecological crisis show different attitudes towards technological development. The first of these is based on a belief in technological progress which maintains that, now we understand the consequences of our actions, the solution to the problems we created is even more technology, such as geoengineering and genetical manipulation. Machine Wilderness supports another approach, which is based on the understanding that we, as humans, will never completely understand the effects of our inventions and try to take nature as a learning school, designing processes that imitate and work with nature.

The environmental damage we are witnessing shows that our design processes underestimate the level of exposure for our landscapes to human activity. Our infrastructures, technologies and machines are not temporary visitors to our landscapes; they have become permanent inhabitants. Machine Wilderness explores these new anthropogenic landscapes in which nature and culture have collapsed in order to research the relation between our machines and biological life forms, by speculating on how a robotic machine could navigate a food forest; engage complex communication systems through chemicals, sound, smell, vision; find out how it can take its energy from flows, ocean ties or atmospheric waves which it inhabits; how it can die and recycle its material construction. Post-humanism does not only refer to the collapse of hardware and wetware, but to the development of different relations between biological life and machines and the recognition of multiple forms of agencies that together shape life on earth.

So how can we start designing technologies that work with, instead of against, nature? Machine Wilderness sets out to rethink our technologies by starting to design from an environment – to imagine machines that are not human-centered but, first of all, that can engage and exist constructively in the specific environment they dwell in. To engage these questions, Machine Wilderness explores experimental design methods which aim to

include diverse ways of knowing, so we can begin taking into account a wide understanding of the characteristics of the ecosystems in which we place our technologies. In collaboration with artists, ecologists, engineers, choreographers, designers, environmental philosophers, farmers and many others from diverse backgrounds, we aim to trace out new contours and map new domains for ecological robotics based on specific landscapes.

Through symposia, we focus on the changing discourse concerning the adaptation of our technologies to nature and exploring the newly appearing hybrid nature-culture landscapes. Machine Wilderness was launched during a symposium at Artis Royal Zoo in the city of Amsterdam, a zoo that aspires to return to its origins as a place for nature, culture and science. In speculative design workshops, we set out to describe specific ecosystems to imagine, together with participants from varied backgrounds, the technological creatures that could coexist and collaborate within it. For the Symbiotic Systems workshop, we worked together with Ivan Henriques, a Brazilian artist who developed an ecological robot which obtains its energy from consuming photosynthetic organisms such as algae. The workshop was a design exercise to explore how to adapt a machine to natural systems. It focused on the needs and functions of a bio-robotic structure inspired by the specific landscape of the Amstelpark, in Amsterdam, where it was held. We investigated the relationship between this hybrid system and the resources and opportunities the park offers so that we could re-think a different equation: how to adapt machines to natural systems while looking at the environment as a partner from which we can learn to communicate with the living and non-living environment.

For the workshop Forest Bathing, we worked together with anthropologist Judith van der Elst, who focuses on the semiosphere – the sphere of communications – and the way technologies can be developed for the enhancement of sensory experiences. The main objective here is to develop technologies that enable recognition and navigation of sensory qualities in the environment. The urgency of this project is to reconnect the digital back to the physical world and identify the looming loss of such qualities. It introduces the concept of biosemiotics that underpins a new direction in sensory research and design. Biosemiotics is considered the transdisciplinary field focused on the myriad forms of communication and signification observable both within and between living systems – the study of representation, meaning and sense. The workshop concentrated on rethinking and considering prototype technologies that can function as ‘interpretants’ to facilitate inter-species’ communications and imagine how a robotic creature can function within the existing semiosphere. Machine Wilderness also organises art science residence programmes in Anthropocene landscapes, such as our first expedition to Ars Bioarctica, where artist Ian Ingram and Antti Tenetz joined Theun Karelse for field work at the Kilpisjarvi Biological Research Station in the Finnish polar region, where they tested and designed new works of ecological robotics.

At the Digital Design Weekend, Machine Wilderness will set up in the garden and present, amongst others, works by Ian Ingram, whose robotic creatures explore the possibility of communications with biological life forms through various means of gesturing and sound installed at a nearby tree and pond, while Slovenian artist and biologist Spela Petric's project Naval Gazing consists of a kinetic art machine, which simultaneously acts as a platform for the attachment of organisms, creating a travelling, uncontrollable transient biotope in the oceans. Machine Wilderness will offer video documentation of further projects and workshops, as well as prototyping design tables where we invite the audience to participate in the imagining of ecological robotics.

Machine Wilderness is a collaborative research project between Theun Karelse of FoAM – a cultural laboratory re-imagining possible futures in the interstices of art, science, nature and everyday life – and Alice Smits, initiator and artistic director of Zone2Source – an exhibition platform in three pavilions in the Amstelpark in Amsterdam which presents art projects, discussions and workshops focusing on developing new relations between art, nature and culture/technology. Machine Wilderness was the theme given by Andrea Polli to the ISEA 2012 symposium, and originates from writings of cultural geographer Ron Horvath in the 1960s who considered the impact of cars on the planes of the Southwest. Machine Wilderness referred to the task for artists and technologists to present "ideas for a more humane interaction between technology and environment, in which 'machines' can take many forms to support and sustain life on Earth." It is used here with full respect for that context.

Project websites: *www.machinewilderness.net, www.zone2source.net, www.fo.am*

When the Plants Go Digital

Image: Into the Garden. Photo: Sarah Martindale

For most of us, technology is not a walk in the park. Although we may be increasingly glued to our screens as we move through life, this relationship can be as frustrating as it is relaxing. Devices connect us to our friends and colleagues, information, products and content; but not to our environment and the rejuvenating influence of the natural world. So the starting point for this work is the question of whether new, networked technologies can help us make the most of time we spend outdoors getting our hands dirty.

Through a series of research projects, Horizon Digital Economy Research at the University of Nottingham and the School of Design at the Royal College of Arts are exploring the intersection between growing and future digital technologies. Working with a wide range of partners – from local growing groups to multinational technology companies – we are mapping out the ways in which growing can be enhanced with technology, and how technology can be enhanced with plants.

Into the garden

This project, funded by the EPSRC and Food Standards Agency, focused on the application of Internet of Things technologies within local growing communities. Internet of Things is often associated with domestic environments: think of smart energy meters and fridges that remind us to buy milk. But we were concentrating on sensors and gadgets that could be used outside: we explored probes that can be planted, providing a remote connection to the garden from your mobile phone; we tested automated planters that water, feed and can provide 24-hour light; and we put together a robot that can see and interact with the world around it.

Bringing these off-the-shelf technologies to a variety of growers in hands-on workshops emphasised their individual-centric nature: these products are designed to allow gardeners and allotment holders to understand their own growing conditions, but offer no capacity to learn from others who grow locally or in similar conditions. Conversely, the growing communities we talked to were focused on how technology can help support the community as a whole by building up shared knowledge about their particular area and growing preferences.

In response, we developed a set of digital probes to help urban and sub-urban growers gather, interpret and share data about their soil and plants. We combined commercial sensor and networking technology with bespoke databasing and sharing software to stitch together data and information to support community sharing of the technology, the data it collects and (most importantly) the insights the data reveal. This communal approach to Internet of Things technology has proven popular with growing communities, with our technology kits currently being used on a range of community-based growing projects, allowing growers to work together to attempt to debunk growing ‘myths’ and understand one another’s growing practices.

Growing data

The second project we have pursued in this domain flips the concept of digital growing on its head, seeing plants and growth as a means for interacting with technology that is more emotive and visceral than lines on screens and plastic peripherals. We are developing ways in which growth can be manipulated in order to communicate information and provide feedback from digital systems.

Our first application in this area is behaviour change and self-improvement, by linking success completing self-selected goals (such as steps per day or calorie targets) with the continued health of plants, we are developing a new medium for interacting with technologies. 'Growth as data' has a lot of interesting properties which we are exploring though this research:

- A plant is just a plant, except when it's not: the novelty of this approach means that even publicly displayed 'data plants' are secure repositories of even sensitive data, as only those with whom you share the purpose of the plant will be able to interpret the true meaning of how the plant grows.

- Tangible ownership: since data is stored physically in the form of the plant, it is very difficult to copy, steal or reverse-engineer the information stored within it. Depending on the nature of the application, plants can be used that provide rapid but short-lived growth or provide a long-term embodiment of behaviour change over time.

- Emotive motivation: as living, changing objects, plants are inherently more engaging than cold numbers and graphs, and fundamentally less disposable. Fruiting plants and herbs can also be used to grow edible rewards for successful self-improvement.

Digital growing at the Design Weekend

Our open, participatory workshops at the V&A give members of the public an opportunity to help us experiment with these ideas for connecting plants and technologies in new ways. Together, we will build a DIY hydroponic system using open source 3D-printed components and recycled household materials; and we will discuss and collectively develop new design concepts for getting the most out of this system and other combinations of technology and plants. Participants will be able to take what they need to recreate a basic hydroponic system at home. We hope they will repurpose it to suit their own circumstances and environment, and hopefully send us updates about their horticultural successes and healthy harvests.

A collaboration between the University of Nottingham: *Prof. Derek McAuley, Dr Ben Bedwell, Dr Sarah Martindale, Dr Michael Brown and Royal College of Arts: Prof. Sharon Baurley, Dr Rob Phillips*

A YouTube Tutorial from the Future

Image: A YouTube Tutorial from the Future, Vytautas Jankauskas

A YouTube Tutorial from the Future appears to be almost identical to the current one: a person breathing straight into a shaky camera microphone, explaining his hacked-together process, to solve a specific practical concern. The YouTuber shows how to grow food, filter harvested water or stick a European plug into British socket with a plastic fork.

Our everyday experience of technology verges on the mundane. It accommodates a secondary set of behaviours and experiences, a world away from the struggles of many lived realities. Technology companies are engaged in spam-warfare, the race is on to build the best self-driving car traffic jams in overpopulated smart cities. There's competition to construct a laundry robot that can distinguish a shirt from a kitchen towel and fold both meticulously; a home smart-lock that can out-smart a burglar, and more often than not, the homeowner. Maybe a climate control with an integrated 24/7 night vision camera storing images of your life on a server? You can always go premium if you want to see what you did last night.

We are faced with slick renders of products and services designed to own us, instead of being owned. Slavery manifests as fast fashion, state surveillance is framed as universal safety. The major issues we thought we had solved through compromises, workarounds and revolutions are emerging from the shadows of convenience and seamlessness. If this trajectory persists, which is looking highly likely, the old world's threats might just sneak up on us from behind: limited access to vital resources, food scarcity due to climate change, increased local racism, and conflicts motivated by xenophobia. In this world, things we currently consider irrelevant, tools for the developing world, tools for survival, might just happen to become our lifesavers again.

A YouTube Tutorial from the Future is about alternatives. It is about taking a stance in a world where promoted conveniences no longer match our values. A water filter becomes a tool for resistance in developed societies, when all of the water is commercialised. Home-grown food serves as a means to fight climate change, when governmental infrastructures and supply chains fail due to their inability to make core decisions in time. A hacked power supply manifests universal access in a world where people are continuously being convinced they have already been granted one. It is a tutorial about stealth Jugaad, innovating with what you have to preserve the freedom of choice.

A YouTube Tutorial from the Future does not look very different, though it might be in post-K five-dimensional resolution. Or you can watch it on your smart fridge that has just sent a report on how many Cokes you had to your insurance company. It then automatically ordered a few more. Sugar is money. Other users also bought a Fitbit. Click below to see more things recommended for you.

The vast majority of useful inventions already exist. Instead of rigorously innovating, maybe it's time to take a step back, open up the designs of our most promising creations, and let people make real use of them. Technology

is at its most avant-garde when it is used in ways the designers did not foresee. For all of our sakes, I hope that most designers would agree with this. A YouTube Tutorial from the Future is about providing templates; open-source DIY frameworks that will give people the opportunity to modify and adapt to their own particular contexts, engineer to their needs, to synchronize with their culture, and integrate their value systems.

Whether it's solving current issues, or providing responses to scenarios that do not yet exist, DIY tutorials encourage agency rather than claim authority. In the face of a range of rapidly approaching, messy, turbulent futures, it will become even harder to provide solutions without compounding our problems. We should champion knowledge distribution through Jugaad-inspired, bottom-up experimentation, risk-taking and failure. Rather than hiding complex systems behind black boxes, flattened user interfaces, smoke and mirrors. This will be key to equilibrium and communal survival. Not everyone will be willing to make things, but they should at least have access, and the opportunity.

It will not all just be about survival; things will eventually become more beautiful and serve various needs, therefore industry might as well become more open-design oriented and find ethical ways to survive from it. A YouTube Tutorial from the Future is therefore a movement for the further liberalisation of design authorship, where personal ambitions give way to collaborative agency.

I would like to acknowledge Jake Charles Rees for valuable contributions, thoughts and insights to this piece.

Landscape Within

Landscape Within confronts the potential health time-bomb that future generations face: waste products and industrial contaminants produced since the Industrial Revolution can impact our bodies and minds in unexpected ways. Inspired by philosopher Brian Thill, the work addresses the ultimate challenge, to 'consider where these waste products go next; or what it means for us if there really is nowhere else to go'.

We are often reminded of the effects heavy metals have on our health and are shown evidence of our bodies in flux with the landscapes in which we live and produce food. Recent media releases from the Food Standards Agency warn of the effects of arsenic in rice, which can increase chances of illnesses such as cancer; any expectant mother will be familiar with removing certain fish from her diet to avoid mercury intake that can affect the development of her baby.

Set in this future landscape, heavily littered with contaminants, and with nowhere else to go, Landscape Within asks what adaptations would we be willing to make when it is clear that our bodies are in constant flux with the environment?

Artists Michael Burton and Michiko Nitta (Burton Nitta), with support from the Wellcome Trust, collaborate with a transdisciplinary group of researchers from the worlds of art, design, synthetic biology and environmental epidemiology. They create speculative enhancements to our body and food consumption processes to adapt us for the future landscape.

In the first stage of the project, Burton Nitta worked with Dr Louise Horsfall, the leader of the Horsfall Lab at the University of Edinburgh, to consider how humans can filter out heavy metals before exposure through the food we eat. Her research in synthetic biology is explored, offering the potential not only to enhance our digestive systems, but also to mine the body itself and convert the contamination into valuable and useful materials. The first outcome of Burton Nitta's collaboration builds an external digestive system to interact with our bodies. As with our digestive systems, bacteria play a crucial role in the process; but, unlike the natural bacteria found in our bodies, the external digestive system of Landscape Within employs engineered bacteria currently being researched by the Horsfall Lab to precipitate out nano-metals from plants.

Through further collaboration with Dr Susan Hodgson, researcher and lecturer in Environmental Epidemiology and Exposure at Imperial College London, the project considers a selection of heavy metals including arsenic, lead and cadmium. These are found in the environment as a consequence

of human activity, such as mining and waste contamination, and their implications on our health after they enter the body through our food, water and surroundings will be explored.

In a later stage of the project, Burton Nitta will work with Dr Hodgson to consider the health impacts of heavy metals, how socio-economic and geographical locations may influence who will be affected, and how globalised systems of production are the responsibility of us all.

As a result, Landscape Within confronts us with the potential need to adapt the body to a world of our making and reminds us not only that 'we are what we eat', but also 'we are where we live' – the landscape is within us.

Landscape Within is a project by Michael Burton & Michiko Nitta in collaboration with University of Edinburgh. Biotechnology and Synthetic Biology, Dr Louise Horsfall, Dr Matthew Edmundson, Dr Michael Capeness, Dr Virginia Echavarri-Bravo, and Dr Susan Hodgson, Lecturer in Environmental Epidemiology and Exposure, School of Public Health, Imperial College London. Supported by Wellcome Trust.

***Project website:** www.burtonnitta.co.uk*

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Image: Burton Nitta

Unlikely Engineering Innovations

Engineering fish food – it's an unlikely start to an even more unlikely venture that has led us here this weekend. To compound confusion further, neither of us is an engineer; at least not in the traditional sense. Then again, very little about our chosen area of study would be considered particularly conventional, but more the stuff of science fiction. Our work centres on synthetic biology, a chimeric blend of biology and engineering science, which aims to repudiate the established perception of biological systems. By considering living organisms as being constructed of a hierarchy of genetic parts, devices and systems, practitioners within our broad church work to restitch the fabric of the natural world to achieve a wide range of goals.

Given its somewhat unconventional nature and remit to circumvent the established biological order, synthetic biology is often likened to hacking or 'biohacking', and this is reflected in its origins. First conceived in 1910 by French chemist Stéphane Leduc, and delivered nearly a century later by MIT computer scientist Tom Knight, synthetic biology inhabits a somewhat eclectic space within the realm of human intellectual endeavour. In part, due to its connection to computational sciences, the rise of synthetic biology has birthed the DIY-biology movement and moved towards an open-source platform for the dissemination of scientific discovery and innovation, wherein non-traditional researchers and research are increasingly welcome and the limits of interdisciplinary collaboration are pushed.

The advent of potent genetic engineering tools emerging from synthetic biology research, expanding its sphere of influence, has given greater focus than has been given to innovation outside of the traditional remit of the biosciences. This theme of versatility and circumventing convention is what has catalysed our interest in the field, and is the basis for our own project. Our work aims to provide disruptive biological technologies to the fishing industry, supporting a global shift from open-water fishing to industrial aquaculture. It is part of a growing trend in agriculture, moving away from traditional farming and cultivation techniques towards more environmentally and financially sustainable methods. We've joined a growing raft of scientists, aiming to engineer industrially relevant organisms to replace established food sources used as feeds in farming – both on land and in the sea.

We work to engineer pond scum. Or, rather more specifically, micro-algae. These tiny photosynthetic organisms have long been favoured in the synthetic biology community thanks to their ability to convert sunlight and carbon dioxide into a range of biochemical products. This has led to algae being

engineered to synthesise everything from biofuels to food flavourings and scents. Beauty is evidently only skin-deep. In our case, we're engineering micro-algae as a food substitute for the ground fish meal typically used to feed fish stocks in commercial aquaculture set-ups. Our hope is to improve environmental and financial control of the way we feed our food.

The point we're at now is the result of a rather circuitous journey through engineering, and is most certainly outside the traditional engineering sphere. However, in many ways, this is what excites us most. As synthetic biology has expanded over the past decade and a half, the routes by which individuals can affect meaningful innovation have multiplied exponentially, giving rise to all manner of new areas to explore and develop. We feel strongly, then, that even as two misfit biochemists-turned-engineers, we have an opportunity to carve out our own niche within the broader field of engineering. That brings great hope for a future in which more non-traditional routes to engineering innovation can be achieved by pioneers from a far broader range of backgrounds, achieving in ever more unlikely areas.

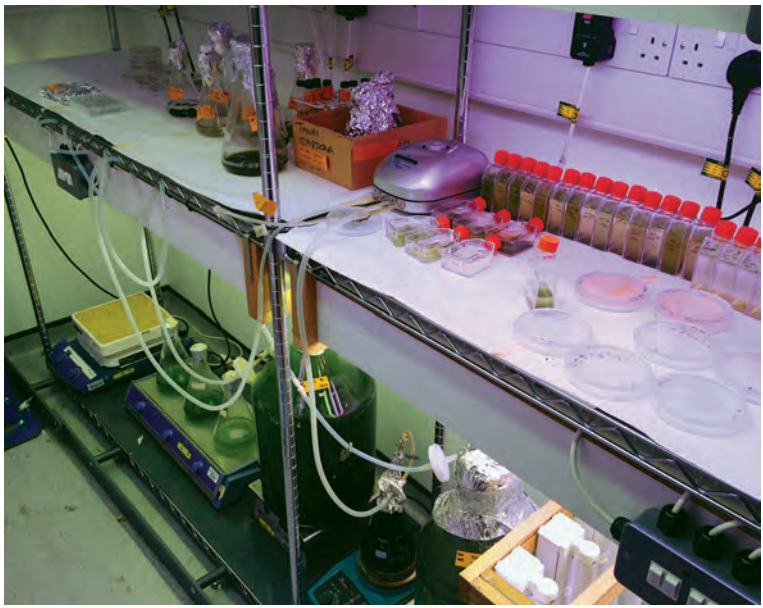


Image: Cyanofeed. Alex Nash & Matt Pope

BioNet

BioNet. Agriculture Ltd is a start-up specialising in edible bioplastics. The company was founded by Will Joyce, Nick Aristidou and Stelios Chatzimichail who are PhD researchers in the Department of Chemistry at Imperial College London. BioNet have developed a unique and patented biopolymer to wrap hay, straw and silage bales. This is their case study, but the wider vision for the company is to tailor edible biopolymer to a range of applications and markets.

You will have seen hay, straw and silage bales scattered over the countryside between June and August every year. They are a large commercial arable crop with the specific purposes of both feeding livestock and acting as a source of bedding. In the UK, thirty million bales are processed each year; and across the globe, that figure extends to eight billion. Bales are an essential feedstock for 1.6 billion livestock all over the world. At present, they are reliant on fossil fuel derived plastic for processing.

Back at home, co-founder Will lives on a livestock farm in the Welland Valley in Rutland, and the idea for BioNet was formulated to solve a problem faced everyday on the farm. Bales are wrapped in approximately 12 m2 of plastic and this must be removed before the forage is fed to livestock. The only way to do this is for the farmer to manually unwrap the plastic from each bale he feeds to the livestock. This is a difficult job and it costs the farmer valuable time, especially at key periods of the year such as during lambing and calving. Enough waste plastic is generated each year from bailage to wrap the world 20 times over. Bulging plumes of toxic black smoke are exhumed from farms all over the world – this is the sight and smell of plastic bale waste being burnt. Farmers have two options: they either pay to have the plastic sent to landfill, where it takes over 500 years to decompose; or, as I alluded, the waste plastic is illegally burnt. For a farm running on tight margins, the latter is always the easiest and cheapest option.

The solution is BioNet – a unique, edible biopolymer to wrap the bales. The animals can eat the plastic directly from the bales, which means the farmer no longer has to worry about removing the waste plastic. Plastic waste on farms will therefore be reduced; and, in addition, our solution is safer for livestock animals, as they no longer run the risk of ingesting leftover plastic. Our unique formulation is enhanced with minerals to support healthy milk and meat production. Mineral deficiency in livestock is problematic, and this is usually aggravated during the winter months whilst cattle are kept inside in barns.

In particular, a fibrous matrix of the biopolymer is cross-linked with a component that has the intrinsic ability to reduce cattle methane emissions.

On average, each year, a fully-grown Friesian dairy cow will produce 80-120 Kg of methane gas – almost half of their body weight. Whilst methane is a potent greenhouse gas, it is also the primary source of inefficient digestion within the cattle rumen. Cattle have four stomachs, which are filled with bacteria required to help digest the large volumes of cellulose that they eat. Unfortunately, methanogenic bacteria are also present in the rumen; and although they are harmless to the animal, they are the primary source of inefficient digestion. The unique chemical composition of the biopolymer has the ability to reduce cattle methane emissions – in this way, it enhances digestion. This means that the cattle are better able to process their food, thus able to accrue more mass.

Will, Nick and Stelios graduated from Imperial College with first class degrees in Chemistry. They are currently studying for their PhDs and bring invaluable research expertise from the three specific disciplines needed to solve the problem. Nick is an expert in materials processing whilst Stelios is an expert in polymer chemistry; and Will brings molecular biology expertise to the team. The venture is in its early stages, but the vision is far reaching. An edible biopolymer has the potential to emerge into a wide range of markets; and the BioNet biopolymer can be tailored to a range of applications.

BioNet. Agriculture were the winners of the Venture Catalyst Challenge at Imperial College this year, winning a prize of £10,000. This is an accelerator designed to bring the best research with commercial prospects together at Imperial to completion. 170 teams entered and the demographic spanned from undergraduates through to professors. In addition, BioNet were voted most promising start-up by the Imperial Corporate Business Partners, receiving an award and a £2,000 prize. We have been interviewed on BBC World Service and BBC Radio 4's Farming Today programme, as well as on Radio New Zealand. Both the Farmer's Weekly and London's TimeOut magazine have published articles on BioNet.

Currently on our timeline, we are in the process of official livestock validation testing and have engaged with a plastics facility to conduct an intermediate scale-up of the biopolymer. In addition, we are field testing and are in contact with farms from Australia, Canada, America, Scotland and New Zealand to conduct harsh field trials on the biopolymer. We estimate that the product could be seen on the fields in three years. BioNet is an initiative for sustainable farming and also for a sustainable future.

Prosthetic envy

Image: Viktoria Modesta. Photo by Lukas Suchorab.
Styled by Joanna Hir. Prosthetic by Alternative Limb Project

As with most technologies, the future of prosthetics has two polar images: a dystopian-paranoid and a utopian-optimist future. The paranoid end of the spectrum is portrayed in Bernard Wolfe's 1952 novel 'Limbo': a society in which limbs are removed mandatorily and citizens face a choice of either government-controlled super prosthetics or a limbless 'Limbo' – the title of the novel should, of course, be read 'Limb Zero'.

On the other hand, the utopian-optimist view is embodied in a modern dream of super-human prosthetics overcoming the shortcomings of the human body: assembly lines run by humans with technological accessories adorning their bodies, bespoke cyborgs becoming ever faster and ever stronger, or Olympics events featuring teams of scientists working in collaboration with a single human subject in order to optimise their athletic ability through cybernetic appendages. The latter is soon to become reality: the first Cybathlon takes place in October 2016 in Switzerland.

The potential of prosthetics articulated by science fiction has led some individuals to a state of 'prosthetic envy' – a desire to exchange their healthy and functional limbs for technological counterparts. This is not the story of 'bionic popstar' Viktoria Modesta who surrendered a dysfunctioning leg at the age of twenty in favour of the certainty of a prosthetic one: it is the state of people with fully functioning limbs wishing to surrender them. It is the fetishisation of a cyborg-aesthetic.

During Virtual Futures' recent salon event[28] on this theme, panellists were quick to insist that current technology is not adequate: prosthetic limbs are not as good as their biological equivalents. While there are some novel features – Nigel Ackland[29] can spin his wrist 360 degrees; James A H Young[30] has an integrated a USB port and laser light in his right arm – prosthetics have not yet reached the same pragmatic functionality as a human limb. The prosthetics chafe, hurt, require charging and are easily breakable. Nigel Ackland's bionic fingers were ripped off while taking a dog for a walk. Congenital amputee Cathrine Disney goes so far as choosing not to wear any prosthetics on her left arm, owing to current prosthetic technology lacking the dexterity she can achieve without it.

Facing this deficiency in prosthetics, everyone with a limb missing faces a choice as to what they want their prosthetic limb to do. What gives the wearer the best quality of life? Nigel Ackland and Nicky Ashwell[31] opt for the maximum functionality possible, trying to recapture the abilities a human hand would afford them. James A H Young, like Viktoria Modesta, chooses to make his synthetic arm into an aesthetic object, into something that exceeds normal human function in proportion to the decreased mobility and dexterity;

[28] Virtual Futures Salon on Prosthetic Envy (May 2016) – http://www.virtualfutures.co.uk/event/vfsalon-prostheticenvy/

[29] Nigel Ackland is the pioneering pilot of the bebionic3 – the world's most advanced prosthetic limb.

[30] Having lost his arm in a rail accident in 2012 James A.H. Young now uses a futuristic prosthetic limb designed by the Alternative Limb Project.

[31] Nicky Ashwell is the first UK-user of the bebionic small prosthetic limb.

while he can charge his phone, the fingers on his prosthetic arm cannot grip. Cathrine Disney, while rejecting the use of prosthetics, notes that every individual possess a 'limb difference' that should be embraced.

There are also two faces to the question of integration: how those with prosthetics view themselves, and how they are viewed by others. Nigel Ackland hopes for a day in which prosthetics are normalised to the extent where people say "so what?" to prosthetic limbs and no longer find anything peculiar about a human using a prosthetic.

Perhaps the greatest damage caused by the collision of technology with the human body is the production of a narrative in which assistive devices (such as bionics) are framed as developments which offer an opportunity for humanity 'augmentation'. Disabled individuals are framed as the 'prototype' for experiments in the possibilities of a cyber-biological future, rather than focusing on increasing an individual's quality of life. Viktoria Modesta has embraced this media perception by deliberately challenging the 'model of the future', attempting to manipulate our perception of hybridity, or humans attached to prosthetic limbs.

At the heart of the debate is the nature of identity: how upgrade-culture plays and preys upon the human body. Considering ourselves as always and already disabled becomes the default. Our bodies, our fleshy restraints that need sleepy standby to function, inhibit the total efficiency and maximum power idealised by late capitalism. A recent increase in the use of 'smart drugs' perhaps indicates a cerebral prosthetics, synthetically enhancing our cognitive capabilities. In many ways we are all prosthetic without wearing prosthetic limbs: our phones are rarely more than a metre away from us and we rely on technology for a vast number of our everyday needs. The emphasis of these technologies is on increasing ease and therefore quality of life: contactless exists because we considered inserting a card and pressing four numbers on a pinpad too much effort. A future in which we integrate these technologies into our bodies is not unimaginable. Indeed 'Grinder' culture, the meeting of body modification with self-experimentation, points to the trajectory through which silicon might be accepted as part of the body.

There is a certain irony, then, that prosthetic envy derives from an ignorance caused by science fiction and a certain laziness of thought. While the current generation of prosthetics wearers look like they are wearing science-fiction limbs, none of these yet eclipses the functionality of a human limb: those who are envious of them are inadvertently wishing for a lower quality of life in a world where technology is seeking to increase it as much as possible. While these individuals are empowered through their bodies, performing superhuman functions such as charging a phone, the greatest joy Nigel Ackland and Nicky Ashwell felt was having their body restored, being able to once more scratch their left elbow with their right hand or turn the page of a book. Those who are prosthetically envious must consider whether they are merely being seduced by the image of a techno-bionic future, or its reality.

Shoreditch, 2012

Shoreditch, 2012. A group of science enthusiasts, hackers and students from University College London are meeting up on regular evenings to investigate the potentials and limitations of Biohacking – citizen science in synthetic biology. Tonight they're building a bacteria incubator out of a fridge box, cardboard, open-source electronics and lots of Scotch tape.

The students are taking part in the annual international Genetically Engineered Machine competition (iGEM), a kind of university student maker-faire for genetic engineering. Each participating group creates, tests and shares BioBricks, small pieces of DNA that are meant to have a specific function. For example, one BioBrick might function as a sensor, whilst another one might function as a reporter by producing a fluorescent protein that makes a bacterial cell glow under UV light. BioBricks are formatted in a specific, standardised way so they can be easily chained together into a genetic circuit, with BioBricks of particular functions acting together to create desired functionality. In practice, many BioBricks only work in very specific contexts and often lack documentation; but the effort to make engineering biology more standardised and, thereby, more sharable has undoubtedly lowered the threshold. A handful of undergraduate students are now able to conduct projects that previously might have taken an entire PhD's worth of lab work.

Image: Bento Lab Beta Prototype

Biohackers are people from many walks of life who have declared the engineering of biology their hobby, and who are trying to replicate the kind of work done by students in the iGEM competition in their own community laboratories. Back in Shoreditch, the UCL students were facilitating, through a series of workshops at London Hackspace and UCL's teaching laboratories, the creation of a first biohacker-made BioBrick, which they named the Public BioBrick. For the students, it was a new experience to encounter biotechnology outside of university walls.

"I was very surprised to find a group of people who are so motivated and curious about biology that they're willing to give up their spare time for this project. They're very dedicated", said one student. "Their approach to science leads them to really see each step in its own right."

Since 2012, the London Biohackspace has successfully become the first community laboratory in the United Kingdom with a license to carry out simple bacterial genetic engineering work. Indeed, all over the globe, biohacking communities are emerging, often within existing hackerspaces and Fablabs. In the United States, New York's Genspace and California's BioCurious and Counter Culture Labs are at the forefront of this movement. They host public workshops, as well as community projects such as Real Vegan Cheese, an ongoing attempt to engineer baker's yeast to synthesize milk protein.

In Amsterdam, the Waag Society hosts an open laboratory, workshops and an annual BioHack Academy, in which participants learn how to build their own laboratory equipment and put it to use. In Tokyo, bio-media arts collective BCL and maker community Loftworks recently opened BioClub, their own open laboratory space, building on the examples of existing communities in the United States and Europe, as well as on temporary hands-on bio-media art workshops.

After facilitating the 2012 Public BioBrick project, Bethan Wolfenden and I proposed a project to complement the growth of biohacking communities around the globe. We wanted to put together all the most essential tools that would allow any curious person to become a biohacker. In the same way that the maker movement in electronics had been amplified by the Arduino platform, an easy-to-use micro-controller initially developed for artists, we hoped to open up biohacking to a larger and more diverse group of people. At UCL's then new Institute of Making, a dedicated student makerspace on campus, we spent the next two years building prototypes and putting them to the test at science festivals around the UK. Eventually, this became Bento Lab, a laptop-sized DNA analysis laboratory combining a centrifuge to extract DNA, a PCR machine, to copy genes from DNA samples, and a Gel Electrophoresis unit to visualise physical fragments of DNA.

To take our idea further, we built 15 Bento Lab prototypes and sent them to beta-testers all around the world. Some were using Bento Lab in their

own citizen science projects, such as Beer Decoded, which is mapping the taste of different beers to the genetic diversity of the yeast used to brew it. Some testers used Bento Lab within universities to teach, or took it into the field for on-site research. In Wales, a group of pensioners is using Bento Lab to analyse the DNA of fungi in the environment. They are part of the Pembrokeshire Fungus Recording Network and collaborate with a local university to contribute to the understanding of the local fungi ecosystem.

When we saw that Bento Lab was of tangible use to a wide set of different activities, we decided to turn to Kickstarter to support our first real production run. On Kickstarter, creators can propose products that will only be produced if a certain minimum of pre-orders is achieved. We successfully raised over £150,000, which allows us to invest in the necessary design improvements, safety testing and tooling for production. In addition to Bento Lab, we proposed a community platform to facilitate exchange and discussions, as well as a set of beginner experiments and instructions. This way, we hope that we can take a big step forward towards genetics becoming an open and participatory technology.

Philipp Boeing is one of the co-founders of Bento Lab, an all-in-one DNA laboratory that anyone can use. He studied computer science with a focus on synthetic biology at University College London. As a member of bio-media-arts group BCL in Tokyo, he explores the relationships between media art, biosciences and society.

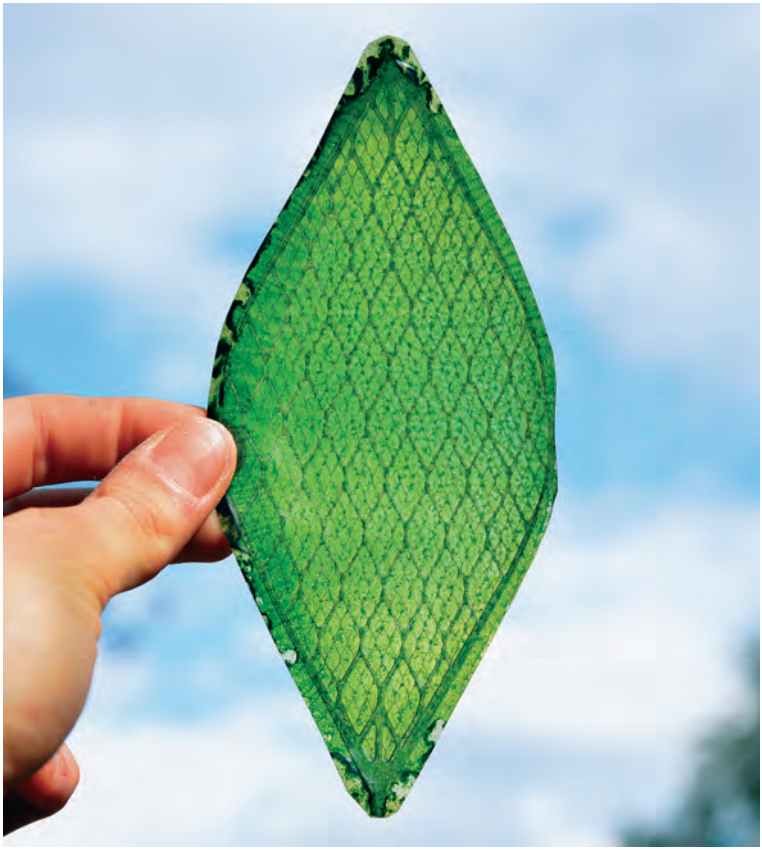
Image: Bento Lab Kickstarter model with Tutorial Kit

GyroGlove

GyroGear designs and builds innovative, wearable technology which can positively transform the way that individuals live their lives. Their products include GyroGlove – a wearable, mechanical stabilisation system for people with the kind of hand tremors which are associated with Parkinson's Disease (PD) and Essential Tremor (ET). Even though the latter is eight to twenty times more common than the former, no specific drugs have been developed for ET – so the current management of hand tremors is often symptomatic. The quality-of-life (QOL) improvements of conventional, medicated treatments are compromised by significant side effects and the eventual loss of therapeutic efficacy. As a doctor, our founder consistently encounters customers who wish there was an alternative that would 'restore independence', 'give [their] life back', allow them to 'just be able to eat and dress', 'stop bothering others' and 'stop [their] families from worrying'.

By directly stabilising the hand, GyroGlove offers a novel approach which complements and potentially offsets current therapeutic treatment. A series of specifically-crafted gyroscopes (spinning disks), coupled to the hand, resist movement, thereby maintaining their orientation by storing large amounts of energy through spinning, compensating both instantaneously and proportionately. Users experience a firm but gentle force acting on their hand, creating an overall effect which feels as though the hand is moving through viscous treacle, thus keeping it steady. The product is not activity-specific, so can be used to carry out activities and tasks which, previously, might have been difficult or impossible, such as eating, drinking, writing or doing-up shoelaces. The beauty of the GyroGlove is its simplicity. Small, sleek and reliable, it can restore quality of life and improve self-confidence – and though still in development, it is conservatively expected to stabilise hands by 70%.

Image: GyroGlove



Silk Leaf

Image: Silk Leaf, Julian Melchiorri

My career-long fascination with natural phenomena and biotechnologies inform my design and engineering practice through the implementation of biochemical reactions, bio-inspired structural optimisation and the mimicking of biological mechanisms and technologies to efficiently solve problems and increase the quality of our lives.

If we look at every natural complex habitat, from rainforests to coral reefs, we can see how these places are constantly evolving, changing and adapting to environmental changes, dynamically reacting to them. Paradoxically, our cities tend to remain static and resistant to change.

I believe in a new renaissance where biomaterials, living objects and architectures will shape our future for good by dynamically reacting and harmoniously adapting to the environment. For this to happen, we need to bring biotechnologies from industrial applications to the human scale, and to rethink interactions and aesthetics in response to biologically driven functions and chemical conversions.

From the early stages of my career, I was able to explore and experiment with light, a natural phenomenon which is a fundamental part of all life on earth. Indeed, light enables all life on earth mostly through photosynthesis, the chemical reaction which involves microorganisms and plant cells to convert carbon dioxide into oxygen and sugars only using water and light.

3.5 billion years ago, this planet was a hostile and desolate place. The atmosphere was toxic and contained no oxygen. Life on earth was restricted to a variety of primitive single cell aquatic organisms. Then a new type of organism emerged with an amazing new capability; it could harvest energy from sunlight and use it to fuel internal activities. This phenomenon is known as photosynthesis and is one of the most important chemical processes on earth; almost all life is ultimately reliant upon it.

Over the last century, our constantly growing population has burnt fossil fuels and destroyed plant life, basically forcing a change in the atmosphere and climate, reverse-terraforming our planet. Having this constant issue in mind, I experiment with ways of making materials that can efficaciously photosynthesize and I explore how this can revolutionise the world around us.

Silk Leaf is the first outcome of this exploration path. It is the first prototype which introduces the potential impact that photosynthetic devices could have on our everyday life. It is made of a biological material mostly composed by silk protein and chloroplasts. Silk Leaf absorbs CO_2 and produces oxygen and organic compounds, thanks to the photosynthetic ability of the stabilised chloroplasts inside silk protein. Any visible light and water is needed to enable the reaction.

Having the necessity to provide water to the chloroplasts to enable the photosynthesis, another embedded technology to deliver water to the

chloroplasts has been introduced, inspired by how natural leaves work. The water could also remove chemical residues and sugars through osmosis, introducing the idea to collect it for energy generation.

The level of oxygen generation could be optimised depending on many factors, from the material composition to the quantity and efficiency of chloroplasts into silk. Recent scientific publications shows nanobionic interventions on chloroplasts increasing their photosynthetic efficiency by 49%. This and other research on genetic modification could allow a dramatic improvement of their efficiency.

Due to: 1) the many benefits of oxygen and CO2 absorption, 2) the low energy consumption, and 3) its modularity, artificial leafs could be used in many applications where the level of CO2 is high or oxygen is needed : inside ventilation systems, architectural facades, free form surface for interiors, together with the lighting, space exploration.

Julian Melchiorri is a design engineer, biotechnologist and entrepreneur based in London. Internationally known for his visionary 'artificial leaf' projects, Melchiorri proposes radical environmental solutions for urban and industrial settings through an innovative exploitation of biological microorganisms and materials to convert waste and pollution into valuable resources. Julian graduated with a Master of Arts from the Royal College of Art and a Master of Science from Imperial College London called Innovation Design Engineering. Julian is the first Engineer in Residence at the Victoria & Albert Museum in London, a TEDx speaker and finalist at INDEX Design Award 2015. He has taken part in major events and conferences, including the World Economic Forum 2016, Venice Biennale 2015, CNN Green Champions, Downtown Design Dubai, Salone del Mobile, London Design Week and ARS Electronica in Linz, Moscow and Berlin.

Image: Silk Leaf, Julian Melchiorri

Divergent Thinking and Meaningful Thinking

Good ingredients don't necessarily make Innovation

Starting my career as a chef, I made my way through three Michelin-starred restaurants in France, Belgium and Italy. An opportunity to launch a restaurant took me to the United States and from there I moved to London in 2011. Looking for a new challenge, I took a position in the R&D Lab of the renowned Fat Duck Group. There, I had the chance to work on exciting projects ranging from meal concepts for the European Space Station to the reconceptualisation of The Fat Duck restaurant and the redesign of the R&D processes.

During those three years, the nature of our work led us to collaborate with specialists from a wide array of industries – from experimental psychologists and philosophers through to biotechnologists and industrial designers. After experiencing the gradual restructuring of the company, and having seen the good and the bad of the transformation, I found myself intrigued by the intricacies of the creation process and found it necessary to move from food into organisational design.

Across the organisations I have been part of, I have been surrounded by highly passionate and talented teams, where members generate many ideas and don't hesitate to put themselves into question. Yet, in most organisations, real innovation rarely manifests. I have often had conversations with passionate individuals, but have rarely seen that passion translated into proportional positive change. In most organisations, somewhere along the line individual initiatives are dulled instead of energised.

This observation is not new or uncommon. Innovation (the buzzword of our times) has been hailed as the solution to all our problems. Countless articles and books have been written on the subject, and yet, every time I see another Dog Walking Uber app come along (or a similar reshuffled idea), I feel demoralised. Not that I have anything against dog walkers. I am even sure that someone, somewhere will be happy with the extra cash. However, I am convinced that we can aim higher and use innovation to solve bigger issues.

We are limited by our conception of what innovation is and how to work towards it.

The Dual Nature of Innovation

Innovation can be conceived as a dual mechanism. It has a divergent component, where a variety of ideas are explored, and a convergent one, where the variety is refined into a single solution. The Dual Process Theory of Reasoning illustrates how both mechanisms happen. On a conscious level, we generate ideas and actively choose among the possibilities. On an unconscious level, our brain is discarding alternatives without us even being aware of their existence.

When working in a group, the exchange of ideas and their selection becomes a much more intensive task. Under the right conditions, working in a team can be more rewarding, but keeping the momentum is difficult. The recipe for a successful idea generation requires flexibility and freedom of thought. Trust is necessary to lubricate the interactions between members and allow ideas to surface. Both intuition and careful thinking are essential in the selection process. The skills required are almost synonymous with opposing mindsets. In fact, we tend to see great success in very diverse groups.

Design thinking provides a framework to organise the creation process in series of cyclical steps: empathising with the user, defining the problem, ideating solutions, prototyping, and finally testing and evaluating. Each subsequent step enables a shift of the balance between the convergent and divergent mechanisms. The distinct nature of the steps allows participants to choose and alternate between methods optimised for convergence or divergence. Having a clear objective in every phase effectively lubricates the interactions between participants.

Uncreative creativity

While working in food, I discovered on more than one occasion the same 'original' idea being born in a different group or company at the same time. 'Being innovative' relied on claiming ownership first. Suddenly, I started to see friends from diverse backgrounds (artists, academics, architects, etc.) sharing this common problem. I was shocked.

The scale and density of trends across disciplines (food delivery apps being a recent example in entrepreneurship) showed me that the solutions we devise tend to be highly unoriginal. Furthermore, competition phases out most organisations who fail to reinvent themselves. Many techniques have been developed to facilitate the different steps of the design process, and there is always room for improvement. Regardless, the divergent mechanism seems to be in particular need of support.

We all tend to follow the same few big-profile companies, celebrity leaders, TV shows, and so on. At the same time, we tend to befriend, hire, and marry people with similar world views and habits as our own. Our brains generate new ideas by recombining what we have experienced. However, we privilege

recent and commonly-found information when making associations. At the same time, our in-group and self-confirmation bias mean we give priority to the opinion of our closer group or tribe, disregarding information that would contradict our current paradigm.

Our very nature creates a strong, self-reinforcing loop towards convergence. If we want to be creative, we need a more conscious approach to selecting our sources of information.

Designing for divergence

At Conductal, we are looking to create solutions at the organisational level. Some of our work is facilitated through Crossmodalism, where we provide meeting spaces for thought processes. A human collider open to the public. However, any organisational effort needs to be coupled with an appropriate design process.

All the steps of design thinking methodology require some research for new information, but the main burden is placed on the empathising step and in the more convergence-oriented defining step. These two steps are engineered towards researching that which is closely related to the topic at hand. However, we already know that cross-pollination is a powerful tool for innovation. If we add a new step, designed to promote divergent thinking, we can compensate for the natural group-thinking tendency of teams. By bringing knowledge from other disciplines, we can find alternatives and save time. Thanks to focused research at the meta level, we can improve creativity.

This brings up a new question: how do we prompt teams and organisations to take meaningful challenges, instead of just generating original solutions to relatively meaningless ones?

The importance of purpose and meaning at work

A shared mission that transcends petty challenges is a powerful motivator. When a common cause is placed at the core of an organisation, it aligns efforts and promotes collaboration over competition. Properly balancing a mission with a culture of playful experimentation leads to engaging and fulfilling workplaces.

The good news is that the talent marketplace will help promote this model. A company where work is meaningful will have a substantial competitive advantage over a meaningless rival who can only leverage salary or promotions. The bad news is that creating a culture of meaning is not easy. While getting two people to agree on a common goal is hard, reaching an agreement between a large group is a massive challenge.

Beyond pure market forces, Fritjof Capra and Pier Luigi Luisi offer a fascinating analysis. According to them, human thought (as a paradigm)

has undulated between holistic thinking and analytical thinking throughout history. Every swing of the pendulum brings a new wave of thought revolutions and discoveries.

We currently live in a super-fragmented society. Our disciplines are specialised to the point that experts know more and more about less and less. Our institutions and organisations follow their individual goals at the expense of society (and hence themselves). Our dog-walking app, in that frame, is the result of exacerbated analytical thinking. We need processes that can lead us to understand the issues that really matter and devise meaningful solutions.

Designing innovative organisations with meaning at their core might be a big challenge, but it is one worth undertaking.

Daniel Ospina is Director at Conductal, Co-Founder and Steering Group lead Crossmodalism, Associate Fellow at CenSes, Institute of Philosophy, University of London and Experience Designer in Residence, Crossmodal Research Laboratory, University of Oxford.

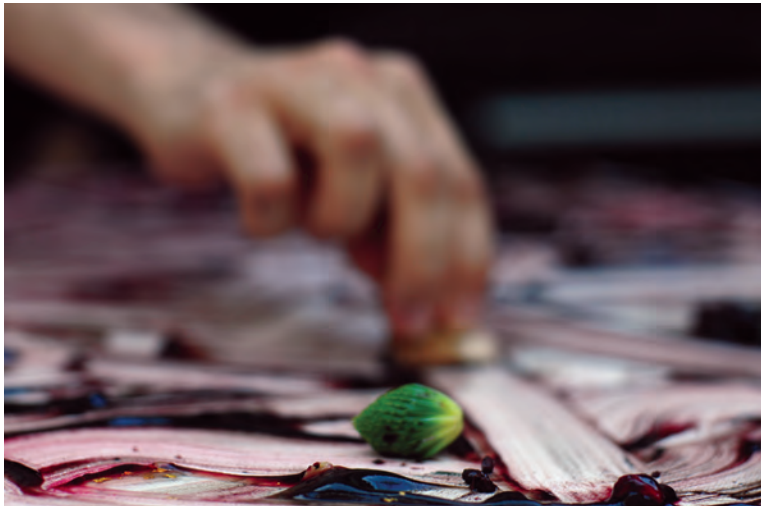


Image: Joe Sarah Photography

James Watt – a VR encounter with the engineer

Non-contact non-destructive 3D imaging methods and 3D printing were used to produce a physical replica of the original 'negative' plaster-cast form, for a unique artefact, a newly discovered portrait bust of the engineer James Watt. In a next step, we use the 3D digital model to create a VR (Virtual Reality) experience so that visitors can explore the 3D dataset in a stereo view in the round. In this immersive experience, you will be up close and personal, and face to face, with the engineer James Watt.

Watt's workshop is the legendary 'magical retreat' of engineer James Watt after his retirement, preserved as it was when he died in 1819. More than 8,000 fascinating objects, left as they were in Watt's lifetime. Amongst the objects in the workshop are twenty-three plaster-cast moulds, most of which had never been opened and were still bound with their original string. Two especially complex moulds contained portraits. One of the portrait moulds was a ca. 30 cm-high bust of a man, dating from 1807 (M.23/ Science Museum inventory), which stirred significant interest by the curators. Was it a portrait of James Watt himself? The bust was found inside the workshop around 1807, and a hint in a letter implies that it was recreated from a mould that may have been cast by Lucius Gahagan for Watt. But the written records were quite inconclusive; this theory needed to be confirmed by seeing the positive cast itself. This project followed a request in 2010 by Ben Russell, curator of Mechanical Engineering at the Science Museum, with the aim of integrating the replica into the new exhibition.

Historical forms of casting for reproduction were excluded, as it was paramount for the conservation of the original to use a non-contact method that did not disturb the material and surface inside of the mould. The form was very complex, composed of four main pieces containing a total of twenty-nine separate sub-pieces. Cutting-edge technology was used for non-contact reproduction of a plaster cast – 3D colour laser scanning with a sampling distance/resolution of 0.1mm. The digital 3D models of the four main negative components of the cast form were aligned and the surface normal direction was inverted to create a positive surface model. The result was a first image of the cast and was immediately recognised by the curator as a previously unseen portrait of James Watt. Further processing took the decision of the curator into account: that the model should show the manufacturing process of the casting and that the joint lines of the single cast form should remain visible and elevated.

In a subsequent step, the full-resolution 10.5 million points were transferred into a high-resolution polygon mesh of 1.5 polygons for 3D printing. The surface was modelled to be a completely closed surface geometry without holes (e.g. watertight), especially around the shirt sleeves. An artificial cutting curve was introduced, to form an even base, and a bore hole on the back, for mounting the bust, was integrated.

3D data acquisition of the negative cast form produced a high-resolution 3D virtual model as a point cloud which can be regarded as the digital equivalent of a conventional plaster cast mould. It also allows the experience in Virtual Reality, in a larger-than-life and immersive environment. Questions of material culture, of authenticity and quality of the real object versus the 3D digital reproduction are discussed intensely in the digital heritage community.

The use of 3D printing allows, of course, limitless and identical reproductions. But if the commissioned 3D print is to be the definitive final object, the long-term conservation of the 3D nylon print has a limit, due to its known photo-instability. In consequence, future reproductions through 3D printing need to be examined and selected for longevity, since 3D replicas will soon become artefacts in their own right, just as Watt's mould has become.

This 3D print of Watt's bust has been officially accessioned (number 2011.14 Science Museum). The new exhibit of Watt's workshop – James Watt and our World. The Workshop, the Man and the New Industrial Age – was mounted in the Energy Hall of the Science Museum, accompanied by a case showing the existing portraits of James Watt alongside the newly discovered bust as a 3D print, and in a prominent position across from the steam engine. You can visit the Science Museum yourself to have a look.

Dr Mona Hess, 3D imaging for cultural heritage, at 3DIMPact (3D Imaging, Photogrammetry applied coordinate technologies) research group at UCL Department of Civil, Environmental and Geomatic Engineering

Further reading about the project: *Hess, M., & Robson, S. 'Re-engineering Watt: A case study and best practice recommendations for 3D colour laser scans and 3D printing in museum artefact documentation', in D. Saunders, M. Strlic, C. Kronenberg, K. Birholzer, N. Luxford, eds., Lasers in the Conservation of Artworks 9 (2013), pp. 154-162. London, UK: Archetype. [www.iris.ucl.ac.uk/iris/publication/407387/1]*

Download your app to see the VR James Watt for Google Cardboard: *play.google.com/store/apps/developer?id=3DIMPact+at+UCL+CEGE*

Underlying dataset commissioned and copyright of the Science Museum, with kind permission to use for this project. VR & app development by 3DIMPact / UCL CEGE.

Connect by Twitter: *@Mona3Dimaging and @UCL_3DIMPact or #3DIMPact. Supported by the AHRC Digital Transformations Theme.*

Image: 3D coloured scan of the object, the negative cast form

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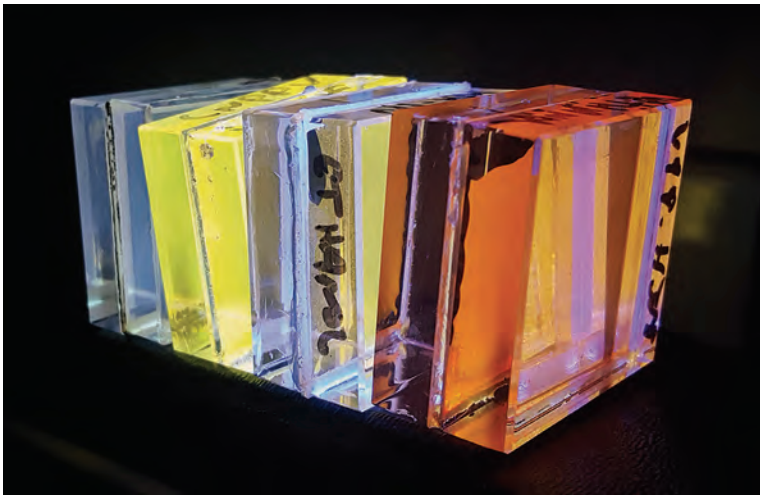


Hacking The Enlightenment – Knowledge exchange through collaborative automata making

Image: Nanoparticles in optical glass, a technique refined with students during the Parallel Practices project at King's College London

I am a satirical metalsmith, a maker of vitreous enamelled, mechanical objects. I have been making narrative based automata, often in response to historic people, places or objects, for over twenty years, utilising crafts skills rooted in the traditions of dying and defunct Georgian and Victorian industrial metal manufactories of Birmingham and the Black Country. My work utilises the lost making skills, material understanding and technology of these trades and applies it to contemporary contexts. By employing this lost craftsmanship, I am able to emulate the aesthetic of the things they produced; in particular, the distinctive painted and printed enamel objects of the Georgian period; then, through the introduction of modern day references, imagery, text speak etc., subvert this historic style to make contemporary craftwork that satirises modern-day society.

The Collaborative Automata Project, my offer for the Parallel Practices residency, explored the shared histories for the fields of Science and Art in 18th Century automata, using objects such as Pierre Jaquet-Droz's The Writer as points of departure. During the project, some twenty students and staff were engaged in the act of making, in collaboration with myself. The automaton, part analogue and part digital, is a celebration of the eminent scientist Sir Charles Wheatstone, a man influential in early telecommunications, whose laboratory we have been working in.

The automaton has been a vehicle for knowledge exchange. I have passed on 'distinctly analogue' craft skills to students through a series of workshops, and in return they have 'enlightened' me to the world of robotics. Three distinct phases occurred. The first two, led by myself, focused on micro engineering of metal mechanisms, followed by the creation of enamelled decoration for the object. The finished automaton is to be 'hidden' amongst a display of Wheatstone's scientific apparatus on display in the main corridor of the King's Building, King's College London. And so the third phase saw the co-collaborators take over and apply their robotics knowledge to innovate technological solutions that would enable audience interaction with the artefact once it was trapped behind the glass of the showcase.

The solutions were ingenious and focused on finding methods for attracting the attention of passers-by to the content of the case, thereby generating awareness of this important display of Wheatstone's instruments. Many ideas did not make it past the blue-sky thinking stage! Two of my favourites were: touch sensitive enamel, where tactile interaction with different parts of printed imagery applied to the surface of the object would generate a variety of movements from the automaton; and audience phone image capture of an embedded QR code in the decoration of the craftwork, scanning of which would send a message to switch on the automaton at KCL via America, the time delay between the two actions being a nod to Wheatstone's influential role in transatlantic telegraphy. Ultimately, two solutions came to fruition. MSc students devised a motion sensor system to detect passers-by in the corridor in which the automaton is situated, bringing part of it to life, the resultant movement attracting these people to stop and observe. Once

captivated, the audience is then invited, through visual clues in the cabinet, to use 'mime handle', an ingenious amalgam of hardware and software invented by a PhD student, allowing the audience to mimic, in the space in front of the cabinet, the turning of a handle (the traditional method of powering an automaton), the clever technology recognising this distinctive hand motion bringing the rest of the machine into a joyous blur of movement!

www.craftscouncil.org.uk/directory/maker/john-grayson

Dr Matthew Howard, Academic Partner

The Wheatstone Innovation Laboratory, the academic partner in the automaton project, is an interdisciplinary laboratory with a novel bottom-up approach to science experimentation and innovation. It is named after Sir Charles Wheatstone, a scientist and inventor who was, according to archival accounts, constantly making new devices and instruments. By embedding artistic makers with skills in traditional crafts, we recapture that creative and inventive spirit, giving our students the confidence to experiment and learn by making, as well as learn new skills in areas (such as enamelling, automata making) that would otherwise be inaccessible to them in the formal teaching of traditional science and engineering disciplines.

The power of light
Dr Shelley James, Glass Artist

As a child, I loved playing with wooden blocks, building endless symmetries. Maths at school terrified me, so I pursued my passion for pattern and rhythm through the optical and material qualities of glass.

I started my residency at King's College London with basic technical workshops, in order to gauge the level and focus of interest. Students suggested new approaches and asked difficult questions. We soon realised a common approach to research and a shared fascination with light, the material and energy that will power our future.

As we looked for ways to share and express this common ground, I started to experiment with the 3D printer installed in the Wheatstone Lab, a space that had recently been set up as a making space in the Strand Campus.

I discovered that I could use 3D-printed objects to create perfectly accurate casts in optical glass. Together, we built hyperuniform patterns, 'whispering gallery' structures and models of light-emitting materials that can trap, direct and even amplify light. This digital innovation quite literally allows us to shine a new light on the structures of the future.

www.shelleyjames.co.uk

Dr Riccardo Sapienza, Academic Partner

As an academic partner of Shelley, I have embarked on this project without really knowing what to expect from a maker in our lab! After our first discussions, we realised we had a common language of light and matter, and have dived into fascinating speculations on light, crystals, colours and lasers. Our students were also easily engaged by the hands-on approach to science and art. The results are tangible, shiny, and let us grasp with our senses light-matter interaction at the heart of optical nanoscience.

Image: Cuboctahedron, optical crystal cast into 3d printed molds, a technique developed with students during the Parallel Practices project at King's College London

The craft of innovation

Digital technologies are revolutionising how things are made, where they are made and who makes them.

At the same time, craft is driving innovation in other sectors. Today we see the tacit intelligence of the hand stimulating innovation in such diverse fields as digital technology, aerospace and bioscience, and in examples such as an embroiderer collaborating with a roboticist to develop wearable sensors for medical and sports applications.

As the fusion of physical and digital accelerates, could the UK, with its twin strengths in tech and craft, become the new Silicon Valley of making?

Innovation through craft is nothing new. Across material disciplines, craft processes have always driven breakthroughs that have passed into other fields. This might seem counterintuitive. For some, not least marketing copywriters, 'craft' calls up notions of tradition at odds with the idea of innovation. Yet what David Pye called 'the workmanship of risk' (1968) – the skilled manipulation of material that affords unplanned breakthroughs – is an enduring characteristic of craft that gives it its innovative edge.

What do we mean by innovation through craft? Innovation in craft refers to evolution of technique, discovery of new materials, and application of new tools. Innovation through craft refers to makers facilitating or catalysing innovation elsewhere. It concerns the so-called 'spillover' effects of craft into other industries.

At the Crafts Council, for many years, we've tracked, profiled and driven craft innovation through exhibitions, research and interdisciplinary collaborations. And it's this intersection of craft, technology and innovation that is celebrated in the V&A's Digital Design Weekend. This year, the Weekend features makers from Parallel Practices, a Crafts Council project that, in partnership with the Cultural Institute at King's College London, aims to demonstrate the reciprocal benefits that arise when makers and scientists work, and play, together.

It is also these innovations generated by collaborations between makers and other sectors – how they occur and how we can make the most of their potential – that form the focus of Innovation through Craft, a 2016 report commissioned by the Crafts Council and authored by KPMG.

In KPMG's view, 'Craft skills and knowledge have a strong economic impact and significant potential to drive further growth and innovation in other sectors.' There are, though, barriers that stand in the way of realising that full

potential. They occur in three broad areas: lack of understanding of the value of craft innovation, an underinvestment in innovation and collaboration, and the threat to craft education and skills.

Alongside the report, we published a suite of case studies and, as we're a visual sector, we worked with creative and cultural consultants From Now On to produce an accompanying graphic to illustrate the potential for craft to stimulate innovation in the biotech, digital and engineering fields.

The report, case studies and graphic are timely on several counts. Recent years have witnessed an acceleration in collaborative open innovation, and a transformation in making, whose scale of impact is conveyed by the label, 'the fourth industrial revolution'. Alongside this, UK governments have given increasing attention to the creative industries' considerable economic contribution. At the same time, 'fusion' – the combination of creative, technological and enterprise mindsets – has been shown to be a key driver for successful businesses.

The UK's strengths in the creative industries and, specifically in craft, are currently unrivalled. However, international competitors are fast catching up, investing heavily in creative education, in research and development, and in facilities that bring the physical making and digital worlds together. China is a case in point. But the same is happening to different degrees in other parts of Asia, as well as in the US and Scandinavia.

Unless we take action now to invest in collaborative innovation and in supporting craft education, we will experience a talent drain and lose competitive advantage, as well as the potential to generate solutions to pressing environmental and health challenges through the fusion of physical making and digital skills.

Currently, most innovation through craft happens through happy accident. Our vision is to move, through strategic investment, to an established culture of open innovation and collaboration. The potential rewards are great: improved productivity and development of new products and services, enabling us to access new global markets and reap both social and economic benefits.

Parallel Practices
Tiffany Radmore, Talent Development Manager, Crafts Council

Parallel Practices forms one part of the Crafts Council's Innovation strand, and is run in partnership with the Cultural Institute at King's College London. The project aims to demonstrate the mutual benefits and value of collaboration between medical and scientific academics and makers.

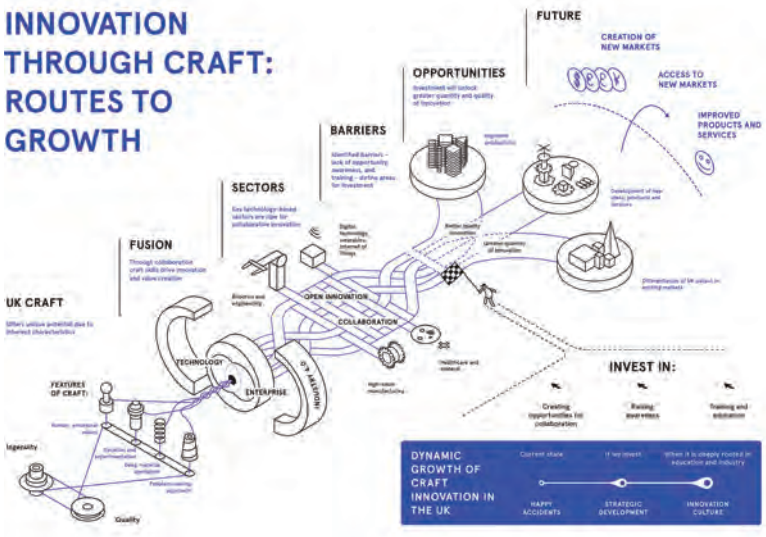
The 2014 pilot project consisted of four collaborations, with each collaboration lasting four months and involving a team of at least one maker

and one medical and scientific academic. These pairings stimulated learning and innovation through a focus on the body, materials and processes.

Now in its second phase, a longer six-month Parallel Practices programme, 'Learning Through Making', allows maker-academic collaborations more time to explore the benefits of their partnership, giving consideration to the pastoral and educational outcomes that were touched upon in the pilot project. Makers John Grayson, Shelley James and Celia Pym worked with academics, researchers and students from undergraduate to postgraduate level to encourage students to play, use their hands and take risks to push the boundaries and enhance their learning experience.

The partnerships for Parallel Practices' 'Learning Through Making' are textile maker Celia Pym and Richard Wingate, Head of Anatomy at King's, who will question the qualities of haptic experiences evoked through touch, the feelings of care and the patterns of wear in material; glassmaker Shelley James and physics lecturer Dr Riccardo Sapienza are investigating making and problem-solving through glass techniques and experimentation to broaden learning and confidence; and lastly, automata maker John Grayson and robotics lecturer Matthew Howard are exploring synergies and movement between synthesising analogue and digital technologies within the realm of robotics and automata.

A further collaboration between the nursing and midwifery team at King's and textile maker Angela Maddock, whose practice explores emotional and physical intimacy, will start in September to enhance haptic and simulation skills for undergraduate studies in nursing and midwifery.



Tanglebots

Image: Tanglebots workshop. Photo: FoAM

In the Weaving Codes – coding weaves project, Alex McLean, Ellen Harlizius-Klück and I reconnect modern digital tools and the ancient and fundamentally digital art of weaving. We ask for the theoretical points where weaving and computer programming connect and develop codes and code machines to pursue these questions. To control the entanglement of threads is not that demanding for human beings and hands – however, it is a challenge for machines and robots. For the finale to the Weaving Codes – coding weaves (www.kairotic.org) project, we are trying a new approach to technology education inspired by this, teaching families about code, robotics and thread by building 'tanglebots' (www.fo.am/tanglebots).

The concept for the tanglebots workshop was to combine programming with physical objects, concentrating on sensor input and movement as output. It's important that we incorporate our weaving codes research process, so deliberately setting goals we don't yet know the answers to. From our perspective, this gave us an opportunity to open up our ideas, and to look for new directions and research questions to guide our future work.

The weaving focus allows us to ground the workshop in loom technology and demonstrate the challenges of manipulating thread, with its enormous history of technological development. For the first workshop, Ellen started us off with an introduction using FoAM Kernow's Harris loom and the fundamentals of weaving. We were also joined by Janet and Jon, from our partner Lovebytes organisation in Sheffield, who will run future workshops in and around their part of the country. When first talking about possible workshops with children, we'd discussed the possibility of making a functional loom in a couple of hours with only broken toys and Lego. We decided that this workshop would be interesting, but was destined to fail and would end up in a mess of tangled threads and broken technologies. Alex suggested turning these difficulties to an advantage, and making tangles the actual goal of the workshop. In the same spirit, we created a series of prizes for 'alternative' categories such as 'Most technical effort with least impressive result' – inspired by Japanese hebocon contests for the 'technically ungifted' where 'pseudo-robots which don't even move properly' go head to head. By focussing on error, we planned to create a fun and supportive environment where conceptual insights and engagement with material were privileged over slick end results.

The workshop format we used was also heavily influenced by Paul Granjon's wrekshops (www.zprod.org/zwp/wrekshop) – wherever possible, we reused technology by pulling apart e-waste, making use of electronics, motors, gears and ideas from the surprising complexity of what's inside the things people throw away. This turned out to have a powerful, implicit message about recycling; parents I talked to had tried taking things apart to learn about them, but the next step – making use of the parts discovered, as we were doing here – needed a bit more help to do.
FoAM always recognise the importance of food in communal events, in providing both sustenance and inspiration for the goings-on. In this case,

lunch was tangled by Amber Griffiths and Francesca Sargent, forming cardamom knots, spiralised courgette and spaghetti fritters.

The workshop went well, but we noted some things to improve for future workshops. The groups ended up a bit lopsided, so in future we plan to pre-arrange them, as we have with previous workshops. In order to do that, we need to ask for more information from participants beforehand, such as family ages and backgrounds. We tried using the small Pi touchscreens – these were a bit too fiddly to get away without a mouse, but are much less overbearing than larger PC monitors – as they are so small, they became incorporated into the tanglebots themselves.

We also thought about different approaches to future tanglebots workshops, perhaps starting them with a manual tangling exercise (such as weaving with rope) in order to focus on the threads before getting distracted by the technology. Likewise, Lego has a strange all-or-nothing effect – once you start using it, everything has to work that way. It would be interesting to try a workshop without, and seeing what different creative options emerge.

All our resources are being uploaded to the Kairotic GitHub repository (www.github.com/Kairotic/tanglebots) to help you run a tanglebots workshop if you wish!

As well as being supported by AHRC Digital Transformations, this project was part of British Science Week, supported by the British Science Association.

The Great Steampunk Game Jam

The National Archives has a huge collection of design records – over three million designs in total – covering a variety of subjects, from clothing to technical inventions. The designs were submitted to the Designs Registry, originally at Somerset House in London, as part of the process of applying for copyright. The person or company wanting to copyright their design had to submit two identical drawings, photographs or samples of their design. One copy would be pasted into an enormous leather-bound volume and retained by the Registry, and the other would be kept by the copyright holder. These volumes of designs eventually came to The National Archives – the official archive of the UK Government – for safekeeping because the Designs Registry was part of the Board of Trade, a government department.

The most visually engaging designs are those submitted in the Victorian period, and these records have provided excellent opportunities for engagement with audiences perhaps unfamiliar with archives. Usually this has taken the form of presentations and publications, but recent efforts to become involved in gaming elsewhere in the Galleries, Libraries, Archives, and Museums (GLAM) sector provided inspiration for a potential new way of interpreting this material.

Several institutions within the GLAM sector have attempted to use gaming to represent their collections, with the British Library in particular leading the way through their annual Off The Map competitions. They have developed themes to allow student games developers to create vivid and exciting interpretations of their collections, with particularly visually arresting games coming from their themes on The Gothic Imagination[32] and Alice and Wonderland.[33] Other institutions have made memorable games, such as the V&A's Strawberry Thief.[34]

The visual nature of the Victorian designs made them ideal for a potential gaming activity. The illustrations are often very detailed, and the written descriptions that accompany them are interesting in their own right. The

[32] *The British Library Website: Digital Scholarship Blog: 2014 Off the Map Competition Winners Announced at GameCity9 Festival, Available at http://britishlibrary.typepad.co.uk/digital-scholarship/2014/10/2014-off-the-map-competition-winners-announced-at-gamecity-festival.html (accessed 26 July 2016)*

[33] *The National Videogame Arcade Website: Gamecity: Off The Map 2015: Alice in Wonderland, Available at http://gamecity.org/alices-adventures-off-the-map-winners-announced/ (accessed 26 July 2016)*

[34] *The Victoria and Albert Museum Website: Blog: The Strawberry Thief iPad Game, Available at http://www.vam.ac.uk/blog/artists-residence-va/the-strawberry-thief-ipad-game (accessed 26 July 2016)*

Victorian period was one of amazing inventiveness, and many of those new technologies changed the way we live. However, for every great idea there were many more that sank without a trace. In many ways, the failed inventions are even more interesting than the major inventions, as they shed light on the interests and preoccupations of people during that period: the small, everyday annoyances they had to deal with; problems they wanted to solve; or ways of doing things better. Sometimes these were rather misguided.
Via Jo Pugh, collaborative PhD student at the University of York and The National Archives, we developed ties with the Department of Theatre, Film and Television and the Intelligent Games and Game Intelligence (IGGI) PhD programme at York. Through a combination of the availability of visually striking records, historical specialisms and expertise, and personal interest we worked towards hosting The Great Steampunk Game Jam, as part of the York Festival of Ideas over the weekend of 18-19 June 2016. Participants from the University and the local community were invited to attend.

We chose three main themes – Invention, Spectacle and Unrest – in order to inspire the participants and to structure their thinking, and selected relevant records. Each had sub-themes which allowed us to identify particular stories (e.g. the Chartist movement during the 1840s, or extravagant exhibitions from the period), with the Invention category similarly split. 'Out and about' highlighted designs for forms of transport, including the 'flying or aerial machine adapted for the Arctic regions', bicycles, and carriages; listed under 'Dress to impress' was Victorian clothing, such as the 'Bona Fide Ventilating hat', and the 'Volunteer reversible trowsers'; and 'Danger' highlighted the Victorians' preoccupation with health and safety, including such gems as the 'Anti-garroting cravat', which consisted of a collar of lethal-looking spikes cunningly concealed by a black cravat – and an artificial leech.

We were available over the course of the weekend, as ideas were generated and initial designs tested, to assist further with interpretation of the records. Following an initial discussion, the teams set about developing their ideas and worked late into the night and throughout Sunday to complete their creations.

Three judges – Professor Helen Petrie and Alenna Denisova (both of the University of York) and Victoria Hoyle (City Archivist, City of York Archives) – were asked to decide on the top three entries based on the technicality and playability of the games, and the interpretation of the archival material. Chris Power, also of the University of York and Able Gamers,[35] judged a 'most accessible' prize, based on guidance provided on the wonderful Includification website.[36]

[35] *The AbleGamers Charity Website, Available at: http://www.ablegamers.com/ (accessed 27 July 2016)*

[36] *The Includification Website, Available at http://www.includification.com/ (accessed 27 July 2016)*

All of the games submitted are available on The Great Steampunk Game Jam page on Itchio.[37] The most accessible award was presented to Hatastic,[38] a game which, alongside engaging game play and storytelling, carefully considered accessibility, through hints to assist players, 'cheats' so that people could re-enter the game, and colour contrasts for easier reading.

Third place was awarded to A Victorian Trip,[39] which picked up on all three main themes and created an immersive experience through a combination of attractive visuals and experimental sound and music. Strong accessibility also helped the game's strong showing.

Second place went to Hatastic, which used the concepts of social disorder to create a game in which the player travels around Edwardian York, following clues under the pretence of attempting to steal Herbert Asquith's top hat. The possibility of being captured by an under-cover policeman added some necessary peril.

The winning entry was The Great Airship Rescue,[40] which pulled together two themes, as an aircraft created to locate Sir John Franklin's lost Arctic expedition had been sabotaged by protesters.[41] The player is tasked with fixing various bits of ailing machinery to keep the aircraft aloft; and the game, which included elements drawn from archival material, was well-designed, playable, and fun.

The winning team worked together well over the weekend and were almost certainly helped by a fantastic presentation, led by a character in full Steampunk gear of long leather jacket and an impressively tall top hat. A generous £300 prize – provided by the Friends of The National Archives – was presented to the winning team.[42]

[37] *Some of the games will require special software to play – usually Unity. The Itchio Website: The Great Steampunk Game Jam: Entries, Available at https://itch.io/jam/the-great-steampunk-game-jam/entries (accessed 27 July 2016)*

[38] *The Itchio Website: Hatastic, Available at: https://generatemeg.itch.io/hatastic (accessed 27 July 2016)*

[39] *The Itchio Website: A Victorian Trip, Available at: https://izzybeau.itch.io/a-victorian-trip (accessed 27 July 2016)*

[40] *The Itchio Website: The Great Airship Rescue, Available at https://project-mayhem.itch.io/the-great-airship-rescue (accessed 27 July 2016)*

[41] *The Admiralty launched a search for Franklin's expedition of Arctic exploration, which was followed by several professional and amateur attempts to find the expedition.*

[42] *Copies of Julie Halls' 'Inventions That Didn't Change The World' and 'The Thrilling Adventures of Lovelace and Babbage' by Sydney Padua were presented to the participants, also courtesy of the Friends of The National Archives. The University of York provided prizes for second and third places – as well as food and refreshments over the weekend, and Able Gamers presented the award for most accessible game.*

Special mentions should also go to Eleanor's Notebook,[43] a beautifully illustrated game which saw the daughter of Sir John Franklin use a fantastical aircraft to try and locate her lost father; and to Aaron, the designer of The Great Leap,[44] who at the age of just 14 demonstrated a high level of skill and application over the course of the weekend.

We learnt several lessons from the weekend. In particular, we could perhaps have challenged some of the ideas earlier in their formulation, provided a greater explanation of what we would expect to be 'acceptable' themes, and reminded participants that a vague interpretation of the period would not necessarily be enough. Also, we could have been more proactive in structuring initial team discussions. However, overall it was a wonderful opportunity for us to see archival material interpreted in this way, and for such talent and skill to be demonstrated by the participants.
The visual nature of the designs proved to be very popular with the participants (the ventilating top hat appearing in several games) and the exercise proved to be incredibly valuable in helping us to understand how we can engage people with archival material in new ways. Building on our experiences will hopefully allow us to develop other similar events, for which we can draw on other visual collections for innovative interpretation.

[43] *The Itchio Website: Eleanor's Notebook, Available at https://yeppoh.itch.io/eleanors-notebook (accessed 27 July 2016)*

[44] *The Itchio Website: The Great Leap, Available at https://pixelformedstudios.itch.io/the-great-leap (accessed 28 July 2016)*

Image: BT 45/10 (1823) – Ventilating Hat – Top hats were heavy and heads could get quite hot – a combination of perspiration and hair oil could lead to an unpleasant atmosphere. The Bona Fide Ventilating Hat, which featured a system of grilles, aimed to solve this problem by 'carrying off perspiration from the interior'

Continuity, innovation and consumption in the birthplace of the Industrial Revolution

The monuments and collections of the Ironbridge Gorge, one of the UK's first UNESCO World Heritage Sites and the birthplace of the Industrial Revolution, continue to develop via creative practice and production and are increasingly accessed and opened up via innovative digital technologies which impact on the way in which we as visitors explore, engage with and consume cultural heritage.

Ironbridge Gorge was inscribed as World Heritage in 1986 for its significance in the earliest days of the Industrial Revolution in the first decades of the 18th Century. Apart from the key sites of the world's first iron bridge (1779) and the world's first coke-fired blast furnace (1709), the World Heritage Site covers six square miles, containing 36 scheduled monuments and ten museums. Over a period of over 300 years, much of what was produced in this small area of Shropshire was destined for mass consumption and export as production met a growing consumer demand for decorative objects. Domestic, functional, iron cooking pots and pans produced in quantity in the 18th Century gave way to highly stylised, decorative ironwork in the 19th Century, which was heavily featured in the 1851 Great Exhibition and subsequent world fairs and international trade events. Ironbridge was not only a place of iron; it was also a leading centre for porcelain manufacture and, for a time, the world's main producer of decorative tiles. The companies and entrepreneurs of Ironbridge were attuned to ever-increasing consumer demand and met this with innovation and creativity in design. Most significantly, perhaps, is that it was also, from early on, not only the products that were marketed, but also the place itself. It was a tourist destination from the late 18th Century and today it remains an important heritage tourism destination and economy.

The nationally designated collections of Ironbridge Gorge Museum Trust (IGMT) provide an important resource through which we can examine how art, design, industry and innovation fused to meet the growing demands of consumers not only in Britain but across the world. The Ironbridge International Institute for Cultural Heritage at the University of Birmingham has a long-standing partnership with the IGMT and seeks to explore new ways of accessing and understanding the collections and the wider World Heritage Site; not as distanced objects, but rather as part of a continual narrative of the Gorge and how this place is itself consumed. Collections are increasingly

accessed through new digital media which also holds considerable potential for the new creative and design industries that are present and which constitute the vitality of the site, holding the key to the long-term future of heritage communities.

Digital innovation is often seen as a key element within the access and consumption of heritage, and also its co-creation and democratic potential. It has the capacity to alter how we access, interact with, question and experience cultural heritage, not only off-site, but increasingly on-site as we move through collections and locations; and thereby not as something that dislocates or disrupts, but as something that forms part of our natural interactions. Digital technologies affect how we expect to see, consume, learn and contribute to – even question – heritage and new visitor experiences, and engagement strategies are increasingly designed with this in mind. The shift from heavy industry through to decorative products, artistic design and heritage tourism across the sites within the Ironbridge Gorge is intertwined with the innovations that enabled it; and it is through this continuation via innovation that we might also understand the value of the innovative technologies that seek to open up and make accessible collections and the resultant accompanying need to design interfaces and objects that enable multi-use and multi-sensory engagement.

The University of Birmingham Digital Humanities Hub worked with Ironbridge, and several other regional heritage organisations, to produce multi-user 'touch-tables' that enabled greater access to collections and also contributed to visitor engagement within the sites. From the co-design process, through to the digitisation of collections, the sharing of knowledge, and finally the creation and installation of multi-user touch-tables, the idea was always to enable the opening-up and also playful engagement with collections. Since then, the designers at the Hub have increasingly explored multi-sensory engagement methods via co-design across different communities and end users.

It is important to be aware that the experience, education and interaction with cultural heritage can be expanded but also be limited by technology. Co-design and co-creation strategies can help to ensure that the transformations enabled by the digital are available to as many people as possible. Technologies can, and should, demand an embodied use, a touch, a response. This needs to be experienced by different bodies, with different needs and perspectives, and it is only via collaborative strategies that these needs can be understood and translated into experiences that benefit our understanding of and interaction with heritage. Without such a process, the touch-tables, as with other digital technologies, risk becoming nothing but expensive mirrors to the collections around them.

Whilst the touch-tables in the Enginuity and Coalbrookdale museums emphasise the playful potential of on-site digital technologies to interpret

and engage the visitor with heritage, it is perhaps in the Jackfield Tile Museum where the continuation through innovation aspect of both the Ironbridge Gorge site and of new technologies is most evident. The decorative tiles themselves signified a shift in production, from iron to the exploitation of local creativity to supply a new consumer demand. The old factory showroom itself is preserved, where once buyers would come in and select tiles. The decorative tiles are now searchable via a touchscreen in the John Scott Gallery. Visitors can now scroll through the beautiful tile collections electronically, opening up, expanding and experiencing – consuming, of course, but also reflecting upon shifts in industry, art, and heritage itself.

Project websites: *www.ironbridge.org.uk, www.birmingham.ac.uk/schools/historycultures/departments/ironbridge/index.aspx, www.birmingham.ac.uk/facilities/digitalhumanitieshub/projects/demonstrator/index.aspx*

Image: De Morgan Tile, John Scott Gallery (Jackfield Tile Museum)

Artists in the technosphere

Technology's progressive saturation of our world and our life is increasingly coming under the scrutiny of artists. Ars Electronica produced an exhibition in 2015 in Linz, Austria, that elaborated on the connections between art and technology. The show, entitled technē, focused attention on an Ancient Greek concept that has had a formative influence on Western philosophers' understanding of art, science and technology to this day. Technē, which can be rendered as skill, craftsmanship and technique, indicates just how inseparably connected art and technology were in Antiquity. The fact that an increasing number of artists nowadays have more technical skills at their disposal—as do people in general, of course—raises the question: Do artists' conceptions of self change as a result? In other words: what influence do artistic engineers or technically savvy artists have on our understanding of the world? They make us aware that we still have not come up with an explanatory model for the highly complex interrelationships of our world and our environment. They demonstrate that our thinking cannot be understood as the movement of a clock, since cause and effect have become blurry. In the wake of technique and technology, we have ended up in the technosphere in which simultaneity, pervasive networks and space are the operative concepts. What does this mean for our thinking and our language? What does it mean for our bodies? What does it mean for our environment?

Six outstanding works by young artists in Linz have been selected to be shown at Digital Design Weekend in London. These creative individuals take highly dissimilar approaches to presenting their various takes on issues having to do with the technosphere. Linda Kronman (FI) and Andreas Zingerle (AT) of KairUs Kollektiv came up with a mode of reflecting on knock-offs and the power of the imaginary: assembling a collection of fake firms and merging them into a family of brands charmingly dubbed Megacorp. Stefan Tiefengraber's work your unerasable text also purports to be something it is not. Data is seemingly transmitted only to be immediately deleted. But why do we believe that the data really was erased? The works by Verena Mayrhofer and Yen Tzu Chang are accounts of everyday household objects and their linkages to a virtual environment: Verena Mayrhofer rummaged around in the past to create Draw:er, a sound installation disguised as a traditional spice rack, while Yen Tzu Chang plays futuristic music on her Retro Product-Vacuum Cleaner Instrument. Dawid Liftinger creates a space for acoustic and visual experience triggered by the brilliant bursts of electronic flash units. Blitzlichtinstallation #1 seems to be controlled by algorithms and chance—an apparent discrepancy? Same goes for the works by Jochen Zeirzer, whose machines are programmed so as to repeatedly conduct the user to the boundaries he shares with the machine; and if the machine doesn't want to be shut off, then

you basically just have to resign yourself to that fact – unless you pull the plug or cut the flow of power in some other way. What importance is attributable to the human being who disrupts the machine?

Art, technology, society. Since 1979, Ars Electronica has been investigating how they're interrelated and where they interface, identifying primary causes and effects. The ideas that emerge here are innovative, radical, and offbeat in the best sense of the word. They influence our everyday lives, our lifestyles and ways of life every day. The Ars Electronica Festival as test environment, the Prix Ars Electronica as competition of the best and brightest, the Centre as year-round presentation and interaction platform, and das Futurelab as R&D facility have branched out into all directions of science and research, art and technology. Ars Electronica's four divisions inspire one another. They form a unique cycle of creativity designed to put visions to the test, an integrated organism constantly reinventing itself.

The works featured at Digital Design Weekend are by students in the Time-based and Interactive Media and the Interface Culture programmes at Linz Art University. Part of Ars Electronica Linz's mission is to nurture young local artists and to exhibit their work internationally.

We would like to express our sincere thanks to Irini Papadimitriou of the V&A for the invitation, and to the Austrian Cultural Forum in London for the support provided to the participating artists.

Project website: *www.aec.at/export*

"Let's talk business" and "Megacorp" – examples of artistic anti-fraud activism

Image: Let's Talk Business, Linda Kronman & Andreas Zingerle (www.kairus.org)

General tactics of advance fee fraud can be traced back to the early 16th Century, where face-to-face persuasion known as the 'Spanish prisoner scheme' was widely used to trick victims. Confidence tricksters would approach potential victims to tell them that they were in correspondence with a wealthy person, who was imprisoned in Spain under a false identity. The scheme continued when the trickster raised money to bail out his friend and promised financial rewards to gullible supporters who could help him to reach the requested security deposit. Once money was exchanged, complications arose and further payments were requested until the victim ran out of money. Over centuries, the basic scheme has adapted to new modes of communication: letters, telegraph, fax, phone and internet.

There are online communities of so-called 'Scambaiters' who fight back against online criminals. The act of scambaiting arose as a counterattack to '419 scams'. This online vigilante community of scambaiters investigates scam emails and implements social engineering techniques to document, report or warn potential victims. Scambaiters are anti-fraud activists who often use similar tactics as scammers, e.g. using social engineering methods to uncover practices of internet scammers.

Scambaiters have their own personal motivations to justify their actions. Their motives can range from community service and status elevation to revenge for being a victim of a similar scam in the past. Through the documentation and sharing of these plots, scambaiters waste the scammers' time, exploit their resources and raise awareness about online fraud. They organise themselves on forums like www.thescambaiters.com or www.419eater.com, the latter with over 62,000 registered users from all over the world. These forums focus on everyday scam types, and members follow their own strategies and ethics when in contact with scammers.

Recent publications that address scambaiting communities mainly focus on how scambaiters humiliate scammers, e.g. by posting ridiculous photos of them on online forums and putting them on a 'virtual pillory'. In our research, we found that the strategies to fight online fraud go beyond public shaming. Over the last few years, we followed these communities and created several media art installations which show the activist methods of scambaiting communities. In the following paragraphs, we want to present some of our recent works which relate to strategies and technologies used in scams and scambaiting.

Let's Talk Business

Let's Talk Business is a multi-channel audio installation which enables the visitor to listen to scammers who try to lure potential victims into advance fee payments. Their phone numbers were extracted from a scam email database, analysed by country, and categorised by scam scheme. Once potential victims called them, the scammers had the chance to tell their persuasive stories. Using SPAM-cans as listening devices, the visitor can listen through the scam stories of once-in-a lifetime business opportunities, distant relatives' beneficiaries,

big lottery fortunes or helping people in need. A SPAM-can with two buttons allows the visitor to be connected with random scammers and puts their persuasive abilities to the test. According to Merriam-Webster's dictionary, the naming of unwanted mass advertisement as 'spam' originates from 'the British television series Monty Python's Flying Circus in which chanting of the word Spam overrides the other dialogue'. The sketch premiered in 1970, but it took until the 1990s for mass emails, junk phone calls or text messages sent out by telemarketers to be called 'spam'. While most of the scam emails tend to end up in the SPAM folder, we chose to mediate these stories through physical SPAM-cans.

In many of today's fraud schemes, phone numbers play an important role. Fake businesses or personas can appear more legitimate, and the phone numbers enable a faster, more personal contact to the victims. When scammers set up a fake email address at free webmail services like Gmail or Outlook, popular VoIP services like Google Talk or Skype are included and can be used for free. These tools enable the scammers to hide their identities with fake names and bogus business websites. With the analysis of a sample probe of 374 emails, we wanted to see which business proposals are commonly used and how believable their proposals sound, once we contacted them by phone.

Megacorp

In the last few years, the web has been increasingly used for end-user e-commerce to buy goods and services. As our everyday consumption activities move online, the number of deceptive websites grow. According to research, fake websites comprise nearly 20% of the entire web, and 70% of '.biz' and 35% of '.us' domain pages analysed in a sampling of 105 million web pages were fake. Scammers use them to pose as trustworthy and professional, with the intent to trick people. An anti-fraud activists' group called 'Artists against 419' hosts the biggest open-access database of fake websites. As of March 2016, this forum has over 4,800 registered users and, on average, 35 fake websites are reported each day.

Our research of the 'Artists against 419' database led to a broader investigation of how this community tracks fake business websites and reports them. Additionally, we wanted to visualise the database by collecting a sample of 1,000 fraudulent companies under the umbrella of one big evil corporate conglomerate that wants to take over the world. Inspired by its equally powerful counterparts in science fiction, we decided to call it Megacorp. The term was coined by William Gibson and inspired many other authors of the dystopian cyberpunk science fiction genre to create megacorps in their fiction, amongst others the Tyrell corp. (Do Androids Dream of Electric Sheep), Encom corp. (Tron), Weyland-Yutani (Alien series), Cyberdyne Skynet systems (Terminator).

Megacorp. visualise the overall business segments and countries where these fraudulent businesses claim to be present. As part of the project, an interim report was published; and in an exhibition set-up, visitors have the chance to browse locally through the repository of fraudulent websites. Additionally, a corporate presentation video and a location reconnaissance video reflect both the imaginary and the real world outreach of the Megacorp.

To reach the sample of 1,000 companies the data-gathering process took several months. From September 2014 to April 2015, the aa419-database was visited on a daily basis and websites were automatically downloaded using a site scraper tool. The scraped websites were analysed and categorised according to business segment, street address, used colour, registered city and country. Once we reached our goal and gathered 1,000 companies, we grouped our initial 20 business segments down to 10. Great deals of our holdings are clones of existing companies' websites published under non-legit domains. These websites, especially in the Banking & Finance segment, are used for phishing; and, according to the Anti-Phishing Working Group's 2H2014-Report, there were at least 123,972 unique phishing attacks worldwide during the second half of 2014, which occurred on 95,321 unique domain names. When analysing different cities and countries, we focused on the top five and examined what the division of business segments were in these geographical areas.

To visualise the gathered data and to tell a compelling narrative about the fake business conglomerate, we decided to re-enact a corporate presentation in the form of a fair booth. To achieve this, we highlighted the main parts of the data visualisations on roll-up posters and created a corporate image showreel that provided a fast overview of key figures and the global outreach. We presented all the gathered material in the form of an interim report; and on a website, visitors can browse through the 1,000 acquired companies alphabetically, sorted by country and by business segment. Another video showed some of the companies' websites and our attempt of physical reconnaissance, where we visited the addresses where the companies claimed to have their headquarters to see what is actually there. During the 'credible fiction – deceptive realities' workshop, we extended this video with a virtual reconnaissance of companies' addresses. In the media competence workshop that was tailored to test the anti-fraud activist tools with diverse participants, we mainly used Open Street Map, Google Maps and local company registrars to figure out which companies are registered at certain addresses. The collected screenshots were added to the existing video, adding the outcome of the workshop to the exhibited installation.

By combining art and scambaiting, we consider our works as a type of artivism, a genre where art and activism fuse. The presented artworks have been exhibited at festivals, in galleries and at academic conferences. They also function as a basis for discussion to raise awareness, as we have presented them as case studies in a series of workshops that we organise in various contexts. The research and exploration of various scambaiting methods for the artworks have given us a wider view on what scambaiting can be. A

reflective scambaiter with the right intentions can be seen as a disruptive anti-fraud activist who jams the scammers' workflow and alerts potential victims by exposing the scam schemes. This can be done in discussion forums by collecting databases of dubious emails and websites as well as through artworks. Scams and fraud have been around for a long time; this dark side of the net will not disappear. While actors are diverse and scam strategies continue to evolve, we need to constantly review our approaches to scams, scammers and scambaiting.

KairUs is a collaboration between two artists: Linda Kronman (Finland) and Andreas Zingerle (Austria). Their work focuses on human-computer and computer-mediated human-human interaction with a special interest in transmedia and interactive storytelling. Since 2010, they have worked with the thematic of internet fraud and online scams, constantly shifting focus and therefore approaching the theme from a number of perspectives. Subjects of their research are online scammers, vigilante communities of scambaiters, and their use of storytelling and technology. Besides the artworks, the artists also publish research papers related to their projects; and through workshops, they contextualise their rather focused research topics in broader discourses such as data privacy, activism and hacking culture, ethics of vigilante online communities and disruptive art practices.

Image: Let's Talk Business, Linda Kronman & Andreas Zingerle (www.kairus.org)

Your unerasable text

Image: Your unerasable text, Stefan Tiefengraber

Easy, uncomplicated interaction with interactive art installations, and an entertaining approach to attract visitors, opens up room to learn the story behind the art. These are the main goals of Stefan Tiefengraber's projects and a big part of the introduced work your unerasable text. Visitors are invited to print out and shred a text message they have sent to the installation. The installation is available for 24 hours and can also be operated by users not in the venue, creating an independence of opening hours. Your unerasable text is easy to interact with – users just need to send a short message to operate the installation. Behind this surface of fun and interactivity, the user is invited to question the background of these technologies. Why do the pieces work this way? What data is generated? Who has access to it? Where is the data?

Your unerasable text is an interactive installation dealing with the topics of data storage and elimination. The installation can be placed in an exhibition, but is ideally exhibited in a window in public space, where it can be used by people passing by, 24 hours a day.

The participant is asked to send a text message to the number written on a sign next to the installation: `send your unerasable text message to +43 664 1788374'.[1] The receiving mobile phone transfers the data to a computer, which displays the message automatically. It is then printed on to DIN A6 paper, falling directly into a paper shredder. There, the message remains readable for a few moments and is then destroyed. The shredded paper forms a visible heap of paper on the floor, growing with every message.

Your unerasable text works via SMS, as it is the easiest and most familiar method for the participant – and almost everybody owns a mobile phone. The standard for the short message service was implemented in the early 1990s and is still used and integrated into every mobile phone, even smartphones. Another advantage is that users don't have to be close to the installation – messages can be sent from all over the world, and they don't need any additional software or access to the internet to participate.

When your unerasable text is used, the sent text message isn't erased. The data is passing through the mobile carrier of the sender and receiver, the mobile that is integrated in the installation and the computer processing the text and sending it to the printer. At each of these points, the data can be saved. The installation stores a file of each message, consisting of the sent text, the phone number of the sender, and the time and date when it was sent. The only part which is actually is erased is the print, which is just a visualisation having no effect on the data itself.

[1] *– phone number of the exhibition "Out of Control" in Ars Electronica Centre Linz / Austria – ongoing*

The storing of data is a rather current topic, given the discussions on bringing back the Vorratsdatenspeicherung (data preservation) in Germany, along discussions in the Austrian parliament about passing the 'Staatsschutzgesetz' (state protection law), including points to bring back the previously overturned 'Vorratsdatenspeicherung', under the guise of this new law.

Also, very recently, the Safe Harbor law was declared illegal by the Court of Justice of the European Union, creating the need for renegotiation between the EU and the US to change this law.

This also raises questions about the locations of the servers we are using and the law applied to the data stored on hard drives all over the world. There has to be a definition of who legally has access to our data and who is able to pass our information onto third parties.

By the end of June 2016, more than 40,300 short messages were collected.

Project website: *www.stefantiefengraber.com/yourunerasabletext.php*

From the machine room

The kinetic sculptures ABANICO and COIN are part of a series of anthropomorphous machines, which have so far been shown under the summary title 'TRIVIAL MOTION'.

The title of the series 'TRIVIAL MOTION' refers to the original event, so to speak –the moment of inspiration, from which the individual works originate. These are often everyday situations, in which a movement or action that at first seems incidental is shifted to the centre of attention; and for this one moment, everything else around it becomes merely a framework. This may be opening up a Spanish wooden fan (abanico), for example, where the noise generates a vacuum, in which all the other familiar impressions of a well-attended summer party with loud music suddenly recede to the background, or a coin falling through a coin slot again and again, forcing the actor dying for coffee into a machine-like endless loop from which there seems to be no escape, and in which this person suddenly begins to act like a mindless machine.

The machines themselves are developed around the central 'finding' of each of these situations. Similar to some types of birds, the robot ABANICO uses the aforementioned fan as an instrument of coquetry and communication. If visitors cross the machine's field of vision, they are recognised by sensors, and the machine unfurls a wooden fan, carrying out a classic gesture for attracting attention and favour. COIN, on the other hand, does not depend on interaction with people to function. Trapped in a monotonous endless loop, it tosses a coin into its own coin slot again and again. Repeatedly, the coin falls through, until the machine malfunctions.

These art machines are constructed on the principles of reverse engineering, and what they all have in common is the motif of the ambivalent relationship between human and machine. Starting from these movements and actions which initially appear banal and trivial, isolation, repetition and mechanisation result in ironic, poetic and humorous situations, which may be perceived at first glance as meaningless or absurd. Indeed, the machines created by the author do not serve to produce identical products or to save time and production effort, as conventionally expected. Instead, they engender projection surfaces, which enable a reflection on technology, the relationship between human and machine, and our technologised culture.

In their pre-programmed processes, it is easy to recognise gestures which have become so automatised in our everyday life that they can no longer be distinguished from the movements of a relatively simple machine. They visualise that to the same degree humans have automatised their environment and working processes; these do the same with the humans themselves. We are subject to daily, weekly, even lifelong routines which ultimately make essential

aspects of our actions appear no more interesting than the interlocking mechanical components of a machine.

The work T2 is an homage to the mathematician Claude Elwood Shannon, a reduced interpretation of his ‘ultimate machine’. This is a machine which appears to interrupt its routine and resist the task assigned to it. In fact, however, the opposite is the case. Until its batteries are exhausted, the machine precisely carries out its specified function, which consists solely of turning itself off every time it is turned on. In light of the wholly incalculable effects that the foreseeable development of artificially intelligent machines will undoubtedly have on human society, the idea of a machine that would actually prefer not to is highly amusing and liberating.

Image: Abanico, Jochen Zeirzer

Retro Product – Vacuum Cleaner Instrument

Retro Product– Vacuum Cleaner Instrument is a hybrid project which mixes analogue and digital sound, and is displayed as an experimental sound performance. It is not just a hacking of daily life machine, but also creating nostalgic atmosphere from the point of the future.

The vacuum cleaner has, since the 19th Century, been one of the most widely used household products – but it can make a loud noise. If we search the sound of household products on the internet, it will show vacuum cleaner sound sources for hours, since they are regarded as a kind of white noise for those people who just want to relax or sleep well. Under this circumstance, the noise of the vacuum cleaner is not negative anymore – it is transferred to positive.

However, as more and more domestic products are improved, sound reduction is one of the targets. Household machines' abundant sounds are gradually disappearing from our daily life, and the vacuum cleaner is not excluded. Instead of a typically noisy one, customers can nowadays only get a low-noise vacuum cleaner with automatic features. In other words, our familiar sound world is disappearing.

In the future, vacuum cleaners may be a symbol of old, decayed machines. Therefore, this work imagines a future approach to reproducing rare and nostalgic sound.

Typically, we record the sound to keep the sound. But what if, instead of recording, we recycle the sound-maker and transfer it into an art work or an instrument? By means of it, we record more than sounds – we also record its entity and our experiences. This is the basic conception of Vacuum Cleaner Instrument.

How to change a vacuum cleaner into a music instrument? Retain the original part which makes the sound, but release the rest from their original purpose to make other sounds. Based on the core of an old vacuum cleaner, the inner part of the system is modified into a combination of a vacuum cleaner and the reed part from an accordion. The external casing and controls are redesigned, and all the components can be collected into a leather bag bought from a flea market.

During the performance, audiences can hear the original noise of the motor from the vacuum cleaner. Moreover, when the air flows through the accordion reed, audiences hear a special melody. What's more, Arduino, relays, ultrasonic sensors and some electronic materials control motors and connect the interface like a MIDI controller. By pressing the keyboard on the Vacuum Cleaner Instrument, microphone-recorded analogue sounds are sent to Pure Data to be processed and remixed and finally played from speakers. In a nutshell, there are three elements of sound – the motor sound from the vacuum cleaner, the sound from reed, and the live-remix of motor and reed. With this nostalgic soundscape and dense atmosphere, audiences can enjoy abundant sounds from Vacuum Cleaner Instrument.

www.changyentzu.com

Image: Vacuum Cleaner Instrument, Yen Tzu Chang. Image courtesy of the artist

Draw:er //16

Image: Draw:er //16, Verena Mayrhofer

The Alps, Mozart, Wiener Schnitzel, ‘The Sound of Music±– typical images that usually pop up in people’s minds when they think of Austria.

Having conversations with strangers who had never been to Austria, I was confronted by numerous stereotypes which are now collected as interviews and sorted into acoustic documents neatly arranged in a spice rack.

You could find such spice racks in so many kitchens in Austria up to the 1960s. It was nostalgia which made me choose this kind of interface. People feel kind of safe when they imagine the past, as it is mostly a place where you know what to expect; a place where life is well-ordered, simple and comprehensible, far away from the challenges of the 21st Century. Parallel to complex technical gadgets, people are looking for (seemingly) traditional values so that they might escape global changes. These range from fashionable traditional clothes to cottage furniture to food labels displaying ‘return to origin’ offered by large grocery chains.

If someone from another country talks about your own nationality, do you take it personally even if you’re not a patriot? Are there stereotypes you know very well or that you have never even heard of? The interviews are translated and recorded to (Upper-)Austrian dialect. How does it feel when they speak in Austrian dialect? Are you nevertheless able to recognise where these people come from when they speak about Austria in Austrian dialect? And if you are not a speaker of Austrian dialect, how does it feel to know that they are talking about stereotypes and to understand little or nothing? Do some words sound familiar to certain words in your own language?

The participants are invited to open the drawers and listen to the prejudices in their individual order or to mix the different recordings to a babble of voices.

I spoke to people from Namibia, New Zealand, Japan, Canada, Chile and Hawaii, as well as to Europeans from Italy, Great Britain, Latvia and Romania. I made an effort to conduct interviews about Austria with people from a variety of regions worldwide.

In the “//16” version, I added Interviews with asylum seekers who are housed in Linz at the moment. For these interviews, there was a slight change in the questionnaire. I asked them what they expected before they arrived and what kind of surprises they have experienced regarding Austria and Austrians so far. The political situation has changed a lot during the last two years; in Austria, in Europe and the world. These are changes which I can’t ignore when it comes to a project about stereotypes and nationality, because these terms are getting bigger and bigger these days and the Austrian stereotype might have changed a bit during (the) last year(s) .

Draw:er //16 is a spice cupboard audio installation. The project was built in 2014 as a part of my Bachelor Studies ‘time based and interactive media’ at the Kunstuniversität Linz (University of Arts Linz).

Flashlightinstallation #1

Flashlightinstallation #1 is an installation which explores electronic flashes as an artistic medium. 64 modified electronic flashes form a hanging 3D matrix in a pitch-black room. Entering the room activates the flash modules. After a short delay, the flashes are triggered in a random fashion, again and again. The driving rhythm of the popping of the flashes turns the room into an intense audiovisual experience space. The installation is non-interactive, but participants are invited to walk freely through the installation and are welcome to stay inside the room as long as they wish to.

The main emphasis of the work was to create an environment using electronic flashes, find out the impact it has on the participants and also isolate the possibilities and/or limitations inherent in this light source. Foremost, Flashlightinstallation #1 is designed to stimulate the visual senses. Experiencing this space can possibly trigger colour visions, can influence the sense of balance and may create a feeling of dizziness. Triggering the flashes in a random fashion adds to the confusion. This could result in the participant being overwhelmed. If experienced with another person, the flashes will create an interesting and intimate shadow-light show on the opposing person.

Sound plays a vital role in this experience. The type of flash used in this installation emits sounds. More precisely, when the capacitor is loading, it creates a high-pitched noise that slowly fades away. If the flash is triggered, the rapid discharge creates a zapping/cracking sound.

The electronic flashes were recycled from old disposable cameras. They have been modified so as to be controlled via Arduino and triggered via relays.

One of the main themes of my light-related works is simply to turn light on and off. Following that theme, in 2012 I found myself on my way to East Asia – precisely, onto the island of Taiwan. I came to find quite a range of sound artists in Asia, working with artificial light as an integral part of their performance, or even as part of the sound-creating process. This can also be seen in the increasingly vibrant sound art scene in Taipei. Two of the most notable artists from there are Wang Fujui 王福瑞 and Yao Chung-Han 姚仲涵.

So, after getting started using regular light tubes for my artistic output and creating a performance called ‘Sound and Light’, I was eager to create a more unique artwork. After researching light art, I quickly realised that light tubes as an artistic medium are already well established, and they could be considered as an ‘old’ medium within this branch of art. Even as early as the 1960s, Dan Flavin, one of the most influential minimalists, used commercially-available

fluorescent lights. So in search of a 'new' medium, I stumbled upon electronic flash. Unlike fluorescent tubes, the electronic flash, or even the strobe light, as a medium to create light art is much less established.

With that in mind, I started creating Flashlightinstallation #1 and plan on creating new works using electronic flash as the main component.

Flashlightinstallation #1 was funded by Art University Linz. Thanks to Dr Funk Gerhard, Mag.art. Smetschka Joachim, Göttfert Gregor BA for their support.

July 2014
Audiovisual Installation, 3m x 3m x 2.7m
64 x modified electronic flashes, Arduino, relays

Image: Flashlightinstallation #1 by Dawid Liftinger. Photo: Florian Voggeneder/AEC

The Austrian Cultural Forum London

The Austrian Cultural Forum London is both a venue and a meeting place for artists of all kinds. We promote cultural contacts between the UK and Austria by organising, initiating, facilitating and supporting artists and projects in the fields of music, performing arts, visual arts, literature, film and science.

While not brushing aside tradition, the focus of our programme is on contemporary work by younger creative minds from Austria and the UK. This is why we are proud to present some of Ars Electronica's young artists at the Digital Design Weekend at the V&A and at the Austrian Cultural Forum London.

The Austrian Cultural Forum London (ACF) is turning 60 this year and we are taking this opportunity to celebrate all the artists, poets, musicians, authors and academics who have come through the doors of 28 Rutland Gate over these six decades.

Austrians feel passionately about their identity as a Kulturnation (cultural nation). At a time when issues of national identity are hotly debated, we can contribute to this discussion with a contemporary programme that goes beyond stereotypes. Austrian identity at the beginning of the 21st Century is also one of strong pluralism in a shared European identity that has always been shaped by strong cooperation and exchange throughout the continent. In this spirit, we embark on this current Anniversary adventure, saying a big 'Thank You!' to our partners and audiences, past and present.

Project website: *www.acflondon.org*

Ingenious and Fearless Companions

Image: Robot autopsy at Birmingham Open Media. Photo: Ian Jukes

This project artistically explores the search for life at the edge of space: the excitement of a rocket launch; the horror of a failed parachute; the despair of a crushed robot; and the pleasure and pain of curiosity-driven research.

It chronicles the work of the High Altitude Biospecting (HAB) team through a series of installations, first exhibited at BOM (Birmingham Open Media) in April 2016, incorporating video-mapped archive films and sculpturally-altered relics, such as weather balloons, environmental samples from the Black Rock Desert, extremophile bacteria, and the remains of the robot wrecked by its fall into the Black Rock Desert which was autopsied in a unique performance. The HAB team comprises Dr Melissa Grant, Dr Oliver de Peyer, Dr Paul Shepherd, Alex May, Kira O'Reilly and Anna Dumitriu.

Ingenious and Fearless Companions explores the adventure of curiosity-driven research through a quest to find microscopic life in space. The title is taken from a letter from French poet Victor Hugo to chemist and aeronaut Gaston Tissandier (1869) on the future of 'air navigation' to our hybrid ways of working across science and art. It is also a reference to the bacteria that travel into space inside and on the bodies of astronauts and spacecraft, as well as the extremophile bacteria that the HAB team have been seeking in the upper atmosphere.

The High Altitude Bioprospecting team first began to form in 2008 when de Peyer, Shepherd and Grant met at a NESTA event, called Crucible, designed to bring together innovative early-career researchers across disciplines to solve complex challenges. At the end of the year-long programme, participants were encouraged to put together bids for research seed-funding. Having listened to de Peyer's fervent desire to build remotely-operated robots, the group began to wonder what would be the best challenge to tackle and de Peyer immediately replied that he wanted to try to detect microbes in the stratosphere! He had previously worked as an intern at NASA Ames with Professor Lynn J Rothschild and was keen to expand this research. Their funding application was successful and they began the design of a helium-balloon mounted device to test for microbes in the skies above the UK. Uniquely, in comparison to other efforts in the field, they aimed to detect the microbes in situ – that is, whilst in flight, rather than the more usual approach of testing once samples were returned to the ground. In-situ testing would eliminate some of the risks of contamination, which can lead to 'false positives' where any microbes detected could have come from their trip from the ground to the testing lab.

Why would anyone want to do this? There was the possibility that any microbes they find might have useful properties that could be exploited. For example, any microbes which have evolved mechanisms to defend themselves from the strong ultra-violet sun rays could be adapted to make strong sunscreens for humans. Another motivation was that the device itself, once proven, could be modified to detect pathogens remotely, in places too dangerous for humans.

Shortly after the design process began, de Peyer received a call to say there was going to be a week of amateur rocket launches in the USA in the summer of 2010. Could they have their device ready to fly on a rocket in 6 months? Well, of course the team said 'yes'! The race was on to create the device, figure out how to control it, develop biological techniques to detect microbes in situ, and get on with their day jobs. At that time, Kira O'Reilly was artist in residence in the same lab as Grant, and through this connection, Anna Dumitriu came to work in the lab to create an art intervention by trying to communicate with microbes in the atmosphere using homoserine lactone hormone, building on a previous project where she communicated with the bacteria of the Earth. And so, the wider art-science collaboration was born, with digital artist Alex May joining the group shortly after.

The second half of the story takes place in the Black Rock Desert (Nevada, USA), where de Peyer, Shepherd and Grant ventured with Rachel Brazil from NESTA and two A-level students, Rainbow Lo and Joe Campion. They worked with researchers from NASA Ames research centre and with 'The Rocket Mavericks', a team of well-funded rocket enthusiasts who allowed HAB to fly on one of their rockets. Over the course of the ten-day trip, the team experienced the extreme heat and dust of the desert each day and sleeping under the Milky Way every night.

The finished HAB device was first tested on a weather balloon, reaching 28km above the surface of the desert. After a few false starts (and nearly setting the HAB device on fire), on 19 July at 3.00pm it was time to launch the HAB device on a rocket. Given the rush to reach this point, it was an incredible feeling for the team to strap their hopes onto a small, homemade, metal and plastic rocket and launch them towards the stratosphere. Forty two seconds after the rocket left the surface of the desert, it reached its peak at 8km and began to return to Earth. However, in the haste to get ready in time for the launch window, the rocket's parachute had been packed incorrectly, and was missing its smaller 'drogue' parachute used to drag out the main parachute. This meant that the rocket plummeted to the ground largely unhindered, with its torn and tattered main parachute streaming behind and providing very little drag. The HAB device met its demise as the rocket's nose cone was buried into the ground and HAB itself was squashed against the rocket casing by its more heavy robust components (batteries and relays). The official recorded time of death was 10.02am on 22 July 2010, when the team finally found time, and sufficient motivation, to test any of the remaining electronics to see if HAB's data could be recovered.

Despite setbacks, the team's excitement about their dream to sample bacteria that genuinely comes from the edge of space has not wavered and the next HAB mission is now in development, using the latest technologies such as 3D printers, robotics, rocket science, DIY biology and cutting-edge DNA analysis tools.

Project website: *www.unnecessaryresearch.tumblr.com/IFC*

Considerations on Michaela Davies

Engineering and extending the human body beyond its normal limitations has been a source of fascination for millennia. More recent expressions of this include plastic surgery, medical (and other) prosthesis, biohacking, and – in cross-disciplinary artist Michaela Davies' case – electric muscle stimulation. This technology allows electrical impulses to be sent to the muscles to generate specific involuntarily movement of the limbs.

Davies' work challenges many of the traditional perceptions of what it means to make music, to be a performer, and perhaps ultimately, what it means to be human. Her use of electric muscle stimulation, delivered to performers by way of MIDI [Musical Instrument Digital Interface], seeks to provoke her audience into considering the implications of a system where performers are willing to voluntarily participate in a performance that involves the involuntary body – muscles which are forced to contract and move based on Davies' compositions, conducted by a computer. The content of Davies' work addresses itself to a series of provocative questions, ranging from the personal and social consequences of automation, the reductionist theory of technological determinism, and transhumanism – even pain as a vehicle for pleasure and the fetishising of dominance and submission. By means of science and technology, the medium of electric muscle stimulation allows participants to form relationships on the most superficial level, and also the most intimate. Cyborg String Quartet and Duty create collective structures that determine the success of each piece – one missing link and the system crumbles. Although seemingly isolating, collective involvement takes precedence.

In Understanding Media, Marshall McLuhan famously discussed how machines alter relationships to one another and to ourselves. His point could not have been more prescient, given the 24/7 culture we live in and our dependence on technology. Cyborg String Quartet and Duty depend on the modalities of science and sensory awareness in order to understand that the `medium is an extension of ourselves'. Although each performer is receiving the electrical impulses sent to their muscles, it is important to remember that each performer still has some control over themselves and their physical function, including how tightly they grip the bow or bell. However, the performer must let go of their preconceived notions of what it is to be human when working with Davies. The experience is not just about the human as a somatic instrument, but more importantly, how the medium allows each performer to experience new forms of expression, ways of being, and relationships to other physical bodies.

The human body is resilient and capable of adapting to most external and foreign stimuli, allowing shocks to evolve from momentary trauma to an almost normal function of the body's design and its usual behaviour. In each of these instances, Davies creates an organic sound sculpture, linking each performer in order to execute inhuman and involuntary movements at changing velocities – unnaturally fast movements the performers would not be able to achieve of their own volition. Sometimes the most vulnerable state allows for an understanding of one's full potential.

This project was supported by the Museum of Contemporary Cuts, and the Australian Council for the Arts, and made possible by the curatorial effort of Irini Papadimitriou (Programme Manager, V&A Digital Programmes) and Lanfranco Aceti (Director, Arts Administration at Boston University).

Image: Involuntary Quartet (2013), Michaela Davies. Image courtesy of the artist

Theatre of Things

Yuko Mohri produces strange little worlds; theatres of things. Mohri creates idiosyncratic kinetic installations out of found objects, taking readymades and remaking them into curious circuits.

Primarily an installation artist, Mohri recasts reconfigured everyday items and machine parts that she collects in cities around the world, fashioning them into self-contained 'ecosystems'. Previous installations have seen Mohri connect together lampshades, bicycle wheels, rubber gloves, dusters, hosepipes and musical instruments, to name just a few. Her installations are frequently free-form – they might spread over the gallery floor, across the wall or, more recently, set into a two-dimensional frame.

In whichever configuration, one constant is Mohri's introduction of an unexpected element – perhaps an electrical current or a flow of water. Mohri frequently looks to her built environment for inspiration, where systems that structure our daily life – transportation, rubbish collection, energy provision – might not always function like clockwork.

Mohri has been working on her series Moré Moré [Leaky] since 2009. A long-time resident of Tokyo – where Mohri continues to live and work – the artist became fascinated by the makeshift repairs to water leaks in Tokyo metro stations. In a city otherwise dominated by elegant technological structures and solutions, the decidedly low-tech 'accidental systems' constructed by station staff to halt the flow of water are viewed by Mohri as a form of bricolage. Mohri has since produced a range of kinetic installations inspired by this, in which she wires together found materials to contain flowing water.

Mohri's series Urban Mining employs the same logic of extrapolating systems around her and creating new whimsical versions. In a recent iteration of the work, Mohri displayed a series of small sculptures comprised of materials recycled from the built environment. Electrified crushed aluminium cans are wired up to model street lamps that illuminate only irregularly; the recycled wires can only complete the circuit when pushed by air currents.

In each work, Mohri recasts systems – leak repairs and streetlights – into new, eccentric circuits where found objects act as intermediaries, persuading environmental forces such as light, gravity and air currents to act upon them. Mohri makes visual the system as much as the objects that are part of it. More than a recontextualisation of the objects she collects, Mohri forces these objects to somehow work together. Yet the artist builds in an element of contingency.

In fact, Mohri likes things to go a little wrong. With an artistic background in new-media art, Mohri's practice engages with circuits and connectivity. She is interested in programming an error into her (decidedly analogue) circuits, but not through her own human intervention. She states that: 'I prefer gravity, magnetism, light, and wind to control my work.' Mohri positions forces such as gravity and electricity as otherworldly and unpredictable.

Mohri's art allies itself to debates in new materialist discourse. 'New Materialism' can be characterised by a diverse set of approaches working against anthropocentrism, principally through an emphasis on inhuman forces within human systems. Mohri's installations also insist on the powers of the nonhuman and the uncontrollable. The artist establishes her systems and then steps back, relinquishing her agency – her circuits are left to their own devices.

With such a coherent philosophical and artistic approach, Mohri's work is remarkably diverse in appearance, scale and material. This stems from Mohri's commitment to research and sheer inquisitiveness. Mohri seeks to bring together found objects, art histories and diverse points of reference in constantly shifting, tinkering installations. For example, in previous sound-based assemblages, Mohri's approach has alluded to experimental composers Erik Satie and John Cage. The artist's most recent iteration of Moré Moré [Leaky] – for which she won the Nissan Art Prize – entered into conceptual dialogue with Marcel Duchamp's The Large Glass from 1915, itself a work characterised by diverse reference points and in-depth research.

Mohri's residency at the V&A during Summer 2016 allows her to continue her wide-ranging research. Mohri has been investigating the South Indian collection ahead of her participation in the Kochi-Muziris Biennale in December 2016, and more generally into methods of display and categorisation.

Mohri, as an artist, is a collector – of influences, materials and references. The restless quality of her practice reflects her spirit as an artist. There's something of the mad scientist about Mohri's artistic approach, which at its base reflects her openness to new ideas and ways of working. Mohri's art and life seem bound together, caught up in her theatre of things.

Yuko Mohri (b. 1980) lives and works in Tokyo. Mohri is the recipient of the Nissan Art Award 2015. Mohri was selected as a grantee of the Asian Cultural Council 2014. Her recent major exhibitions include: Yokohama Triennale 2014 (Yokohama Museum of Art, 2014), Sapporo International Art Festival 2014 (Seikaitei and Chi-Ka-Ho, 2014), Unseen Existence (Hong Kong Arts Centre, 2014) and Orochi (Gallery waitingroom, Tokyo, 2013). Mohri's upcoming exhibitions include THE BEGINNINGS (or Open-Ended) (Minatomachi Potluck Building, Nagoya), The Way Things Go (Taipei Fine Arts Museum, 2016) and Roppongi Crossing 2016 (Mori Art Museum).

Mohri is currently in residence at the V&A as part of the Digital Design Weekend, and will have a residency at Camden Arts Centre in September-October 2016. In February 2017, Mohri will have her first UK solo exhibition at White Rainbow, London.

Yuko Mohri at the V&A is supported by White Rainbow Gallery, London, in association with Nissan Art Award coordinating organisation AIT, Tokyo.

Image: Moré Moré (Leaky): The Falling Water Given #1-3,
Yuko MOHRI, Nissan Art Award 2015. Photo: Keizo Kioku

British Council UK/Indonesia

In March 2016, the British Council invited key UK producers and artists, who work in the arts and new technology, to Indonesia. It's a country which is not very well known to people in the UK, but one which South-East Asia looks towards for new and exciting work in the arts.[36] As the world's largest archipelago, with 17,000 islands and the fourth most populated country of more than 250 million people, Indonesia is a country rich in talent and creativity.

The purpose of the visit was to introduce UK and Indonesian artists and producers to each other and to explore the possibilities of working together for the UK/ID Season 2016-2018. We believe that there is huge potential in developing a good relationship where both country's arts scenes have a vast amount to gain.

During the visit, we gathered that there are two key themes that UK artists and producers found intriguing in the Indonesian Art Scene: the innate make-do culture, and collective community-based cultural practice in the arts.

To introduce this interesting aspect of Indonesian make-do and collective culture to the UK, and introduce UK maker culture to Indonesian artists, three of the UK organisations – V&A London, Maklab Glasgow and Invisible Flock Leeds – are inviting two Indonesian artists from Lifepatch and MakeDoNia to the UK for a residency.

Lifepatch and MakeDoNia are both Indonesian art, science and technology organisations based in Jakarta and Yogyakarta, and are perfect examples of this Indonesian cultural practice. Both organisations were founded without any financial support from the government and exist simply to provide artists and producers with support and a sharing platform. Each organisation has several artists and organisations under its umbrella. The artists invited to the UK are Andreas Siagian and Miebi Sikoki.

Andreas Siagian is a cross-disciplinary artist with an engineering background focusing on creative communities, alternative education, DIY (Do It Yourself) and DIWO (Do It With Others) culture and interdisciplinary collaboration in art, design, science and technology. His collective, Lifepatch, is based in Yogyakarta and uses social design methods to encourage experimental thinking and practice amongst the community.

As a trained professional in computer graphics and software programming, Miebi Sikoki aims to explore new possibilities in product designs and creative processes. In 2014, he founded digitalnativ – a digital fabrication studio –

which actively processes digital materials into products that offer interactive experiences to users.

The visits hope to create a long-term conversation and collaborative work between the UK and Indonesian art and digital scene.

More information of the British Council UK/Indonesia 2016/18 can be found on www.britishcouncil.id

***Instagram and Twitter:** @idbritisharts*

[36] *Asia Pacific's art market comes of age – Guardian, 16 July 2013, www.theguardian.com/artanddesign/2013/jul/16/hong-kong-art-basel-asia*

8-bit Mixtape

8-bit Mixtape is an open-source project on building an Arduino-compatible synthesizer using the 'Algorithmic symphonies from one line of code', better known as '1 line C music'. The project was initiated by Marc Dusseiller – dusjagr (CH), Budi Prakosa – manticore, www.lifepatch.org (ID) and Andreas Siagian – squaresolid, www.lifepatch.org (ID) from a geeking session at lifepatch Yogyakarta, Indonesia in 2013. It was started as a collaboration to create a pocket-sized synthesizer that is able to generate and modify '1 line C music' with a simple interface which allows any user to play and use it in a live performance.

8-bit Mixtape was originally developed using the Babygnusbuino from Anyma, a ridiculously small Arduino using ATtiny85. Despite its limited functionalities, ATtiny85 was considered suitable for this project. It is also relatively cheap and reliable for the simple interface of 8-bit Mixtape. The interface of 8-bit Mixtape mainly uses two potentiometers and two buttons to control, live, the '1 line C music'.

The project has grown following years with geeks such as Urs Gaudenz – Gaudilabs (CH), Christoph Stahl – Stahlnow (CH) as the core developers of the 8-bit Mixtape team. This has resulted in new variants of 8-bit Mixtape being initiated simultaneously over the years. Several variants that were developed included 8-step Mixtape – Berliner Schule (using ATtiny84), 8-bit Mixtape Classic, 8-bit Mixtape Next Level Edition (using the Atmel 32u4), 8-bit Glitchtape, Glitchtape Mixtape (using Arduino Pro Mini), and 8-bit Mixtape Pro (using Arduino Uno). The development team not only develops new codes and hardware, but also organises workshops using the 8-bit Mixtape workshop kit to introduce programming and making to the public. The core team prioritises homemade fabrication and accessible technologies.

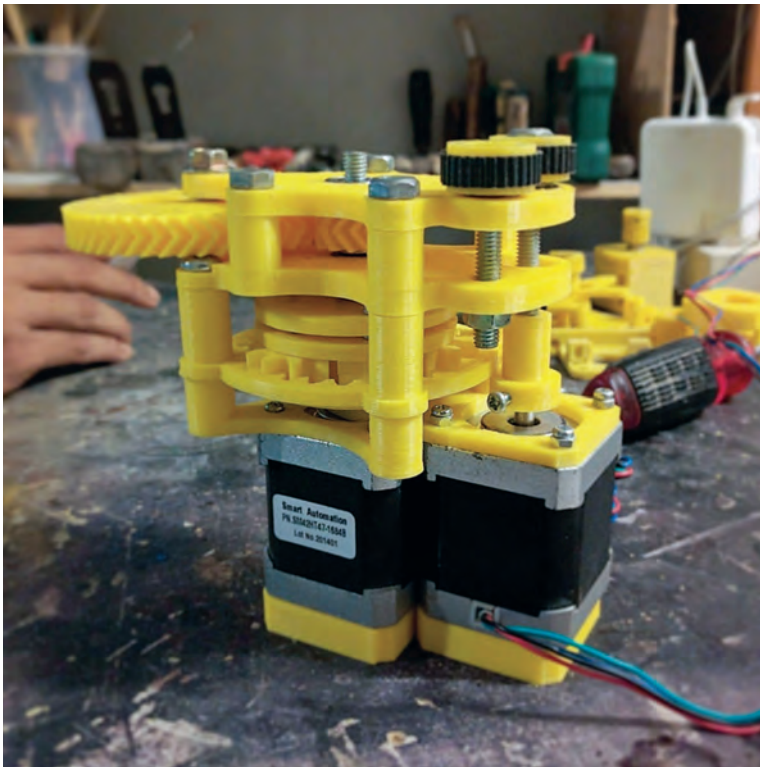
The main ideas of the project can be seen in the 8-bit Mixtape Classic Edition, using hacked audio cassette tape as the enclosure. 8-bit Mixtape Classic is a combination of low-cost, custom and homemade production with diverse enclosure using used audio cassette tapes. The 8-bit Mixtape Classic Edition uses the ATtiny85 chip as the core of the synthesizer with the original simple interface.

In 2014, the 8-bit Mixtape 0.8 was introduced as a workshop kit, with two variants developed in Switzerland and Indonesia. The workshop kit was designed with very few components and can be quickly assembled by anyone. The workshop kit is designed with a freestyle graphics Printed Circuit Board (PCB) in the form of a cassette tape and has been presented in stand-alone workshops and festivals in many countries. Since then, the workshop kit has mainly been used by dusjagrlabs, Swiss Mechatronic Art Society (SGMK) and lifepatch.

Other variants of 8-bit Mixtape are still being produced by request for synth geeks and experimental sound lovers. Other personals such as Adhari Donora – antirender, www.lifepatch.org (ID), Jelly Pin – Gynepunk (ES), Yuliana Rodriguez – Platohedro (CO) are further developing and distributing the 8-bit Mixtape projects. The core team is now preparing the 8-bit Mixtape for mass production, although special, custom, handmade versions will still be produced on request.

Project websites: *www.github.com/8bitmixtape, www.lifepatch.org/8-bit_mixtape, www.wiki.sgmk-ssam.ch/wiki/8bit_Mix_Tape*

Image: 8-bit Mixtape, Andreas Siagian, Lifepatch



LiveWire

Image: LiveWire, Miebi Sikoki

The conceptual basis of LiveWire explores the relationship between ideas and tools. Both enable each other in a perpetual Catch-22, technology advancing as social constructs become more complex.

The capabilities of computer technologies are constantly improving and spreading further into different areas of modern life. From 3D printing to CNC Routing, digital technology offers a new genre for exploring alternative digital fabrication techniques that can be used to communicate, develop and actualise ideas. This is an explicit characteristic of the place computer technology holds within our culture.

Open-source software, online 3D object repositories and the democratisation of manufacturing through 3D printing are integral to this project, as they add to the evolution of the tool by continuously changing the context of its use, keeping it in a constant state of iteration.

LiveWire is an open-source mini CNC wire bender that promotes the creation of novel structural systems through processes of digital fabrication and assembly. It can take lines and curves created digitally and replicate them in brass wire. It can output any 2D vector line and can be clipped or soldered together to create more complex 3D structures.

These sculptures are direct externalisations of digital data, captured and implicitly translated in objects that can be touched. This physicality to data layers its meaning, even triggering latent connections to its digital counterpart.

Music-making >= computer programming

Music notation is probably one of the earliest forms of sequential programming. Each note on a stave informs the performer of what action to take and the output is generally reliable and repeatable. Of course, one thing that makes music-making different from computer programming is the ability to add human expression and interpretation to the performance – adding pseudo-random events and character to the sound that is created. Nowadays, computing systems are able to introduce fuzzy logic parameters, and modern processing speeds are sufficient to enable humanised responses to be incorporated. With all this in mind, it's no surprise that collaborations between computing and musical experts have resulted in wild and wonderful innovations that unlock new forms of musical expression and creativity.

Music programming has increased exponentially with the growth of computers since the 1950s. Early approaches to music programming included Daphne Oram's Oramics machine, which allowed dark shapes painted on transparent film to be mechanically drawn at a set speed over photocells, blocking light and affecting the parameters of a synthesizer circuit. Pitch, timbre, amplitude and playback speed could all be manipulated and programmed, allowing the same composition to be performed time and time again by the analogue synth.

During the `60s and `70s, the first reliable music programming languages appeared, including the first systems to utilise the Fortran high-level programming language in 1967, and moving to the C programming language in the `70s and `80s. Programming languages allowed digital creation and playback of sine waves that could be combined and modulated by algorithms and equations, generating sounds that had never before been heard or used in music composition. In the 1980s, the use of MIDI systems, digital samplers, drum machines and polyphonic synthesizers became ubiquitous, shaping a generation of music-making and defining a whole new genre of its own.

It wasn't long before computers found their way into the music recording studio, bringing functional benefits above the traditional analogue tape and mixing console approach. With digital audio workstations (DAWs) such as Cuebase and Pro Tools, the 1990s music producer could record sound straight into the computer and also cut, paste and loop sections, resulting in a whole new tool to experiment with. The music studio became an instrument in its own right, enabling musicians to explore innovative creative ideas. But the digital systems just didn't sound as good as analogue tape and valve processing units. Before long, computers were sufficiently fast and intelligent to perform digital signal processing algorithms that can make digital music sound analogue, but

now it was also possible to modify sound in a whole manner of ways: to digitally retune an imperfect recording, to make a singer sound like they are stood in a cathedral, or to make a piano sound like a guitar, for example.

More recently, touchscreen interfaces have disrupted the way we make music. Apps on a mobile tablet device can be used onstage and enable novice musicians to experiment easily with software packages which make, for example, drum loops and synthesized sounds. The software language itself has now become a musical instrument, too, with the real-time live coding capabilities of Supercollider and Sonic Pi. With live coding, the computer code is the music score and performers write musical code as fluently as a violinist might perform in an orchestra.

Nowadays we not only hack software, but the computer electronics too, incorporating ARM mbeds, Arduinos and Raspberry Pi devices into the DIY music-maker's toolkit. It's now possible, therefore, to re-evaluate the importance of and connection between computer programming and music-making, and it's no surprise that one another can be used to support education methods in both subjects. In many respects, the future for creative music-making and computer programming lies in bringing the virtual and physical worlds together in collaboration – imagine robotic drum machines, instruments played by drones and clothing that turns body movement into performance sound. These technologies are with us already, and with the next computing revolution – the Internet of Things – just around the corner, the future for computerised music-making still has a lot of innovation and creativity to be realised.

Image: Dr Sam Aaron, inventor of Sonic Pi, performs live coding for nightclub partygoers

The V&A Samsung Digital Classroom

Digital technology plays a big part in children's education. More than before, it's present in their lives from a very young age and is increasingly integrated into the education system. The development of easy-to-use portable devices has changed the way students can learn, but it is being placed within the old framework of education. Most classrooms are still laid out in the same way, with children sat in rows of desks facing the front – but this isn't conducive to all types of learning, particularly now this traditional set-up is mixed with children having personal devices in front of them. These technologies give us the opportunity to adapt and rethink everything about the 'learning environment' so that the physical space complements the digital tools students use today.

In February 2016, Samsung and the V&A launched a series of Samsung Digital Classroom workshops which aim to take learning out of the classroom and into the galleries, creating an immersive and contextual learning environment. Dubloon was approached with a very open brief to design this new learning environment. Making use of phones, tablets and laptops, the workshops are inspired by the V&A's galleries and exhibitions and are designed to provide young people with the digital skills needed to equip them for a career in the creative industries including art, fashion, design and product development. The programme ranges from topics such as projection mapping, virtual reality, 3D printed jewellery and digital animation, among others.

With this rise of learning through digital devices, the classroom can become a much more flexible space, allowing the physical environment to be redesigned to best aid creative thinking and learning. This drove Dubloon to experiment with various classroom formats and, consequently, they developed an easy-to-assemble structure that defines a space with little restriction – an open learning environment within the gallery spaces of the V&A to immerse teaching, learning and inspiration in the same physical environment. This provides an exciting space for the workshops to take place, being amongst the exhibits so that participants have the ability to use them as reference, inspiration or directly within their work using 3D scanning and other forms of technology.

Part of the challenge was to design a pop-up structure that can be easily assembled and clearly defines a non-public space for the workshop to happen within the public galleries. Using tubes of light as the material, the structure creates an attractive environment in which to work, without putting up solid barriers. The tubes create a visually unobtrusive space within a space, framing an area while the public are still able to see the excitement of the workshop happening. The structure is not the absolute defining parameter for the

workshop, with large entry and exit points designed to allow the movement of people, encouraging a more dynamic style of learning to take place. Along with the structure, there are additional pieces of mobile furniture which facilitate the running of any workshop, from the storage unit which was designed with integrated steps to assist the assembly of the structure, to lightweight aluminium trestles and glass tabletops which fit onto the storage unit for transit and are quick and easy to set up. The glass tables can be drawn on with marker pens to aid the development of the children's ideas in a free-flowing, fun way. We hope other educational spaces adapt to complement the way children are learning, particularly as digital technology moves forward and the methods of learning adapt.

Dubloon is a London-based design consultancy founded by James Boock and Henry Franks in 2015 after graduating together from the Royal College of Art. The studio works on product development, experience design and physical branding. They have worked on various projects with musicians, scientists and psychologists to produce considered work with a focus on original and exciting experiences.

Special thanks to Alex Flowers, the V&A Learning team and Samsung

Project website: *www.dubloon.co.uk*

Image: Dubloon

Scan the World

Image: Bust of bearded man

For people who would like to see particular objects of cultural significance in person, but are unable to do so, or even own their own version, Scan the World makes this all possible. Using 3D scanning and printing technologies, a series of overlapping photographs are taken of a physical object or environment to create a three-dimensional representation of it.

Scan the World is a non-profit initiative aiming to give people the chance to experience representations of artefacts in a remarkably tangible way, enabling the public to obtain content that they may otherwise never had physical access to. By also facilitating the proliferation of 3D scanning and printing, the project makes the public aware of its uses and how the technologies are becoming an ever-increasing part of our lives. By bridging the gap between technology and the public, the project has become a community-built platform, encouraging people to get involved in different ways which are rewarding and easy to do. Scan the World serves as a growing, living archive built by and for the public. The data that is collected for the objects is curated by users and professionals alike, serving as a concept for an open access museum of the future. Once made printable, these objects can be brought back into the physical world and, in turn, be used for numerous outputs:

Cultural heritage

Cultural heritage is crucial to how we see ourselves as people and is important for historical research and education. It reflects our long historical past as human beings, giving people a sense of identity and a documented past. Cultural heritage comes in many forms, whether that be in a particular belief, object, monument, ritual or tradition. Damage or complete demolition of cultural sites would mean, in a sense, losing one's identity, as well as impacting the economic benefits that the heritage site or monument can produce for the community it is in. This loss has become increasingly apparent in recent times with environmental changes and human conflicts across the globe. Scan the World's intention is to simply preserve endangered cultural heritage by digitally producing facsimiles of these objects which, in turn, create valuable records of culture. As a result, potential risk of damage and destruction are mitigated.

Accessibility

What does a museum's collection, a public sculpture or even a building mean to those who are partially sighted or blind? The traditionally enforced rule of 'don't touch the artwork' makes accessing culture close to impossible for people who have visual impairments. By being such a cheap means of producing accurate representations of these objects with intricate detail, Scan the World makes it very easy to give someone the incredible experience of touching and engaging with artwork. Similarly, for someone living in Australia wanting to explore the V&A's collection, the virtual archive not only allows people to 'visit' a museum's collection, but also to print it.

For many smaller communities whose culture is not globally recognised, or is at risk of being damaged or destroyed, Scan the World serves as a platform for copies of these objects to be placed in a rightful location and shared with a global audience.

Education

Many educational institutions are starting to think about how 3D technologies can be useful for their students, and there is added pressure to implement it into the school's curriculum. Scan the World provides a platform for people to learn about the technology, from generating a digital representation of a scene or object (photography and photogrammetry software) to the manipulation of it (zBrush/modelling software) and the output of 3D printing. Additionally, it teaches students about the artworks in ways which are stimulating and interactive. It is important to be present with the piece, and seeing its physical form in 3D (as opposed to 2D) makes it easier to understand what the artist is trying to portray and how they have achieved this by being able to move and touch it to study the transitions of space, angles and light.

As part of the London Design Festival 2016, Scan the World digitised most of the three-dimensional artefacts in the V&A's New Europe galleries. All of these are made available on www.myminifactory.com/stw alongside more than 4,000 other artefacts in the archive from across the world.

One thing leads to another. When design meets engineering and other creative processes.

Image: Arianna Mazzeo

Having the ability and the power to create – yes, human beings are creative animals!

Design is everything and happens in the context of relationships, material, immaterial, not in a vacuum. In our society, we still think about design (and not only about it, unfortunately) as a category or box where we close our skills and expertise.

Specialisation: the separation of tasks within a system

Design is a process which uses creativity and emotion, framing and re-framing our mental picture towards the actions to create an impact in the society where we live and grow. You can design education, you can design your house, you can design the community, the life you want. Our disappointment is the basis for wanting to improve the things we observe.

Design is an inclusive, creative process of expression and communication, `necessary for everyone in a civilised society'. It is for common good and for persons. Movements, gestures, languages of human being, beauty, elegance as form of respect, poetry. Above all, there are human needs and behaviours and the challenge for everyone to make life better, qualitatively better, meaningfully better. Design is a commitment, a sense of respect for all people's stories, memories behind the objects, discovering how they connect to our world and our everyday, in the streets, in the public space.

What happens when design meets engineering?

Creativity is a productive capacity where fantasy and reason are linked, and its result is always a concrete output. Fantasy is a faculty of the spirit, capable of creating imaginative pictures in our mind which cannot always be realised in practice. With fantasy, we can sleep on a chocolate cloud and make everything we want; with creativity we are looking to a synthesis from data, driven from the different insights in the context we observe, to find comprehensive outputs.

Engineering then uses this capability of the creative design process and they learn from each other. In this dialectic and dynamic dialogue, at the centre of it all, there are persons, with needs and expectations. Bridging the two worlds offers great opportunities for access and opportunity to innovate for and with the community, to learn how to work with others as multidisciplinary teams and act for a better common ground. When participation and collaboration share new scenarios, they are acting in crucial fields of our life.

And other creative processes?

Design meets art, biology, neuroscience, robotics, music, dance, theatre and performance. At the centre of innovation still remains the creative process of design.

We are creative animals.

Feedback is fundamental for the common voice and intelligence of people to act for good and learn how to work with others and with the community to improve better human conditions and design the life we want. Interacting with people is the major challenge of engineering and other creative processes such as art, dance, music, neuroscience etc., but is essential if we are to overcome stereotypes and the barrier of specialisation that neoliberalism imposes on us in order to control our movements and our life.

Meaning, quality and beauty are the transversal pillars of this dynamic dialogue (a cross-cultural understanding) in the fields of economics, design, architecture, planning, science, design research, engineering and so on, where collaborative and participatory design for a sustainable life is the major challenge to face. Creativity is the key word to make effective the opportunities to share the power to dare, have the courage to design the life we want, do our own thinking and put local needs at the centre of our innovation process through design. One thing leads to another, only if we can act as change agents together and work in a common creative ground of access and opportunities for all. Let's go!

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