

**QNS: How would you define genome editing?**

Genome editing basically would be deliberate alteration of DNA sequences in the cell. Here, such an intervention may be directed to alter a particular gene function or otherwise epigenetic sort of intervention to alter some, broadly speaking physical traits, but without a lasting impact of changing the DNA sequence.

**QNS: What are the risks of genome editing?**

Quite a few, currently one of the most pressing [thought] about risk would be in terms of welfare and safety. As you know, the technology itself is still being developed there are many things [that] we don't fully understand. Most broadly, we still don't quite understand how the genome itself works. If we are hoping to rely on this technology for instance to have some changes in say behaviour or something as complex as intelligence, then clearly such an expectation will not be properly granted. But most immediately, if you are talking about particular disorders, such as [Huntington's disease], at least we understand that we are not quite there yet in terms for being [sure] that is safe for patients.

**QNS: Is there a possibly where genome editing will be abused? When genome editing is quite established in the future, do you think there will be abuse in any other way, not only for medical but for cosmetics?**

I think such misuse, is likely to happen. We've seen that in relation to other types of technology, for example stem cells. It's been use for all kinds of purposes, some of it would not be supported by the Science itself. So, one of the biggest problem with that is that over time it undermines public trust in scientific initiatives. I think quite rightly one of the concerns of our scientific colleagues working in the field is to ensure that there is proper communication with the public in order for them to understand what is currently achievable and what are the challenges ahead. And in terms of, feasible targets we are working towards. I think setting the right expectation is extremely important at this stage so that we do not have development that will hamper this important scientific development.

**QNS: In your personal opinion, what do you think is the greatest challenge to confirm that genome editing is okay for the public? What sort of opinions they will have towards genome editing?**

I think it's hard to say but the public broadly speaking tends to be quite optimistic about the technology. Looking at some of the surveys that have already been done, I think in the minds of certain individuals we are already there in terms of clinical applications. This may be true for a very limited number of somatic cell intervention in terms of gene editing or planning the gene editing technique but certainly not when we think about say, modifications at the germline level. But still, if you were to talk to some others in the public, they might think: "Oh we can maybe do this." and perhaps they might even think that they should be already doing this but clearly that sort of expectation would be wrong, and I think it is important to help the public understand where we are going with this and what are some of the current struggles.

**QNS: One of the questions we have asked is: “Do you think public engagement is necessary and important in navigating the ethics of human genome editing techniques and why or why not?” So at least from the people who think that it’s necessary, they said that the unawareness of genome editing can bring about misconceptions and misconceptions can actually cost unfounded fear in anxiety in the society and they also said that there are a lot of ethical and religious issues and concerns around genome editing, so it’s also important topic of discussion.**

Yeah, absolutely. Well, you may be already aware of the Nuffield council’s report, released a few weeks back, so Nuffield council is, I think broadly seen as the main bioethics body in the UK and of course in their deliberations they highlighted a number of important considerations in relation to genome editing, of course they highlighted concerns for parties that are directly interested in the technique, of course these are essentially individuals who already may have a particular genetic disorder so they would have a direct interest in how this disease could be addressed with this new technology, especially if they do intend to have genetically related children. So of course for them, as I have indicated earlier, the key concern would be welfare as well as safety and of course we hope that at some point this technology can be chronically applied to help them with their particular condition. But of course this raises other broader concerns for instance, how will people already with particular disabilities get affected, will they be stigmatised, will they be discriminated against, and if such technology becomes more widespread, will individuals already affected by this condition feel compelled to have to undergo this sort of interventions as treatment. And then, of course there are also broader social justice kind of issues, will-if this technology become more widely available- it be only available to the rich for instance, because we’ve seen with other technologies, they tend to be accessible only among the rich until after a certain period of time.

**QNS: Do you think that Singapore has a good framework to ensure that social justice will be well carried out, in term of the accessibility and the availability of such medical technologies?**

I think Singapore’s position is quite similar to what we see in a number of these advanced countries, and I think that it’s a sensible approach in that we are attempting to deal with the development in a measured way, currently it is to assess the risk and more broadly the safety concerns. So the key question now would be how do we introduce this particular technology into clinical practice in a measured way. So we do have a governance regime now for emergent technology such as this. So assuming that we are to apply this rhythm at clinical setting, technically this would have to be introduced by a way of clinical trial. This is to ensure that this new intervention is safe, for it to be used more pervasively within the preparation. So we do have this measured approach, in a way that in other countries such as the UK, there is a regulatory bounty technically involved and this practice will be used in a carefully licensed manner so that we can monitor the safety of the intervention, as well as the welfare of individuals who are involved over a period of time.

**QNS: Do you think that our frameworks are robust enough to take care of the very diverse religious and ethical diversity that we have in Singapore?**

Well, my understanding is that we are approaching this at different levels, so for instance in terms of germline genetic modification, so currently there is a moratorium that has been set by the Bioethics Advisory Committee. So as you know the Bioethics Advisory Committee or the BAC in short is an advisory body established by the government, basically to think through ethical, legal and social issues. So the BAC has earlier on prescribed this moratorium because of the a lot of uncertainties involved in the germline genetic modification. So this of course is also similarly the case the number of international conventions. But of course this particular position is being re-looked at, to see if we can relax it in relation to some aspects of technologies that relate to germline genetic modification. For instance, mitochondria transfer, so if we do define germline genetic modification broadly, mitochondria transfer such as ooplasmic transfer, will be one intervention that may be allowed on a case by case basis. Of course this is because we already know that it is generally safe to introduce or to begin but of course we just need to be sure that over a period of time the well-being of individuals concerned are secured.

The Bioethics Advisory Committee has also indicated that they are deliberating on this topic. So which means that they will be responsible as they have done in the past to gather the opinions of experts as well as the general public on a variety of interventions relating to genome editing. And what we will expect from the BAC is eventually they will provide a set of recommendations to the government and I suspect that this set of recommendations will include how the technology should be introduced, how it should be monitored, and also in terms of the continuing involvement of the public.

**QNS: So how much choice are bioethical legislation in comparison to the rest of the world, not just limited to Asia Pacific, maybe if we compare it to the people in maybe Europe for example?**

I mean if you were to compare ourselves with countries that have an interest in this technology, I think we are comparable, we, like these other countries, have a measured approach, so we don't want to rule it out. We think that it offers quite a lot of benefits eventually, for people who will need access to this area of technology, but of course we need to balance that realistically with the current challenges, especially some of the safety concerns. So I think that we will have a phased approach, we are looking quite seriously at understanding certain aspects of germline genetic modification, just like mitochondria transfer, and I think if this technology proves itself to be safe and effective, then it will encourage our regulatory system to eventually allow more of these technologies to be applied more broadly. But I think that it is also important to highlight that the BAC made clear that the priority will be very much on allowing the use of this technology to address serious illnesses or therapeutic needs rather than to use the technology for broad social reasons because this tend to be harder to justify.

**QNS: What do you think about RNA editing, compared to maybe germline editing if I think I'm not wrong with that, I think that it actually focuses more on the genomic DNA.**

Yeah. So at least in our standpoint what would RNA editing mean, since you've mentioned that the BAC is trying to relax some of the technologies and with RNA editing, at least the changes would be more transient than permanent.

I think that RNA editing would be interesting depending very much on the condition that we are attending to address. So if it's able to help alleviate some of the safety concerns that we are currently confronted with, and provide a measured way forward, I think that will be extremely beneficial to holistic development. Of course one of the big concerns with germline genetic modification indicated is that 'cause you have made the change, it's going to be there in the population, it's going to be difficult to control its impact and we don't know for sure how this will affect things like population genetic diversity'. Whereas if you are just able to make that temporary change, with RNA editing for instance, then I think that will be helpful, in looking at what are some of the outcomes that will arise at this particular intervention and then perhaps think about whether such an approach could be made more permanent.

**QNS: What are the ethical issues and problems encountered currently?**

Well, depends a bit on the context, I've already referred to the recent report published by the Nuffield council, of course will be helpful to join their frame, or their framework work in concern during ethical researchers, because they have identified individuals who are directly interested in the technology because these are actually individuals with serious genetic conditions and then the broader public. Because for them, if we think about the ethical issues, they will vary somewhat since the affected individuals are most likely to want to have this technology applied to them. Beyond that of course we will have, I think, more broadly social justice concerns and concerns in solidarity. So what do I mean by that. In the event that we are able to say, sometime into the future, scale up on this particular intervention, then it's a question of whether it will divide the population into those people who have undergone genome editing from those who have been produced the natural way, depending on how you understand by natural. So then there could be very well divisive effect in the technology. Of course I've also mentioned social justice, that's really important because we need to think about whether the application of this technology [and potentially] the application of this technology especially for non-medical purposes, could contribute to social divide.

**QNS: Regarding the quiz that we've given online that survey, we also asked the public on their opinions on what genetic enhancement is , could you actually give us-how would you define what genetic enhancement is?**

Enhancement is a difficult concept to pin down, but just for the sake of discussion, if we are to think of some of the social and behavioural changes, that one could perhaps attribute to genome editing, say for instance, a certain behavioural trait, or perhaps a physical ability, that is perhaps more than what we would attribute to an average human person. So if we are to understand enhancement in that sort of context, then the use of the technology, to produce this sort of enhancement, is ethically challenging. The reasons as we've seen in movies like

Gettysgal would make clear what some of the problems would look like in the event that it is broadly applied. Think outside of that context, because here we do know this from the current position of the BAC, that we should not be going into that domain, but we should just limit the use of that technology, to essentially address serious illnesses, or for therapeutic reasons only, then it's unlikely to create this sort of division, that we might anticipate in a brave new world sort of context.

**QNS: Some people say it is unnecessary to communicate the public on human genome editing and they say that it's because that there's too many diverging and diverse views on the topic on human genome editing, and it would be too chaotic , and then that they feel that the general public may not have the capacity to actually understand these kinds of issues and it would probably be best to just leave it to the professionals. So what do you think about these kinds of statements?**

I would disagree, I tend to think it's more of an issue of how you ask the public, and how you frame the discussion, in order to get a meaningful response. I mean it's not of course helpful to just basically pull very open ended questions to the public and expect them to be on par with an expert in terms of the scientific background of the topic, that would not be realistic, but I think there are important issues relating to safety, in relation to justice for instance, that the public can contribute to in a very meaningful way, because ultimately it's going to affect everybody. So if we do want to think beyond the science, I do think that it is very important to involve all stakeholders and that would mean every member of the public ideally. So which is why I think that the earlier report published by the Nuffield council, that is in the 2016. They've highlighted that as far as a topic like genome editing is concerned, we must recognise that science in itself is a moral enterprise, it is not something that is out there in outer space, socially embedded, and it will be pretty much a part of society, therefore in recognition of this particular aspect, it makes every sense to engage all of the stakeholders, because this development isn't just limited to the experts, ultimately everyone must take home a stake of this development. In fact, I think I should add that it's not simply about our public, but there's also been a strong move towards encouraging international dialogue on the topic. So in an international summit on genome editing, that was conveyed in Washington DC in 2015, it was decided that there should be continued engagement among key stakeholders, of course the first meeting in Washington DC, was hosted by the National Academy of Sciences in the US, collaboratively with the Chinese Academy of Science as well as the Royal Society. This year, the second summit will be held in Hong Kong, I think an affirmation that as far as these stakeholders are concerned they want to sustain that international dialogue, not just among the experts but as far as possible involving interested members of the public as well.

So, I feel that this actually could be a blowback against the genome editing issue, especially if people-the public who are not scientists- don't understand how CRISPR technology really works and that these kind of results are actually quite expected if we think about it. We don't really understand CRISPR technology that well, but if this is presented in the social media, it's like a

clickbait title and says that “CRISPR technology is mutating not the sequence that we want, it’s mutating off-target sequence.” so I guess this kind of news can actually [cause] widespread misinformation at least through the general public. So how can people like scientists, or bioethicists actually quench these kinds of ideas that genome editing technology are still under development and we’re still looking at it. It’s not like a try and true method yet. How can we actually radiate these kinds of backlash towards this topic on genome editing, especially if results like that actually come up and show that these things can happen?

I think here it is an occasion for us to better understand what solidarity means because solidarity as a principle suggests that for endeavours such as this, developing an emergent technology, it is not or it shouldn’t be just the initiative of one particular party, but rather, scientists may also want to think about using bioethics as a platform because bioethics, ultimately, is an interprofessional multidisciplinary field where people with different knowledge come together. Of course we have scientific knowledge, in this particular case as a very important contributor you got other knowledge parties that will become involved because there are quite a [few] different applications that will arise from this particular development. Of course we want an important output of this interaction [to be] proper engagement with other members of the public and the broader society in general and [also in] explaining the sort of concerns where we have to think quite seriously about how particular development could matter to a society more generally. Perhaps I can rephrase, so if we are to think more carefully about what solidarity means in this particular context, it does require scientists, because they are closest to this development, to engage with other experts in different knowledge areas to see how as a moral enterprise these developments could be explained to general members of the public in a way that would be meaningful and helpful for them to take an interest in this particular development. So that’s how I see bioethics actually. So bioethics is not, or should not be in my view, seen as a distinct group of individuals who then perhaps bring knowledge to the masses. Not quite. I see our role as making this development real and accessible to members of the public and when I say real, I mean therefore avoiding the hype that we see with a lot of scientific development. We’ve seen all sorts of hype that people attribute to it, all kinds of promises that are not realistic, and I do think that as we see genome editing as a technology develop, we do need to set expectations correctly, and the best way to correct hype is to involve people in a meaningful way, so they are involved in the development with you, then they will be able to see how they can themselves maybe not directly, even indirectly being involved in contributing to its progress and perhaps sensible support for its research would be a meaningful expression for the public.

**QNS: On the talking about expectations, what would you expect genome editing to be 10 years on from now, so what sort of expectations you have and what sort of things you find are realistic, that can be done within the next 10 years, what would still be on the works ?**

Thank you, I think it’s a difficult question, because on the one hand, technical capabilities and expectations associated with that and then more broadly, the ethical as well as the social

aspects, and when I say ethical and social... legal considerations as well. So if we are talking about upscaling, the technology such as this we've already mentioned a number of considerations relating to solidarity, in relation to social justice, and then of course we have to think quite seriously about the reproductive rights of individuals. How would the availability of this particular technology affect the reproductive choices, these are important issues that we will need to think about should the technology itself become more broadly available. But I think there are already important issues that we must deal with now, in terms of some of the somatic interventions, that is already available, and of course from what we can tell, is a major concern, of course that creates already a lot of the justice equity related issues. But then of course we subsequently think about mitochondria transfer, and if we are to allow that in Singapore, then of course we also have to think about some of the implications with that. We are not a 100% sure that it is safe, we need to monitor perhaps a generation, closely, to see what some of the impacts are likely to be, but then of course there are other priorities, social considerations that we need to take into account, particularly in terms of how culturally we think about children who are or are not genetically related to ourselves.

**QNS: How would you evaluate the extent of engagement that the bioethics in Singapore have to, because we published a survey, we tried to reach out to people of different demographics, and then you mentioned genomically or RNA editing to adults of people who are not in the scientific community, they are not really aware of what is happening , so how would you evaluate our extent in Singapore?**

Thank you for the question. So having been involved in some of the BAC's earlier activities, I thought an effective approach would be through focused group discussions . So that's where you get interested members of the public to gather, and typically before initiating the discussion there would be an introduction into the science, and of course some of the key ethical and social concerns. And then after this premiere so to speak, we would invite the public to contribute their thoughts, so I think this has been effective because, I myself having been involved in the exercise, found the discussions to be very sensible, and members of the public here of course I'm speaking of lay members essentially, people who are not familiar with science at all, they would input to participate in a very meaningful way. I myself have gained quite a bit of insight from them, and so did our colleagues who are scientists.

**QNS: What are some of the key concerns from people who are about genetic engineering?**

I think there are essentially issues that I will recognise. For instances, concerns about safety, concerns about fairness, concerns about how society would look like in the future, concerns about how this would affect the human race overtime, and concerns about our moral responsibilities. It may sound rather broad stroke but of course I think [it's] very instructive, from certain past experience, to hear about how some of the justice concerns were for instance get articulated in a culturally defined and culturally appropriate manner.

**QNS: So how do you think bioethics access checking mechanism for advances in genetic advances?**

Thank you for that point. It's a complicated. Sorry, let me just rephrase that. So thank you for the question. I think it's a complex question, although it might be helpful to emphasise that within bioethics principle that has been emphasised, is there a transparency. So I do think that when we consider an appropriate regulatory mechanism for instance, we need to think about how to make the entire process more transparent. Because it is with transparency that you are able to involve and engage with interested stakeholders and also for those people who may eventually have an interest in this development, to choose to involve, should they decide.

**QNS: How do you think this is applicable back to the Singapore context?**

I think as far as Singapore is concerned, highlighting a number of these requirements is a good start. For instance, if we do emphasise that there is a need for greater transparency, communicating this need to policy makers, is I think, a very good first step. And then of course also, again as a more general platform, to allow interested members of the public to come onboard, and follow the development, I think this will also be an important way that bioethics contributes to development.

**QNS: So on the topic of education, how do you think efforts to educate us to learn about this bioethics issues?**

Thank you for the point. I think what you are doing is fantastic. Which means to think outside of the specific field of work, so as students in Science, the fact that you're reaching out and taking into account other perspectives, on the technology and also involving others in the conversation, is a very important step forward in, broadly speaking, education.

**QNS: Do you think it's necessary for more education to be done, for let's say, people who are younger, so they are more engaged in a conversation in earlier age. So that when they are at their adulthood stage, they would be more likely to be engage in such a development.**

Thank you, I do like your word engagement. I think that's a lot more pertinent than education [which may sound] restrict[ive]. Because here you're not just basically telling people you should know this or that, about the technology, but also hearing from them, what they would make of this broadly speaking capability, should they become available. So that's essentially taking the scientific capability down to their level, something that makes sense for them and engaging with them at that particular level. So I do think that's first step in getting people involved, in this particular array of work. In others, I think it is more like moving into their social world, in a way that is meaningful for them, rather than expecting them to move out of their comfort zone into



yours. So I think this step of moving out and reaching out is extremely important, and I do see this to some extent it's a moral responsibility as knowledge holders, because we know this area, we have a greater moral responsibility to relate or to help others relate to what might be of interest to them.

**QNS: How does the judicial body come into place in term of with the bioethics?**

In terms of the law, of course, broadly speaking, the law is intended to safeguard the crucial interest of individuals typically framed as rights. So here we are, talking about different degrees of, say, reproductive rights. So in some countries, it may be felt that individuals must have access to the sort of technologies if proven to be safe and effective, other countries may have a different perspective or view on this. The law may come in different ways, so that's one way of thinking about the legal involvement, but I think another important way that the law will be applicable will be in terms of safeguarding the population of vulnerable individuals against stigma and discrimination for instance. So this is essentially the protective function of law, and ensuring at the most basic level, there is fundamental respect, for the sort of rights that every human being should be recognised as having. We're not quite there yet, but I do think that for instance, if we feel that at some point, there may be individuals who are for instance, compelled to undergo genome editing, because of particular traits that they have, that's considered to be socially harmful, then the law may have particular application in determination of whether such a forced intervention may be applied or not.

**QNS: Could you elaborate a bit more about the term you used, socially harmful?**

For instance, it still remains controversial, for instance at one point, it was considered that individuals who suffer from intellectual disability, should be sterilised, so this would be a mandated practise, and of course, we do know now that such a position is highly questionable, and of course it's highly discriminatory as well in a very negative way. The law has a particular function in protecting the rights and interests of these individuals. So in Singapore for instance, if someone is to be sterilised, and it concerns a person who is unable to decide for themselves for herself, the courts will technically be involved in ensuring that the interests of these individuals are not unduly compromised. For instance, it shouldn't be a situation where only because it's just easier for everybody for a particular individual to be sterilised, in this particular situation that should just be done. Rather, i think that a holistic assessment needs to be done in ensuring that the welfare of this individual, is safeguarded.

**QNS: We were talking about intellectually disabled individual, so if it were to say like we try to touch this into the future, whereby genetic engineering, or genome editing is rather advanced, let's say social division happens to be you know some of the important laws or important ethical guidelines must be implemented?**

Thank you for that question. Of course if that should happen, and if we hold true to the principle of social justice, I think it is very important for to ensure that such a technology is not used indiscriminately, in other words, it shouldn't be applied in such a way that will contribute to even greater social divide. We do know that individuals who suffer from intellectual disability, may also suffer discrimination that is unjustified, so let me rephrase that. So maybe this is the part where... Let's go back to your question about individuals who are intellectually challenged, of course when we talk about being intellectually challenged, we are talking about [a] spectrum. It's not a very clear cut. So in the event that the technology could be applied, perhaps to, broadly speaking, address this particular problem, then I think a broader social discussion needs to be had in terms of what are the sort of goals that as a society is hoping to achieve, what is ethically responsible, like in that particular context to do. So here if we apply or we should apply the technology in a way that will cause a particular group of individual who thinks society suffer even greater harm, then I think that we should refrain from the application of the technology in that particular way. So which means actually that prior to the application of such a capability, we need to have a careful evaluation of the implications that could go wrong. So it shouldn't be a situation where in applying the technology, not only do you contribute to serious discrimination of a particular group, to their disadvantage, and to contribute to a great social divide, but rather I think we should think about how this technology could be used in a way that can help to enhance the capabilities and opportunities of individuals who are socially disadvantaged.

**In the context like Singapore, how well is this being carried out, to let's say, elevate the abilities of the socially disadvantaged to let's say be at equal level to the rest of the society?**

Thank you for that point. Ultimately, we as a society, believe in meritocracy, because we believe that every individual should have equal opportunity to excel, and this should be independent of his or her social economically dispute position. I think that when we think of such technology it should applied in a similar way, I think so far in terms of technology in general, our policies have be [as] such, and by policy, I also mean our roles that are in place, so we try to capacitate people in order to live the way that they would want to live in a way that essentially makes sense to them. I guess an example, it may not be the best example, it doesn't quite relate directly to technology, but in terms of our legal framework for individuals, who may eventually lose decision making capacity, so example, individuals with dementia. Of course this particular framework is intended to protect their interest, first of all, in the event that they should lose decision capacity, but also at the same time have supporting mechanisms so that other individuals would provide care for them for instance, would be able to help them to continue to live, as least as closely possible to in a way that they believe in.

The concept you are talking about is something like beneficial, about let's say, this someone deserves their ability to make conscious. If you bring it back to the context of..because now

there're some clinical trials that are being done, so in the context of let's say gene therapy, what do you think are the possible ethical issues that maybe brought about gene therapies have?

The application of gene therapy?

**Yeah.**

Do you mean beyond safety concerns?

**Yeah, beyond safety concerns.**

Essentially, I think the current thinking, and of course we have spoke at some length already, about some of these concerns, will again be very much on a justice related considerations, and also I think from the biological standpoint, the human gene pool. So if you are able to start defining the sort of gene we want in the population, then it will be quite worrying, because it presupposes that we can already conceptualise all the possible combinations that can happen in the future, but we don't quite know that. Of course the whole point having diversity, is that this will give a better chance of responding to things that we do not expect or cannot predict. So I think this is one aspect that we will have to be content with, once this technology matures to the point that we have much greater control over this sort of genetic diversity that we find.

**Let's say given that we are at the stage whereby safety is not really a concern for genetic engineering, so I think previously we were talking about semantic geneline editing, so let's say parents were to know via screening that their children are going to have some sort of genetic disorders, do you think that paternalism should be allowed such that parents can make decision to alter the genome of the child?**

Thank you for that point, so not really and I think that this is where broader societal dialogue is required, but currently the law is such that if parents are to decide on behalf of their children, then this must be in their children's best interests, best interest of course is holistically defined. So typically in this context, we basically mean therapeutics, best interest meaning things that might help them, say if it's a particular medical condition and this would typically be a serious medical condition. And of course beyond that, we also take into account, broader social considerations how that would better enable the development of the child, in optimal way. So of course if we think about the application of such a technology, then all of these considerations will apply. Of course what's difficult to account for now will be this sort of prospective development, because we still don't quite know how the genome functions in its entirety, you see. And to say therefore I should intervene at this stage because it will maximise the opportunities for my child. I think it is probably unfounded, and frankly I'm a bit skeptical that we will ever be able to fully account for how the genome works. So until we're at that stage, I don't think there will be such a day that parents can freely and fully decide on just basically altering the genome of their prospective child as they like.

**Talking about risks, a lot of the policies that are made, are about mitigating risks right, so let's say genome editing, so in Singapore how willing are policy makers to take advance for let's say this type of technology, given that we might never ever know 100% how the body works, there will always be certain unknown mutation or things that we can never find out about, does that mean that we should never advance in sciences?**

Not quite, I think that our policy maker has been very sensible, since they have embarked on the biomedical route, so as you know from 2000 onwards, there has been a concerted effort to capacitate our nation, in terms of capabilities and biomedical sciences. And there, I think it is fair to say that as a matter of policy, our policy makers have decided to be somewhat more adventurous, in terms of investment in the Sciences and promoting a number of developments. But at the same time, I think that they have also been very careful, so they have not been overly adventurous, I think for one of the better description, of course we can always debate as to how much care do you need in venturing into these new uncharted area, but I think with the establishment of the BAC, they have attempted to engage and involve the broader public in this particular enterprise.