



Aims

Our topic this year is 'Risk, resilience and response'. As in previous years, a panel of three expert 'witnesses' from across and beyond Cambridge will join us each month. They will be a rich mixture of policy- and decision-makers from governments and businesses, and technical experts and each of them will provide their perspective on the gaps in our knowledge and burning questions for future research.

This term, we are focusing on food and water security and supply chain resilience. This is the first meeting in the series and we will be taking a global view and starting to explore new ways to bring together 'big' datasets from different sources to assess risk and resilience in food supply chains.

We are jointly hosting these three meetings with the Joint Research Centre (JRC) of the European Commission and we are hoping to co-produce a brief white paper for EC policy makers identifying future research gaps and opportunities in this area.

Agenda

All the witnesses will give a 10 minute introduction and their perspective on the two core questions followed a general discussion:

- 5:00pm Welcome by the Chair and an introduction to the topic
Each witness gives a short introduction and thoughts about the questions (10 mins)
Questions and beginning the open discussion
- 6:00pm Coffee break
Continue the discussion
- 7:15pm Reception and dinner, which will include a working session

Witnesses

This month, the three witnesses are:

Steve Peedell	Senior Scientific Officer in the Land Resource Management Unit at the Joint Research Centre (JRC) of the European Commission (based in Ispra, Italy)
Dr Mukesh Kumar	Research Associate in the International Manufacturing group at the Institute for Manufacturing, University of Cambridge
Professor Alan O'Neill	Emeritus Professor of Meteorology and former Director of Research in the School of Mathematical and Physical Sciences at the University of Reading, and currently a visiting professor in the Cavendish Laboratory and a visiting fellow at Clare Hall

Questions

The witnesses have all been asked two core questions:

- 1) What do you perceive as being the main gaps in our knowledge?
- 2) What would you include in the 'next generation' of research questions?

Each of these questions will be posed to everyone and their answers will then be used as a springboard for further discussion. The main points raised will then sent to everyone to use as a starting point for the next meeting.

Witness profiles

Stephen Peedell

Senior Scientific Officer in the Land Resource Management Unit at the Joint Research Centre (JRC) of the European Commission (based in Ispra, Italy)

Steven Peedell is a multi-lingual specialist in geospatial information technology with 25 years experience working with maps and mapping technology, the last 18 of which have been at the Joint Research Centre (JRC) in Italy.

He has an MSc in Natural Resource Management from the University of Leicester in the UK. Prior to 2005 he was very much involved in technical developments supporting EU environmental legislation (Natura2000, Water Framework Directive), and then led a research team working on development and implementation of specifications for a European Spatial Data Infrastructure (INSPIRE).

He joined the Land Resource Management Unit 2009 where he focuses on projects in the African, Caribbean, Pacific (ACP) regions and developing spatial databases, catalogues and interoperable web services for geoinformation. He is also the JRC project leader of the Biodiversity and Protected Areas Management Programme (BIOPAMA) which aims to address threats to biodiversity in African, Caribbean and Pacific (ACP) countries, while reducing poverty in communities in and around protected areas.

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Dr Mukesh Kumar

Research Associate in the International Manufacturing group at the Institute for Manufacturing, University of Cambridge

Mukesh Kumar is leading research in the areas of risk and resilience in international manufacturing and supply networks. Mukesh's main research and practice interests are in the areas of risk and resilience in emerging and developed industrial systems. He has developed risk management processes for global manufacturing investment decisions and supply networks. Before joining the University of Cambridge, Mukesh's previous roles were in the financial sector as a senior analyst and corporate finance consultant. He holds a PhD from the University of Cambridge in the area of Manufacturing Investment Risk.

He is currently working on various projects related to supply chain risk and resilience and involved in masters' thesis supervisions and teaching (DTC cohorts, teaching involvement in ISMM, MET and CPSL courses / seminars for industrial executive). Additionally, he is member of the CUED PostDoc- academic committee and the faculty board.

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Professor Alan O'Neill

Emeritus Professor of Meteorology and former Director of Research in the School of Mathematical and Physical Sciences at the University of Reading, and currently a visiting professor in the Cavendish Laboratory and a visiting fellow at Clare Hall

Alan O'Neill's early research career when employed at the Met Office was in the area of large-scale dynamics of the stratosphere and its relevance to the formation of the ozone hole. On moving to the University of Reading, he ran large national collaborative programmes in climate science and, as founding Director of NERC's National Centre for Earth Observation, collaborative programmes on the use of satellites in environmental science. He has been heavily involved in developing strategies for Earth Observation from space both nationally and with the European Space Agency, the latter in his capacity as chair (till end 2014) of its Earth Sciences Advisory Committee.

One of his prime objectives while at the Cavendish, and soon to be in its new Maxwell Centre, is to build capability in the use of satellite data and "big data" analytical methods (e.g. machine learning) for diverse applications in the environmental and climate sectors, in particular in the area of agri-food and sustainable production. He aims to do this in collaboration with external partners in both the public and private sectors.

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Expert Witnesses

Steve Peedell (SP)

Dr Mukesh Kumar (MK)

Professor Alan O'Neill (AO)

Forum Members

Doug Crawford-Brown (DC-B)

Hildegard Diemberger (HD)

Ian Hodge (IH)

Paul Dupree (PD)

Miles Parker (MP)

Rosamunde Almond (RA)

Susan Owens (SO)

Martin Roberts (MR)

Therese Rudebeck (TR)

Kirsten Van Fossen (KVF)

Kristen MacAskill (KM)

Danny Ralph (DR)

Julian Huppert (JH)

Theresa Marteau (TM)

Transcript

Duration: 2:42:25

MP:	Welcome to the first session of this term's Cambridge Forum for Sustainability and the Environment. Those of you who have good sight still will realise I am not Martin Rees, he's sending his apologies as is Paul Linden, so you have me for the evening to chair the session, I'm Miles Parker from the Centre for Science and Policy and I've been a member of this for a while.
	Welcomes to our three speakers tonight: Steve Peedle from the JRC, Mukesh Kumar from the Institute of Manufacturing and Professor Alan O'Neill who is visiting at the Cavendish from the University of Reading. Welcome too to our three new members, Julian Huppert, Theresa Marteau and Danny Ralph, welcome.
	What we start off with always is a quick round the table to explain who we are so that you know who you're talking to and indeed so that we get to know each other. So I've explained myself. Roz, would you like to take it away?
RA:	Hi, I'm Roz, I've written all to you so you know who I am. I'm a conservation biologist by background. I'm sitting in Mathematics with Paul Linden bringing together these meetings for the next year and I'll tell you a bit more about those before we start.
IH:	I'm Ian Hodge, I'm from the Department of Land Economy, I'm interested in rural land, environmental issues, agricultural issues from an applied economics institutional



	perspective.
DR:	Hi I'm Danny Ralph, I'm from the Business School and I'm here really on behalf of the Risk Centre. There are two risk centres in Cambridge University, one is represented by Hugh Price and Martin Rees and the one I'm in is in the Business School and we are interested in systemic risk and I think I'm particularly keen to hear about thoughts on supply chains and food security for that reason because it's a complex system that we're dealing with.
PD:	I'm Paul Dupree, I'm a plant biochemist, I work on plant biomass and natural materials from plants, so in building construction for example and for food and for energy, bioenergy.
KVF:	I'm Kirsten Van Fossen and I'm going into my second year of my PhD. I'm with the Centre for Industrial Sustainability at the Institute for Manufacturing and in my PhD I'm looking at how actors in the food sector are working with actors in the healthcare sector to give consumers greater access to healthy foods and helping the shift to a healthier diet.
TR:	My name is Therese Rudebeck and I'm also going into my second year of my PhD supervised by Sue Owens sitting over there in Geography and my interest lies in the role of the private sector and business in water governance, particularly at a global level.
MR:	I'm Martin Roberts, I'm from the Institute for Sustainability Leadership here in Cambridge and I work on natural capital with many multinational companies.
HD:	I'm Hildegard Diemberger, I'm from Social Anthropology and director of the Mongolian Inner Asia Studies Unit and I'm coming from the whole question from the angle of extreme landscapes and people who live in them.
SO:	I'm Susan Owens from the Geography Department, I'm interested in science and politics and the interactions between knowledge and policy-making, I just published a book about the 41 years of advice from the Royal Commission on Environmental Pollution and the effects of that on environmental policy.
DC-B:	I'm Doug Crawford-Brown, I was the director of the Cambridge Centre for Climate Change Mitigation Research before retiring on the 1 st of October, although I still spend a little bit of time doing that. I'm a physicist by training, I've spent most of my life on risk assessment issues.
JH:	Julian Huppert, I trained as a chemist, ended up as a physicist, now in the Politics Department after spending five years on leave as the Member of Parliament here in Cambridge, so I have a broad interest in any aspects of public policy but trying to narrow it down a bit.
TM:	I'm Theresa Marteau, I'm a psychologist and I run a research group based in the Clinical School here in the Institute of Public Health and my interest is in changing behaviour across populations to improve health and focused on consumption of food, alcohol and tobacco and sedentary behaviour, consumer sedentary behaviour.
MP:	Thank you very much. So the normal format we operate is that we invite three witnesses along to talk to us, we give you 10 minutes or so each to introduce your take on the particular topic we're dealing with, in this case risk, resilience and response but in the context here of food chains and food availability. We'll take it in turn as from the top, so Steve first and then Mukesh and then Alan. After that we go into discussion, there will be questions, there will be discussion, we take that through until around 6.15pm, then we break for a drink and then we have further discussions over supper, less formal ones.
	Roz before we go in, the things you need to say about the programme.
RA:	Yeah sure. So I just thought that the forum as some of you know who have been here before but for the new people it's been going for about two and a half years or so. This is the third topic that we've been talking about. So we started off with sustainable cities, last year was land use, land use change, as Miles said this year the umbrella for the area is



	<p>risk, resilience and response. There are around 25 members in the forum, this year they are from 19 different University departments, new people from POLIS, the Centre for Risk Studies, from Computer Sciences, Institute for Manufacturing as well as architects, engineers, so it's a really broad group and the idea each month is to think about the questions that I've given you. So everyone gets the same questions, so what are the questions that we're not asking yet, what are the gaps in what we know and what are the burning research questions we'd like to ask in the future.</p>
	<p>This year is a little bit different, we're tackling something slightly different each term. As Miles said this term is food and water resilience, next term is going to be city resilience, particularly the role of technology in how cities might evolve in the future. The third term is going to be health, well-being resilience and then the final term, well really October next year, is going to be financial resilience. So each group of those three meetings will all focus in that area, will be looking at research gaps and future challenges and will each end up with an output.</p>
	<p>So this term we're working with JRC, the Joint Research Centre for the European Commission and we're going to be over the course of the three meetings bringing together what we're hoping is going to be an EU White Paper around gaps and challenges that will feed into EU policy-making. So that's the ultimate aim of this term and I think that's enough about that.</p>
MP:	<p>Thank you. Right, in which case Steve the floor is yours.</p>
SP:	<p>Thank you very much and thank you for the invitation to talk to you this evening and I look forward to some very interesting discussions. It's probably actually very appropriate that I go first because I'm probably the one here that knows the least about food security directly and particularly about supply chains. But as a bridge between the previous topic of land use that's very much my domain, I'm a geographer, I've been working for the last 30 years with geospatial information technology applied to natural resource management, initially in Europe but now outside of the EU.</p>
	<p>So I work for the Joint Research Centre which is part of the European Commission and the European Commission is very much looking beyond the borders of the 28 member states and has a strong international agenda that we support working at the JRC and where we also have a very long tradition of the use of geospatial technology to gather information around those themes. So I know I'm in good company when I see a banner on this welcome sheet that has a remotely sensed image on it.</p>
	<p>So that's what I'm really qualified to talk about and in particular those of you that may have heard my colleague Alan Belward speak, I believe he spoke at one of these previous meetings, he would have talked a lot about the work we do in terms of land resource management and water resource management as well. The reason the EU is interested in that from a policy point of view, we do sit at that science policy interface which is not always a very comfortable place to be but it's certainly very interesting, is because the EU is a major donor. By most reckoning it's the largest global donor and in my case we're looking particularly at the impact of the investments that are made from the EU on biodiversity and trying to make the link between that and development of where food security will obviously be an issue.</p>
	<p>The EU is planning to spend €850 million directly between now and 2020 just on biodiversity programmes as part of its overall official development assistance portfolio.</p>
	<p>So we're looking at areas in my case, my geographical domain is Africa, Caribbean and Pacific countries, these are part of the Cotonou trade agreement between the European Union and the ACP group of states, 79 countries across that region, so basically Sub Saharan Africa, Caribbean and Pacific Islands. These are areas where you have large amounts of rural poor that are very much dependent on the biodiversity and ecosystem services that exist within particularly the areas that we're interested in from a conservation</p>



	point of view of protected areas.
	I run a project called, BIOPAMA, it stands for Biodiversity in Protected Areas Management, jointly with IUCN, the International Union for Conservation of Nature, that's a €20 million programme over five years, to provide a sound knowledge base for decision-making around protected areas, not just from a conservation point of view, but from a development planning point of view overall. Because what we've found is that the knowledge landscape is very fragmented, there are lots of challenges with data availability, data processing and that's why I'm interested to see that you have the topic here of big data. Quite often we do have a lot of data, it's not about data gaps but it's about data fragmentation, it's about diversity of data, lack of standardisation, lack of cooperation around data sharing in that domain.
	So I think just to underline that although we are very much focused on a project which is protected areas and land and marine resource management, the whole issue of populations that live in and around protected areas and globally that depend on the resources that come out of these protected areas, or the impact of agriculture development encroachment on those is significant.
	Despite all the information we have, despite all the policies, despite all the money that is going in we have a rapid decline in most of the indicators of the well-being of the protected areas that we work with. We are in what can only be called a wildlife crisis. These are areas which are under extremely strong competition for land and marine resources, that are often degraded and I underline the fact that we are talking about very finite resources.
	Interestingly I've just actually come back from Tanzania where I've been visiting areas where as a key sort of indicator species the African elephant has suffered a 90% decline in its numbers since the 70s, largely attributed to poaching and illegal resource use. But the good news is that it's not the first time it's happened, it happened back in the mid-80s and was down to about 80% of the population but the population recovered. So some aspects of these landscapes are resilient and can recover but the trend now is slightly more worrying and longer term downward trend in these areas.
	So we're able to measure I think a lot about the risk that the landscapes that we study face but our challenge is to bring in the stuff we don't know about and what we're looking for is to hook up with organisations, research initiatives that particularly have information about the socio economic aspects of nature conservation and designation of areas as protected. We are also interested in being able to trace the use of the information products that are generated in decision-making itself. We provide a lot of indicators, we provide a lot of data but it's sometimes extremely difficult to see those things being used downstream in the decision-making process.
	In our project BIOPAMA we are working very closely with what are called the regional economic communities in Africa of which there are several: East African community, Southern African development community. So these are groups of states that make decisions on the development agenda often with donor funding from overseas but they don't have a strong emphasis on natural resources, particularly from the conservation side. So we're trying to encourage the use of these information products within the decision-making in those type of environments rather than within the ministries of environment, wildlife, tourism and so on.
	It's also very useful for us to know exactly where and what are the data gaps. We've just done one study which is to map knowledge of plant distributions across Africa using information from the Global Biodiversity Information Facility and then to correlate that with areas that are subject to high change. These would therefore be areas where we would like to invest in new data collection if appropriate. So finding those areas of knowledge gaps is important to us.
	The other area where we struggle to get information because as I say we're comfortable



	<p>with the earth observation side, but on the ground particularly remotely it's difficult to engage institutions to provide us with data, but certainly land tenure, land rights, mining concessions. Tomorrow I have to reply to an EU Parliamentary question on why our system doesn't have information on oil concessions in the Virunga National Park which is a very politically and economically sensitive situation at the moment and the reason for that is that that data costs money. It's commercially sensitive, it has a high value and we don't have the money directly to purchase those things, or if we do we can't then distribute the information products that we have because of the various rights that are inherent in that type of commercially sensitive data.</p>
	<p>The other thing we would like to promote and are seeking to promote is the use of open data for that very reason. So encouraging government departments to open up their information resources. I'm sure other speakers will talk about the importance of an open data policy around things like the new Sentinel satellite. But overall transparency of access to information and the use of that information is key to us in some of the countries we work in.</p>
	<p>So the key research questions coming from that are if we have a lot of data how can we manage and process it and we're not always talking when we talk about big data in terms of big data volume, it can be complex or very heterogeneous information and we're always looking for unconventional information sources to assist us in our work. I was just looking today at a map of mobility in Western Africa by tracing the movement of mobile phones and the impact of that on the Ebola crisis and why that has been so much more marked than in Central Africa where Ebola is a fairly regular occurrence but doesn't have such a wide spread in its mobility and access issue.</p>
	<p>One other project that I work on is to try and map the tropical road infrastructure, so how accessible places within tropical forest ecosystems and that is a very changing and dynamic landscape and again is a big data issue as we have many millions of very small geometric features that we need to analyse using GIS and other techniques.</p>
	<p>That brings us into all other aspects, things like crowdsourcing and the quality of data and using that.</p>
	<p>The other thing that we're interested in is maximising the efficiency and relevance of data collection. When we do have to go out and collect new data it's an expensive business, how can we target that and certainly through the funding programmes that we have make sure that the data collection is smart and is coordinated as far as possible.</p>
	<p>In terms of the role of resilient landscapes I guess our other research area is looking at the current protected area network globally and determining whether it is appropriate for the future. It's quite often not appropriate for now but whether it will be appropriate for future scenarios of climate change, habitat change and so on is a very big question. So we're certainly very interested in taking the data we have and combining it with other resources to understand that better.</p>
	<p>We need to go beyond the idea of the Aichi Targets which are these ideas of having a certain percentage of your marine or terrestrial surface covered by protection, but actually to look at the effectiveness, representivity and vulnerability to change of whatever makes up your 17% or your 10% of your surface area.</p>
	<p>We've also got lots of new reporting challenges at the global level under multilateral environmental agreements to policymakers who don't funnily enough use GIS in their daily work, don't use data-processing themselves, they need things that are ready to consume, they need information products that are ready to go. And so at the global level but also with the types of institutions we're working with in Africa, in the Caribbean, in the Pacific to make information really, certainly on natural resources much more a part of the decision-making chain.</p>



	<p>I guess in conclusion the more worrying aspect is the timescale that we have to do this. We've been very used in the past to look at long-term land use change. We have a project running now which has taken land cover data for 1990, 2000, 2010 and we can analyse change statistics and that's all very nice but the pace of change is just off the chart now in many areas, certainly some of the most vulnerable. So we have to be able to respond quickly with what we do in terms of getting data into information products which are then used as part of decision-making. Certainly as part of this wildlife crisis the pace of change is very, very fast and we need to respond much more quickly than we currently do.</p>
	<p>I think really that's all I've got to say in terms of an overview. I'm very interested to see how that ties into the idea of food supply chains. Just one other aspect for example that is specifically related to food in the areas I work on is bush meat. I think the figure for the Congo Basin is 6 million tonnes a year of bush meat comes out of the Congo Basin which is about the same as the beef production of Brazil, that's in an unplanned, unsustainable way, but there's a lot of dependence of populations on the protein that comes out of the forests of central Africa, the Amazon and other areas. So if I can make one direct link to that it would certainly be of interest to us is how to understand the whole issues around the bush meat crisis and its link to population growth, increased urbanisation and it becoming no longer a sustainable use of those resources. Thank you.</p>
MP:	<p>Thanks very much Steve. The way we usually work is we work through the three witnesses talks and then we start into the discussion. So I'll ask you Mukesh to lead off next.</p>
MK:	<p>So my name is Mukesh Kumar and before I start I would like to say thank you for inviting me here. This is the first time here and it looks daunting to me to be here truly.</p>
	<p>Just to give you a little bit of background. I've just completed 10 years in Cambridge, I came here in 2005 to do a PhD by mistake and then the Professor did a mistake after that accepting me as a PhD student and then I continued here. My background is pure accounting and finance and I worked in investment bank before, very different background than anyone in IfM who are mostly engineers.</p>
	<p>The food supply chain, almost we started looking at food supply chain around three years ago when we got the first grant from UK-India Research and Education Initiative, particularly looking at how we can actually understand the food system within India and the UK. That continued with another grant that we got from EPSRC and Department of Science and Technology of India looking at sustainability issues in both countries' food supply chains. And a third one we just this year got it in January looking at climate change impact on food supply chains as well.</p>
	<p>So these three are the background. Personally I would like to mention, especially mention Professor Doug Crawford-Brown here because we started almost looking at first four or five months funding that we got from Three Guineas Trust to 4CMR looking at climate change impacts on supply chains. So that's the funding background and going back to the research.</p>
	<p>The food supply chain risk and resilience when we look at is basically is not a particular technological research area or it's not just even social science area, it's a multidisciplinary that actually we are dealing with. When we look at resilience there are three factors that I would like to mention here: one is related to crop failure; another one is related to product failure and a third one is actually related to failures within supply chains and supply chain issues and I'll pick up these three topics one by one.</p>
	<p>Crop failure. Crop failure is one of the major issues which has multiple dimensions, one dimension we can look at because various places in this world, climate, because of climate change and other weather events these crop failures happen, but there are some social dimensions to this. Last month I just came back from India and what I heard from</p>



	<p>farmers and some government officers that in one of the states where the farmers are very rich farmers are doing suicides linked with crop failure. Now let's go back to why they are doing suicide and we even investigated that one but what we are finding out is the farmers are actually now becoming main landowners and the farmers don't have land, those who call themselves farmers. These farmers are using genetically modified seeds now and that requires special care and special pesticides and these pesticides I think it's being sourced by the government and currently in this particular crop which I can't name it got some pest problem and they imported some new pesticides from a different part of the world and these pesticides were fake, they didn't work. The crop failed and now farmers who have taken loans to pay the lease for the land, seeds, they are finding that it's better to do suicide so that their family can be saved and the world stops. So that's the social damage that we are looking at here.</p>
	<p>Now when you look at the second point I want to talk is related to product failure. Product failure we have seen in the UK, the horse meat scandal, although fortunately it didn't...people were not emotionally, it didn't happen or anything and if you get the chance to Google in India you will find people are dying because they eat, some people got killed because they eat beef and in Middle East if somebody eat pork, that could be illegal. So now we are seeing a product that is supposed to be a product, particular kind of product, if it is not it has various dimensions. Legal dimensions are there but another worse one is also harmful chemical in the product. If you look at Australian news, a few Australian people got hepatitis disease because they ate some frozen food imported from China. What particularly all these things also is that we don't have any visibility, any transparency, we can't trace the food also very quickly.</p>
	<p>The third dimension I would like to bring to your attention is within supply chain issues. Supply chain issues again it's linking farmer, it's linking to customer. Just to give you a figure in the supply chain what is the main issue is the wastage, there are currently 27% wasted in food supply chain and currently 1 billion population also go hungry every day. If we just half that wastage we can feed 1 billion population. So issues...solutions are not just including the food, production that actually exists within the current system there are lots of inefficiencies there. Also this supply chain issue has some social damage inside as well. So we investigated some grapes grower in a region called Maharashtra in India and that's very interesting because that region, those farmers were banned to export their grapes to EU in early 1990 because those grapes have arsenic elements and arsenic is actually in the water there. Now these farmers are very clever, they created a society, got some funding from the government, imported water purifying machine, used a drip irrigation system, now they also have organic pesticides and fertilisers that they are using, but what is the social damage when these farmers are growing grapes using mineral water but still drinking arsenic water.</p>
	<p>These are the challenges that we need to look at. Now when we look at whole supply chain what are the other major issues that we should be looking at and I think mostly I learnt through 4CMR work is there are two dimensions. One is there are lots of sustainability issues within the food supply chain in terms of high energy use, water use within the food supply chain because of open irrigation system in most of the developing countries area and also we are looking at various other key resource use in terms of wastage, the third point is the wastage. All these three factors contribute to the climate change. That's one dimension, how we can reduce and how we can make food supply chains sustainable. Why we have to make food supply chains sustainable? Because if we don't do it climate change acceleration is and climate acceleration will happen. The second part climate change is happening and current food system is not resilient and adaptable enough. And these two areas that when we look at it's the same coin but two different perspectives that we can see.</p>
	<p>So all these things that when we look at what we are finding is the solution could be in the area that we look at is looking at a more distributed system of food supply chains. And what I mean, I can just explain. India currently wastes 40% of the food which can feed</p>



	<p>whole Australian population for one year. That wastage happened in upstream supply chain. Upstream when I say it's more about farmers at the farm and after the crop has been cut and processed. If you look at the UK, UK food wastage happens at the end of the supply chain downstream near to the customer and retailer. One of the dimensions that we can take is why not we can bring the best side of India and best side of UK together and it will solve our problem. Wouldn't it be nice?</p>
DR:	<p>How about the worst of it?</p>
MK:	<p>I had always the [inaudible 0:34:01] that Indian food upstream supply chain wastage happens because there is lots of fragmentation, it's much more distributed to small farmers and in the UK it's much more consolidated and that's the reason and the solution would be is to create consolidation in upstream supply chain in India and because Indian food system also very efficient in downstream where the wastages are not happening because retail is much more distributed. When you compare to UK 73% of the retail is captured by only four big retailers and that's contributing to the wastage, so it would be nice to make it distributed here.</p>
	<p>Although both arguments can be stupid from various perspectives a solution could be that we can't do this consolidation there and in India upstream the solution could be can we consolidate the information and integrate the people through new technologies like ICT and farming. It could be that solution but what are the technologies that we should look at? How it can be implemented and how people can take benefit out of it are the big questions that we need to be asking.</p>
	<p>Similarly looking at is it really viable to interfere into the open market where the retailers are capturing 73% market. Again I don't have any solutions if we break them. In the old days no need to break them. Again there could be a solution that we should be looking at which again can be provided with the latest technologies and again ICT and distribution last mile logistic solutions that we can think about it.</p>
	<p>So until now I haven't defined any question, I've given so many questions because when we look at the food supply chain resilience there are three actors: three actors are customer, farmer and companies and everyone has a different question and it's very difficult to actually put those questions which is in very valid forms in one question. We need to take a fragmented approach, we need to take a multidisciplinary approach and define these questions taking some more time from various academic disciplines because one discipline won't be able to answer these questions. Thank you.</p>
MP:	<p>Thank you very much Mukesh. So finally Alan, thank you.</p>
AO:	<p>Well I must say so much of what I wanted to say has been said so I can relax and we can go on to dinner.</p>
	<p>So yes, I'm Alan O'Neill, my background is as a climate scientist and I've been involved for a number of years both with the Met Office and the University of Reading and leading climate modelling groups in trying to understand how the coupled climate system changes. Then my interest particularly evolved into the use of satellites and how we can use satellites. Integrated I should emphasise every time I say satellites I'm always thinking about other ground-based and other systems as part of the information chain so if I forget to repeat that please take the view that that's what I'm thinking about. It's that side of things that has really started now significantly to interest me because of the vast amount of data that are coming from space and the space sector and the fact that if we can cleverly integrate those data with other big ground-based systems and involve a much wider spectrum of people in this activity than the traditional science to society approach that we've tended to adopt in the past I think a lot of opportunities are going to emerge.</p>
	<p>If I were looking and taking as I do of course your directive seriously about the kind of questions I would pose in terms of what are the big questions, where are the data gaps, I think I would revert to type and present them in rather traditional ways and I don't think I'd</p>

	<p>tell you anything new. I would say for example on the climate side one of the biggest issues would be from the point of view of agriculture, food resilience, food security is what kind of use for predictability is, on what timescales over different parts of the globe. Now that's not a new question and this will be a question that will be with us for the next 20 or 30 years and maybe even longer.</p>
	<p>Whilst we can say quite a bit about the global temperature change the regional and temporal specificity of that is a big issue. Then I would say, but I'm not going to because I'm going to pull away from this in a minute, then I would say well great, fine, how would we integrate that then with other models let's say of crop yield and so on and that's a very traditional kind of approach and one can build a whole raft of issues around that. But I kind of feel that would be great and we will have to undertake controlled experiments in the good way of traditional...of physical and biological scientists, but I think we're getting into the stage now with the data that we're getting from space and other systems is giving us the opportunity to do what I call slightly facetiously uncontrolled experiments where the world is now...the kind of questions we're going to ask will be very sort of data driven. To misquote possibly Rumsfeld "We don't know what we don't know" and it's the ability to capture and gather data and Steve has mentioned the heterogeneity, it's not just big data, it's the heterogeneity of the data and how one integrates that information.</p>
	<p>Thinking about food security and supply chain there's going to be data required all along that particular chain, it's not at the start or the backend, it's all the way along it and it's our ability to explore the data, not necessarily in the way as we do as scientists with some hypothesis, in many cases we won't have a hypothesis, we won't know what we're looking for. We have to have some intelligent design of course as to how we think because otherwise we'd have infinite possibilities.</p>
	<p>So just in that regard I think we're at a transformative time actually with regard to space and I think that will trigger ancillary activity in supporting ground-based systems. We've now through the European Union deployed a constellation of satellites that is going to be ongoing and sustained, so this is the Sentinel Copernicus system. There's two things that are very important about this: one is that the investment unless we all fall apart politically will be sustained into the future, it's indefinite, it's operational, it's a global kind of earth system approach of integrated observations or released observations that potentially can be integrated both for climate, oceanography, land and what to go on, water and so on. So that's going to be an integrated observing system. The second key thing is that the data are open and essentially free.</p>
	<p>Now the US has had that policy for some time for publicly funded data, not commercially but publicly funded, now we're having that within Europe and that opens potentially the floodgates. Along with that is the private investment in small, agile if you want to call them that, less powerful constellations of satellites that give rapid revisit times. So the technology in that regard is changing along with massive increase in power of high-performance computing. Then comes another particular technology I think that again is relevant all the way along the food chain, it's the use of very powerful mobile devices, again you know all of this, I'm not telling you anything you don't know, both for data gathering and data dissemination and I think that's where that opens up completely the spectrum of people who can be involved with this. I think Steve talked about crowdsourcing and that's a real opportunity to have people involved at a number of ways and get to understand actually by being participants in the process of data gathering and use, to actually fully understand what is potentially on offer and to steer what the, if you like, the upstream activities that are designed to supply solutions, to steer that in the right kind of direction. So I think that's a real chance now for a change in the way we work with data.</p>
	<p>So technically - and I won't go into that too much - I'm particularly interested in this data exploratory side of it, there are mathematical tools that we can develop to do...and many of these tools to some extent are data and field and specific application independent. So</p>

	<p>this is the data discovery to find out what are the relationships between weather and crop yield or particular use of consumers in particular areas.</p>
	<p>Emphasising again the mobile devices I think it's true to say I think the World Bank has just noted that many countries, particularly in the developing world, have a greater percentage of people who use mobile devices than we do in the UK and US, I think it's about 50%. I think Gabon a place in Africa was something like 85% and the reason was this is not a kind of little toy that they text their friends with, it was absolutely vital to their livelihood, their ability to live, their ability to trade.</p>
	<p>So I think that's the angle I'm coming from but the question for me then is not particularly a direct research question, it is how on earth can we implement this capability? There are a lot of initiatives taking place, many of them will be publicly funded, some are going on at JRC, some are happening at the European Space Agency, some will be happening at Cambridge University, how can we get the best value out of that? In some cases we have to allow that heterogeneity of approach, we can't control it, how can we, but are there layers on top of that that can take leverage from these individual initiatives?</p>
	<p>So that's all I wanted to say at the moment.</p>
MP:	<p>Thank you very much. So the three of you have given us a very broad picture of both the capabilities and sheer extent of the data that is available now ranging pretty well over every discipline we could possibly have considered.</p>
	<p>What we'll do now is get into discussion around that within this overall umbrella about risk, resilience and response and I guess while other people are thinking about questions my first one would be around how we can get away from the utilisation of this data in what I think of as a sort of passive historical mode, charting as I think you were mentioning the awful declines of various indicators, into a more predictive mode of identification of emerging risk and indeed how would we use this sort of data to identify the factors that lead to resilience. Is that a feasible question to ask you?</p>
AO:	<p>It's feasible, it's not an easy one to answer. I hesitate to start because that is actually...you've put your finger on in many ways a particular...that is in a sense the big research question, that is the big question, how do we actually do that and the predictive element in particular is particularly challenging from a scientific point of view because clearly it is evident that from data one wants to make predictions about the future or future circumstances and I think that the answer to that particular question would depend on the application. In some cases there will be a lot we can gain from the data itself from looking at past relationships and unexpected relationships that we hadn't actually appreciated before. That's the kind of data mining terminology if you like.</p>
	<p>There will be other cases where we'll need, whether it's physical models or crop yield models or a more traditional sort of model that we kind of think mathematicians and economists know about. But it's that mix, I think we're all kind of trying to figure out how to do this and I think one of the interesting things this forum can do I would say is to think about precisely that and how we implement these capabilities. So it's not really answering your question, it's throwing it back [inaudible 0:45:54].</p>
MP:	<p>That's fine. That's what tends to happen. Do either of you two want to make...?</p>
SP:	<p>Yeah, I mean I would say I agree that it's not just about measuring how awful things are, it's about...certainly what I'm always pushing to the teams working on the projects that I work on is to look at what the future impact might be and how to drive that into decisions that can actually turn some of these things around.</p>
	<p>The problem we have is that in many cases we just simply don't have the data to allow us to do that. So we're doing the mundane housekeeping stuff right now to be able to answer those questions, we'd love to be working on those things, but quite often it's just trying to compile from all these different sources what is there and understanding that.</p>



	That's why I'm very interested in the sort of techniques that might be available to let the data do the talking because we don't have the time and the energy to just be trying to just gather stuff up from all these non-coordinated approaches. Certainly in the domain I work in there's a lot of islands of data that we have to try and pull together and that's where a lot of our energy goes right now unfortunately rather than in the cool stuff.
MK:	Aligning to all these views, I think one is we don't have a data and one is we have a data and if we have a data what we are doing with that data. I think there are various data, various forms that exist but it's not being currently used correctly. For example climate change data when I started doing that work and mapping it, [inaudible 0:47:27] four different database, it was so difficult for me, because I'm not a climate scientist, to try to even understand what actually it means and how to use it. The data is there, can somebody work a little bit more to make it user-friendly, a common people can understand, a farmer can understand. Mobile devices are there in developing countries and people are using that and I think there is a good opportunity and I just particularly mention one particular app called Rice Screening in there and this app downloaded by any farmer who has a simple mobile phone can download and get information what kind of pesticide they should use, what kind of fertiliser they should use, what is the crop cycle. It's just simple things, how to make the most use of this current observable data that we already have and make it available to people.
MP:	Doug?
DC-B:	So an example from the US of where things go horribly wrong - we have lots of examples from them, I can say that now as a British citizen - in the 1980s we created in the Environmental Protection Agency the EMAP program, the Environmental or Ecological, depending on which group you were in, Monitoring & Assessment Program and the aim was to collect massive amounts of data. Now I can't tell you how many literally exabytes of data were collected in there. The aim was not just to understand how these ecosystem functions and services were changing, it was to identify or try to identify whether policies were influencing these changes so that you could use it as a policy evaluation tool. What we found after 20 years of it was that you couldn't see a policy signal in it at all, there was just no change when different policies were introduced. That's either because policy didn't in fact change anything or because the data was so noisy that you would never pick up such a signal.
	So is there any sense in which these kinds of data can be used to assess what works in the policy arena or does it really need to stay in the sort of science realm of what's actually happening in the ecosystems?
AO:	The policy issue is another issue, it depends on to an extent to which politicians make evidence-based decisions, I mean that's another issue which I'm not qualified to talk about.
	But what I would say, apart from my own personal prejudices of course, what I would say is it's absolutely not the case, and I'd be very interested to what happened to the data, because it's not the case that these data should remain purely within the science domain I think. If we can get to the point, and I know there are risks associated with this in various ways, of openness of access and the platforms to allow people to develop innovative use of data, that's going to open it all up and I think Steve and I were talking before we started about the geek in a Californian garage or something, maybe it's a Cambridge garage, who with access to the data is going to do the kind of thing that we don't tend to do when we do the science to society gig, or we do a sort of science initiated project supposedly geared towards a policymaker.
	I think it's this openness is going to be the key to the innovation and the infrastructure to support that. Now it's a rather generic remark and I'd be very interested for example if those datasets that have been collected fastidiously, where are they, are they open, are they documented, is there any metadata that says to somebody now in this point of time



	30 years later well this is how it was done, because if you do that the values could be gold in there, it may not be for us to find it but this could be gold in there.
DC-B:	All you need is a tape reader. Anybody have one of those?
MP:	Which is rather the problem. Do either of you two want to comment on that?
MK:	Just very quickly because we are talking about food supply chain resilience, there is very less data on supply chain, we really don't know where the food comes from. There are different domain of looking at crops and [inaudible 0:51:47] satellite using the data, it's there, climate change data is there, but we don't really know the cross-sectional supply chain, for example seed supply chain, where the seeds are coming from, where the pesticides are coming from. I can just give you an example, in the UK 50% of tomatoes comes from one location in Spain, other 80% of the fresh food and vegetables get imported to the UK, do we really know where it's coming from? We don't know. Actually supply chain data I would say generated in a much more grounded form which we don't have any visibility.
MP:	Okay. I now have Ian, then Susan and then Julian.
IH:	I was wondering to what extent it's possible to target, I mean I presume there is an infinite amount of data we could collect, so some sort of targeting, some strategy is necessary, but to what extent it's possible to target data where simply the availability of the data and giving that information to particular people in particular places could almost directly enhance resilience. So an example might be helping understand local property rights perhaps, where simply the knowledge, the general knowledge that certain groups of people in particular place have particular rights would influence the way in which someone goes about putting in a claim to do something or trying to buy land to do something. So it actually might shift resilience to particular groups. Another example might be with food waste, simply accumulating the information on food waste would actually demonstrate to potential entrepreneurs I guess that there is an opportunity here that by assembling something to a particular scale then a particular activity would become possible. So I wonder if there's a sort of class of data that simply by getting the data, passing it to people in particular places almost without processing it very much, actually would help resilience, add resilience to a system.
SP:	Yeah, I mean I agree. I think there needs to be some sort of intelligent generalisation of the information to a level at which it can be used openly, because quite often there's issues of sensitivity and so on, particularly in landownership. I don't need to know who directly owns a parcel of land but I would love to know what typology of organisation, person, whether it's individual, community owned, owned by an industrial actor or whatever, and those sort of things would be very useful for us to know to also understand the sort of processes that are going on and why they're different. I think that comes down to the sensitivity of data, when we talk about open data I want to underline what Alan was saying is that...use the example of Tanzania again where in theory I think Tanzania has an open data policy and you can get lots of stuff about government, but it's also happened to have passed a new law which makes it illegal for any information to be published about anything to do with Tanzania unless it's been vetted by the National Statistical Office.
	So in principle some of the work we do on the ground in Tanzania is illegal and I have some colleagues from World Bank that are doing stuff on the ground and they walk around with a letter which is a get out of jail letter basically if they do get picked up for anything they're doing which is to do with data collection, but they've got a pass card because they're taking it very seriously. So I think the whole issue of...some of it is sensitivity down to the individual, so you can generalise that up and I think there's a lot we can know usefully about what we need for a whole bunch of questions around natural resource management. Then there's the issue of transparency and good governance and unfortunately that isn't always the case which means it's very difficult to unlock exactly the type of data that sits in a government department in a lot of countries.



MP:	Were you going to say something else Mukesh?
MK:	Yes. I think what I want to say here is awareness of particular issues really helps to change behaviour, but what we have seen, especially the consumer behaviour or customer behaviour, it doesn't affect their behaviour unless until it affects them. So in the UK we say that okay don't do food waste, keep it for more time and eat it, it won't change their behaviour because they haven't experienced food shortages. If they want to binge 24 hours, 12 months they can buy it. So it's very difficult to actually change the behaviour and somewhere I think there I want to see is how we can work towards these behaviour changes. And it's also looking from other company perspective. If I want to buy a particular can of beans it's big, I don't want to eat all of them, family size is getting smaller, now more one person people are living and I have to open it and then I have to throw it because I don't want to keep it. All these things, I think the answer could be in a different domain that we have to start looking at. But awareness and experience, if we add it together the impact on resilience can be developed and it will be much more impactful.
SO:	Thank you. I thought those were really, really succinct sets of ideas and questions so it's very helpful. Miles said you ranged very widely over different disciplines but the one I didn't hear very much about, although Mukesh touched on it rather obliquely, is politics. I mean I realise that your particular disciplines may not be in that area but what you're doing seems to be to collect data, possibly to turn them into information products as you said, in order to inform decision-making processes. I mean I would defend to the death the collection of knowledge just because it's interesting, but that didn't seem to me to be what you were saying was your main objective. So the question is what's it for? Because from my own research it would seem...just as a disclaimer I'm not remotely for one second implying that it's not important to know things or that data isn't important, I'm an academic so it's a kind of lifeblood really. There is a question of what's it for because actually it often seems that political actors and decision-makers are not actually short of information or data or products or evidence, so what they do is actually not necessarily directly related to that information, especially in the short term. I find it quite difficult therefore to...in a way...this is unfair but I'm going to say it anyway, so to say that well what happens to it after we've kind of shoved it out there is nothing to do with us, that's all to do with evidence-based policy and what politicians do, that seems as bad almost as political actors saying just give me the truth and I'll act on it, which is often said, not quite in those words but is honoured only in the breach usually.
	I think I'd like to understand a bit about whether the data gathering particularly with the capabilities of big data and all the data technology, does it just become kind of compelling in itself and it's a bit like Ian's question, what is it for if we don't understand how information is actually used, if it's used at all, by those who make rather critical decisions? So it's related to your point about the effects of information on individual behaviour but I think there's also a very important area of...I hate the term, but the so-called knowledge policy interface, it drives me completely round the bend, but nevertheless we need to understand that as well don't we in order for all of this to have some point to it?
MP:	Before I bring in the speakers, Julian, you were going to be next, were you in the same sort of territory as Susan? I'm just bringing in our local politician.
JH:	Not directly, but I can be.
DR:	Actually my question is sort of so why don't I just bundle it in?
MP:	Yes do.
DR:	It sort of is but then it's not exactly the same.
TM:	Can I bundle mine in as well because it sort of [inaudible 1:01:25]?



MP:	Okay, let's collect a few.
DR:	So I said recently, it was sort of a...had a big data flavour meeting and there was a guy from Vodafone who said...this is just an example [inaudible 1:01:39] question, "We do a lot of derived data because we have 25% of the UK on our books on a 30 second or whatever, one second basis, but we have had to develop our own internal rules for derived data. For example we might..." He didn't quite say this, but this kind of conversation "We might send you a text that the Tube that you normally take at 8.15am is out of action even though you haven't even told us that you take the Tube at 8.15am. But what we wouldn't do is send you a text and say we regret on behalf of transport for London that your favourite Tube is out of action and we'll give you 20p off coffee at a Starbucks of your choice." You can sort of see why, even though there ought to be a win-win there it's just that second step is one step too far and then the consumer of the data or the holder of the phone doesn't know if they're being played.
	But the bigger question was the following or the issue is the following: we're going into new territory as we have been forever but the data territory is something we're still discovering and the question really is what should governments if not other large organisations of any kind be trying to put up a scaffold for developing an intelligent conversation around what one does with data? Because in the absence of any policy about what good behaviour is we're going to create some large gorillas that we're going to wish had been visible from the beginning of the conversation. So you might create a little volcano there that just by not spotting a problem that is going to arise later from derived data. There are lots of little examples of me finding out things that I wish I didn't, about my family or whatever, etc, etc. These are all small things, I'm sure you've heard of these issues. But we're in a space where I'm hearing the Holy Grail is more data and doing intelligent things with it which I think we all like, but data isn't like that, the information derived from data is whatever it is and it's not always what we think is beneficial. So that's kind of...it's not quite Susan's point but it's not unrelated in the sense that politicians might do what they do anyway, are they going to use the data to say that what they're doing is a good thing or is it...? What's driving what here? That's part of it. My question is slightly on the bigger picture again. We don't even know the territory that we're in.
MP:	Theresa are you in the same space here? We'll use Susan's unfavoured term of knowledge policy interface.
TM:	So I'll just make two points, one on the back of not knowing the space we're in and then I want to I think speak more to Susan's point about what's the point, what's the problem we're trying to address.
	So in terms of the space we're in this is a very personal example. I'm collaborating with people in Psychology who have data from I think it's 50 million Facebook users and it's proved terribly difficult, and we haven't cracked it, to get ethics approval for use because the way in which... So that's just one example. But luckily we have the ex-Archbishop of Canterbury who chairs the University Ethics Committee and said he is focused on finding out the different ways we can use these data and it's about spotting patterns being data driven, but some of these data were collected with a very focused end in sight which was spotting patterns in terms of voting. So how many people do you need to poll in order to call for Utah? So I was going to just make one point, where there is a commercial will certainly they are finding a way with these data and I think part of what the three of you were talking about was here are all these data, actually we do have some of the facilities, the maths and the computer resource to crack it, but actually it's a bit like awful drunks, really people can't see what the commercial gains are.
	Just finally on Susan's point, I too...I kept struggling with. So what's the question? You've all talked about, well in my mind anyway, different...I think about things in terms of behaviour, behaviour in systems and behaviour as an individual, so Mukesh you were very clear about the behaviour of the farmers, the suppliers as well as the consumers and

	you generate all the data, sometimes one wants to change the behaviour of those individuals and very often the information tells you about the problem but it doesn't tell you about the solution. So we need to be a bit clearer I think about what the data are doing.
MP:	I'm going to bring Julian in on this first and then let the three of you respond and then we'll take a deep breath and go for some coffee.
JH:	There's some really fascinating stuff from the three of you and from others. In terms of data protection we do have lots of laws, I think the problem is we're working so hard to have lots of complex laws to avoid all the gorillas that we're going to trip over all the laws that we've just put out to stop the gorillas.
	There are some really interesting problems about it's personal data applies to one person, applies to more than one person it's not personal, so if it's two of you living in a place it's not personal exactly what you do but as soon as one person moves out it is. There's lots of issues there. I think [inaudible 1:07:31] I find the data stuff...in defence of politicians and political decision-makers and there is a lot of famous use evidence, there is a lot of good evidence use if nobody is looking, and so on areas where things are just being done then it doesn't get into the media, it doesn't have a driver 'No we must or mustn't do this', and then you can actually have really good data driven, evidence driven work and different to the huge amount of work that is that. Because there isn't a big argument of exactly what we should do in Tanzania. So part of it is separating that public scene from actually the bulk of public policy.
TM:	So you get the politics out of it and [inaudible 1:08:08] people.
JH:	Precisely, yeah, because everyone can then agree what we're trying to do and now nobody cares about the details and just go and do it. Defra has an awful lot of areas where there just isn't a lot of excitement about it. What I was actually going to talk about though was, because I'm quite interested in some of the stuff you can do with the space data in particular, where we were very rudely I think chatting you can serve effective policy from space data. The Haiti-Dominican Republic border, you can see exactly where is because one side has trees and one side doesn't have trees, it's really, really clear-cut.
	But it seems to me, and it applies to the space data as well as the others, that there are different stages. There is one which is observing what's happening and in some areas I sense that we have the data to do that in some places and not in others. There is the next phase which is trying to predict what happens which probably means you have to have had the observed data for long enough to be able to see the trends. Then there's the third one which is what you need to do any sensible policy-making which is to be able to see the changes because although something may indicate what will happen to something else five years later it's not the case that if you change it you will change the outcome, because they could be both features of something else. So that is a much more complex one. I'd love to know roughly where we are.
	The other thing just because I thought Alan's stuff was really interesting on what we can do, the sort of coverage that you're talking about, is that Europe only?
AO:	Oh no, no.
JH:	Or how good are we at doing that elsewhere? Because one of the interesting things about space is that you are less affected by national boundaries and you are less affected by the level of infrastructure in a country.
MP:	Right, gentlemen, you've obviously sparked a bit of discussion, would you like to try and pick up some of the points raised and then as I say we'll break briefly.
AO:	In terms of what's the point I have to confess I have two aspects that affect me in terms of gathering data: one is the profound view we're getting about the world as a system, as the most complex object we know in the universe, a deeply fascinating perspective that 10 or 15 years ago we hardly suspected and the interaction between the physical system and I



	<p>can go on and wax lyrical, and that's a very deep emerging knowledge base that's coming. So from a purely scholarship point of view this is completely dramatic.</p>
	<p>But there's also, without being too melodramatic, the recognition and I've sort of been sketching it on this piece of paper, see those curves? So all those curves are the same shape of curve and they have CO2 in the atmosphere, population growth, pollution, I could go on. And I think the point is as Al Gore in his speech I think in '98 was looking at some way that we can in a sense manage, and I don't think he meant it in a sort of malicious way, manage the planet or manage how we live on this little spaceship earth. Fundamental in this ability in the grand scheme of things is going to be our ability to gather, access and utilise data to solve problems. One of the big problems that we could well face in the next 10 to 20 years is a gap between food production and population, at least in large parts of the world.</p>
	<p>So I think there are very, very real problems that we have to address and I think it behoves us that we...of course it does, that we should be working as scientists to make sure we can do that. In some cases our problems will engage policymakers from the outset, in other cases perhaps not. If you talk to Sainsbury's, Sainsbury's is a very responsible...I shop at Waitrose actually, but Sainsbury's is a very responsible supplier...not supplier, whatever the word is, they operate a consortium of suppliers and they have a policy around the world where they try to ensure stability, resilience and all the rest of it and they are looking for ways to gather data to help their suppliers in that way. So if there's an El Niño which destroys a coffee crop in Brazil the tendency might be to say "Goodbye, we're not going to work with you again, we'll go to Africa", but they don't want to do that.</p>
	<p>So it's those kind of problems that are coming up time and time again, it has a commercial value but it has a societal value and I think it's the problem-solving and the way that stimulates science that particularly interests me as a matter-of-fact.</p>
SP:	<p>The so what question is one I use quite a lot and in fact it's my nickname at work because I do quite often sit in front of very fascinating things that have been done and say "So what?" Because I am trying to think of how it can be used to actually make some change. I think in terms of where we're at, in terms of what I work on, and I'm speaking on behalf of the projects I work on, not the broader portfolio of the Joint Research Centre where there's a whole bunch of activities and you'll have the opportunity I think in the future to hear from my colleagues that work directly on food security for example.</p>
	<p>But going back to what I work on, I mentioned that the European Union administers on behalf of the member states a vast amount of development assistance and money and if I can put in a good word for the European Commission, slightly biased though I am, it is that they are really seeking to make those policy decisions around the targeting of that money based on a solid information base which they recognise in many areas they don't have. Quite often therefore they come to the JRC and say "We have this policy, we need to quantify it, we need to see its impact, can you help?" and the projects I run are very much based on that premise.</p>
	<p>What I'm seeing now and why I'm travelling a lot round the regional economic communities in Africa to try and implement the work we're doing is to get that trickling into decision-making that they are making which is often not the case and they recognise that too. These regional economic communities are a bit like the Commission, they're bringing together countries with different perspectives but that have to share data because they have common challenges. They have a development agenda but they recognise that natural resources are very important as part of that.</p>
	<p>The question I was asked last week is when we were talking about the role of biodiversity information and information on protected areas is "How can I integrate this with agriculture decision-making?" So integrated spatial planning, bringing data together. So the point is to try and get some traction there, then it's up to those organisations, those authorities to</p>



	do the right thing whatever that is, but at least to give them a solid base to work on.
	I'd like to talk a load about the sort of data that mobile phone companies have but I think we'll do that over dinner because that's very exciting and also very frightening too.
MK:	Very quickly I go back to that point of knowledge policy interface. First thing, I don't have any authority to talk about politics and politics of food but one of the things that we know is there is a limitation of knowledge as well, there is a limitation of data as well, there's lots of uncertainty that exists within the data.
	Even though if we look at Indian food safety, again I'm going to talk about India because there I am currently working, the government knows that current food products are harmful to its population, they know that they have limited resources, it's only 16 labs for 1.2 billion population to test a food product and most of these labs are not equipped with all the equipment and chemicals which can test a food product is safe or not. There is a limitation of the government because they have limited resources and in some cases political compulsion and market forces also plays a big role.
	Four years ago the Indian government put wheat outside and they were storing and then it rained, so the government of India asked to distribute to poor people and our economics plan is to refuse to do that in its own right. I think it is better to let this crop be destroyed rather than distribute for free because we are interfering with the market. What will happen to the company? Will the company destroy our economic structure?
	So there are various other facets there and when we look at this knowledge and policy interface those facets, those dimensions generally in my opinion they have been ignored. Also another part is the policy implementation. Yes, we have a policy in various country about food safety, like are these being implemented?
MP:	Thank you. Let's take a deep breath, go and get a cup of coffee. We're running latish so if we can make it about 10 minutes for a comfort break and a coffee and maybe bring the coffee back to the table. Let's try and start again about half past. That will give us 45 minutes or so to carry on. Thank you very much for what you've opened up so far.
After Coffee Break	
MP:	I'm bullying everybody back to the table because we were beginning to get into some really nice discussion there and time is of the essence.
	A lot of issues coming up there which I'm sure we'll want to follow up. One I was discussing with Steve during the break was getting back to this issue of identification of risk, potential resilience and so on, was the extent to which we could generate simple indicators, things that would gain political tractability as indicators of potential risks and so forth.
	Steve, would you like to just say some of the things you were saying to me back out to this audience?
SP:	Also before I start to...make it clear that a lot of what we do at the global level is very simplistic, it's kind of a lowest common denominator. We'd like to have more targeted, regional information, that's very much what we're working to on a lot of initiatives on biodiversity, food security and so on. But if we look at the global level one of the things we do is we come up with a simple agricultural pressure index for all protected areas across the world and that's nothing other than a modelling of habitat and land cover information. Then combining with things like species indicators, using standard available global data but it is BAD, best available data, and quite often by doing it we are highlighting some of the deficiencies within those data themselves.
	So we produce a range probably of about 10 or 12 global level indicators for all protected areas over 150 km ² and are now looking to do it more as a landscape approach which would bring in more of the areas that are being used for agriculture and food supply.



	<p>Infrastructure, so the effect of accessibility as an indicator, the presence or otherwise of mining concessions, so one of the game reserves I'm involved in, Selous in Tanzania, 80% of its surface area is covered by mining concessions. This is one of the crown jewels of African conservation but in theory 80% of it is potentially available for at least exploration and if they find something you can bet, as they've done with the uranium mine that sits in the middle of it now is they've quite nicely just cut out a piece which is no longer protected which nicely delineates the extent of the uranium deposit, so that's the sort of thing we're dealing with.</p>
	<p>On the food security side we do produce a number of bulletins that are based on indicators. We do it certainly for Europe but we also do it particularly in the Horn of Africa because it's such a vulnerable food security area and links so much to our development assistance. We have a number of also near real-time information products that are related to this. So we have water availability, we have temperature anomalies, we have fire - these are remotely sensed information products that we're able to generate on a daily, biweekly, weekly basis using different types of earth observation sensors and then validating that with ground truth.</p>
	<p>So there's a lot of products that we have but they are constrained by not always having the link to the institute data and the variability of that information to really bring it out to make it more than just a simple comparison across different landscapes.</p>
MP:	<p>Do either of you want to come in on the indicators issue?</p>
AO:	<p>Nothing to particularly add on that particular point actually.</p>
MP:	<p>Well let me broaden out the discussion then and see who wants to come back on some of the points we were raising earlier.</p>
HD:	<p>Can I bring in a kind of very bottom-up question in the sense that having worked out in remote communities who are gradually being transformed by mobile phones and access to data, what seemed to me an issue of the big data that is accessible is to what an extent do we also understand, at which level it percolates. So on one point you have the situation in which it may or may not inform policy makers in their decision-making, but on the other hand it's a question that regard especially dealing with natural resources or for very localised food security problems where the decision-making happens at the village level or at the district level. And the question is to what an extent can this kind of data, be it remote sensing data concerning a potential glacial lake that might burst or it is a question of availability of water or anything of this sort can be made available to people who take the decisions and on the other hand how much do we know whether local communities agree with that information and/or other concerns which might be of a cultural nature, of a spiritual nature or others.</p>
AO:	<p>I think that's a very good point and I feel instinctively that there are risks of course with data and how the data is interpreted and all that, but let's leave that aside and let's be imaginative for a minute. I think the ability to permeate data down to any level now, I think the technology is getting to the point where that can actually start to happen. And I don't know exactly where I saw this, I think it may have been at the European Space Agency last week, I was looking at a situation where a community were looking at holes in the road and were mapping them locally and developing that information and I think that is increasingly going to happen.</p>
	<p>I also feel - and again this may be a slightly romantic way of putting it - that to the extent that one can use the local community in data gathering that the very same issues that they are maybe confronted with, they get a much deeper appreciation. It's not some external party providing them with supposed solutions, they get a real knowledge and a sense of ownership of what's going on and will influence the upstream data delivery. But I think that's the world we're in now, technology is now such that we can disseminate it...when I say the lowest level I don't mean it in any pejorative sense, I simply mean to community</p>



	level and I think that's the exciting possibility, receiving and participating at the same time.
TM:	But isn't this where precisely your discipline of anthropology comes in potentially to understand?
HD:	How it really works on the ground because that very often is a real challenge, it's not just about having the information, it's about also understanding better how community dynamics work and the same data might be used in very different ways in different places.
AO:	Yeah, and I won't be smart enough to figure it out because there will be people who use it in very imaginative ways and look for other things and I think that's again where the openness comes in, it allows the innovation to flourish, whereas if we were just in the supply chain from science to society, the traditional way of thinking, that's not going to work.
HD:	This is precisely why I think it's very important it's much more kind of dialogue across levels rather than a top-down approach.
AO:	Yeah, absolutely.
MR:	I've got a slightly different point but it relates to huge data. The timescale that it takes to produce data of interest in the academic community are obviously quite long. In the business community that I work with they are needing data that is relevant for their particular problem as quickly as possible. What I'm getting a sense of is that they are producing less than rigorous data to make the case for a business intervention and Mukesh's example of the agricultural package is a very good one. Back in the late 90s the cost benefit analysis was very, very clear and we've seen the damage that's caused obviously in India and when I worked in Ethiopia it was exactly the same.
	So my question to you is how can you get the business question in place before you start the long trek to produce the data so that we avoid this lack of getting rigour in the process?
SP:	I was just going to underline the point which was made before about the social aspects of data collection. We are finding in a lot of cases that's as valuable if not more than the data themselves, it's just that engagement around a particular problem or issue fundamental. I'll then pass on the business question.
MK:	Before business question I come back to the point which is made beforehand. There is a danger when we look at information flowing to the individual and the individual is taking a decision at village level and community level, because at community and village level people can develop [inaudible 1:37:12] resilience capability and that resilience capability might be short-term focus which will be actually helping the long-term resilience of a system. Today the discussion which is actually going around in academia as well in my domain is short-term versus long-term resilience and that's the thing that we need to be aware of this constant data flowing. For example farmers can say there is a shortage of food, particular food, I will keep some, I will start doing that particular food production and they keep on doing it without realising that that particular crop is making the water table down for a particular reason. Short-term for five, 10, 15 years it might not affect them but after 20 years suddenly they will find we can't do that particular cultivation, our area is completely barren now. So we need to be a little bit careful on that information and the way it's being used at community level and actually it's about the whole system, it's not about just particular one information, it's whole system, can we understand from that particular information perspective.
	Martin has a very nice question and I think it's from the industrial perspective because that's the area that I come from because we are studying companies and companies' relations and how the product is flowing through the companies. If you look at 2012 World Economic Forum report on supply chain disruptions and what they say is that these are the five top supply chain disruption events, that these events will disrupt the global supply



	<p>chain. Whenever I talk to companies they say “Okay, what does it mean to me? We are aware but is it me that I will get affected? It's my company.” Most of the companies they don't know their supplier beyond tier two.</p>
	<p>It's difficult. I'll just give you an example, fish is actually...people are catching fish in the sea north of England, it's going to Vietnam for processing, then again second processing in China and coming back again to UK. It's more complex. We don't have the data and one of the things that we should be thinking about how we can interpret this understanding and data, the understanding on these specific issues and then we can say how we can actually think about looking for a particular solution. Again I'm going to more management side of the research which is actually focusing on some industrial solutions and targeting industrial challenge, but also that links to the community challenges as well.</p>
	<p>So yes, it's actually defining industrial challenges, the benefit to community...if we move in the industrial world or business world can we start with what community needs and start defining questions from that and then defining what data we need and collecting and maybe finding what is the configuration of that data.</p>
MP:	<p>This is raising a lot of points isn't it? There's the issue about scaling this in time and space and whether these things are straightforwardly scalable or whether actually there are emerging properties at each scale. Then the sort of data you're talking about is not going to be what emerges from the satellite programs is it? So while floods of data are coming on from those programs actually you're saying there's a great area which is not being fed at all with the sort of data you need and the question arises then about how one could actually do that on the sort of scales you're talking about. Anyway enough from me.</p>
TR:	<p>Just kind of related to how this data is going to be used but who actually owns all of this data? Where is it actually coming from and especially if we start involving the private sector, some of those companies might actually like their own data which might be quite apart from open access. So you both mentioned open access as something important and transparency but in many cases it's not open and also the storage of that data, how it's stored and where it's stored and for how long. Especially if we start looking at community level and the lack of all this data from people, of people, what is it actually...who owns it? Is it the communities then? Especially if we start doing a crowdsourcing thing where you actually collect data from the people but then store it somewhere else. There's a lot of implications there.</p>
MP:	<p>Steve, you're going to have to mention the INSPIRE Directive at some stage, but fire away.</p>
SP:	<p>Okay. Well I was going to go more with the fact that what we're seeing in a lot of cases is the data are often available and open through government level authorities, so from the sort of official data perspective, but the time it takes to put that together from a business decision. You get people that will pay the likes of Deloitte or Price Waterhouse or...who is the other company that does it on mining? Well there's drilling info. And what they're doing is they are packaging up open data but selling it as a product because it's usable, because it comes in a nice report like this and an investor can say “Okay, I know what's going on here” and they've got a synthesis of what they need. But there's not a lot of original data in there, it's the interpretation of that that you're paying for and then that becomes then commercial and then we can't then use it for the type of things that we want.</p>
	<p>Then is all the data that is owned now by private companies and often with the mobile phone connection is that that's often very behavioural and of great interest. You will find that companies will have much more power in data than government authorities, if not already but certainly in the future. You look at the type of information that Google, Vodafone, Facebook, etc, etc, have. In some cases, I mean I haven't done it myself but somebody mentioned taking a large packet of Facebook data and processing it, I'd be very interested to know what is the process for doing that? How do you approach</p>



	<p>Facebook and say “Can we have that data?” and on what basis they give it to you. We're currently in negotiations with Google to have a generalised product from their map data. We don't want Google roads, I don't need to know at the sort of Ordnance Survey level of where a road is, what I want to know is in a 1 km grid cell how accessible things are, I want to generalise that out and Google are actually quite open to maybe doing that. So a generalised product that keeps their IPR and their investment but then can be used for research and policy purposes which doesn't impact on their model.</p>
	<p>The other one is Google map drive times. When you see your orange or red bar on your Google directions which says you're going to have a nightmare journey that's coming from mapping mobile phones, logging onto GSM towers, they've bought the technology to do that.</p>
	<p>So Google are effectively mapping the movement of phones around the globe and it's not out of complete consideration, we're in a situation we want to map where roads are in tropical forests, if there's decent GSM coverage and you see a mobile phone moving through the forest at more than 10 km an hour either you've got a marathon trainer or you've got somebody in some sort of vehicle which has some sort of access.</p>
	<p>So those are the types of innovative uses of data that actually some of these companies might be open to, but there's no protocol for doing that. At the moment it's a kind of negotiation, “Will you let me do this?” “What's in it for us” whereas a government department has it set of rules, you might not like them but at least you know what you're playing with. I think with the commercial companies it's on a case-by-case basis still.</p>
KM:	<p>Sorry for being late. My name is Kristen MacAskill, I'm just finishing my PhD in the Centre for Sustainable Development in the Engineering Department. But just to pick up on that we have a PhD student who is doing that with Google data from mobile phone data and he's using it to do his PhD on...the original idea was to look at analysing carbon in different transport methods, but what he's actually done is found a new way of transport modelling rather than creating these models from scratch and using transport data that has being picked up in various places around the city. He's got all the mobile phone data and he's got an agreement with Google to use it. But yeah, I agree, of course it's what you're saying, it's a case-by-case basis. He was using it and then Google came along and said “What are you doing?” He was downloading all this data and he had to go and check with them about it.</p>
SP:	<p>That's a big question we have when we talk about high-performance computing, Google has built on top of their infrastructure a thing called Google Earth engine which we use a lot with the image processing stuff and you've got 30+ years of landsat data and you can throw your own data in there as well and do all sorts of amazing things and it's currently free, but will it be free forever? So there's a lot of reticence from our side for example, it's okay to use it as a sort of pilot, you can do research, but to do something operational and rely on being able to generate information products on a repeatable basis from that platform when you don't really know what the long-term deal is, that's risk.</p>
MP:	<p>We haven't talked about risks in this.</p>
DC-B:	<p>[inaudible 1:47:08] because I mean Google...so this is a US-UK collaboration, Google and Esri, Esri that brought us ArcGIS and so forth. Esri this week I think it is launches their cloud-based version of this and they are therefore inviting collaborations from all over the world to begin to put in these data.</p>
	<p>If you look at that do you see any possibility of the sort of crowdsourcing acquisition of data or is that at all going to be reliable to have people popping in all sorts of pieces of information? I mean in epidemiology we have terrible problems with publication bias and so forth that you begin to ask who would ever put on the data about Haiti-Dominican Republic? Probably somebody who wants to make a political point about...</p>



DR:	Is it like a Wikipedia? Is that what you're saying? Is it the same issue or are you talking about something else?
DC-B:	Well it's sort of like a Wikipedia. With Esri you can start popping in...so Susan can go to her backyard and she can map species in her backyard and just upload it to the cloud and then Mukesh does it in his backyard and so forth.
SP:	Does anyone here know about OpenStreetMap? So OpenStreetMap is a massive community that has basically built...certainly within Western Europe, North America, a dataset of equivalent quality to Google Maps, for free, just from community basis, either by uploading stuff from their satnav system or from a GPS device or just tracing on top of satellite imagery which is typically what happens in developing countries. That model could be applied to other sectors, OpenStreetMap, OpenFoodMap, Open whatever. You will be astounded at how many people there are out there that will contribute data. Of course you've got all the issues of quality but with a well-designed interface or app to put this information in you can avoid a lot of those errors and that's where a lot of these initiatives have been very smart.
	The other one is the approach by the Gates Foundation which is basically a paint by numbers for different themes. So what you do is you divide the world up into lots of cells and you have different themes and you say "What does that dot represent for land cover, for soil, for...?" and then you just get the community to do that, so you build up datasets in that way.
SO:	So there's a very interesting issue I think which is that when you're collecting large quantities of data which we are now more and more capable of doing some of it is observational say of earth systems which nobody I think is going to complain that that's violating someone's personal data. But as you move more and more towards crowdsourced or community sourced data or data sourced from people's smartphones or whatever it is then it raises a different set of issues which I don't know much about but Theresa will know a lot.
	So in the social sciences there's this critically important principle of informed consent for any research, otherwise it's deemed to be unethical and I wonder whether...
TM:	There are exceptions.
SO:	Yes, there are exceptions, I know there are some exceptions but there is...
TM:	Caldicott Guardians for instance.
SO:	Yes, I mean there is a real kind of obligation.
TM:	That's the default.
SO:	That's the default option. I'm struggling because this is really way outside anything I know anything about but if you are aggregating data then...now the question has flown out of my mind, it will come back to me in a moment...but it's something... Talk amongst yourselves and come back to me.
MP:	While you're thinking perhaps I could just briefly...this is a very interesting multifaceted question and I don't have any particular answer, I wanted to make just a couple of points to this... I shall shut up and let you ask, no, no, you carry on, no, no, please.
SO:	Well I think that sometimes the argument from the people who want to acquire and use the data is that it's aggregated so that therefore that kind of bypasses the issue of informed consent. But I think one of the things that many people fear is that it isn't really aggregated and that somewhere it is still disaggregated which was precisely what did for care data in its initial manifestation. I think it's come back slightly more quietly now.
DC-B:	Or a triangulation can take place within organisations.



SO:	People don't trust the systems that keep the data anonymously aggregated. So that's what I was trying to express but I don't know how valid that is or what the implications are.
MP:	I was going to come to one small part of the business question actually in terms of openness of data and there's a policy point here as well which again is hopefully not too trite. It's simply this: that leaving MI5 out of it, publicly funded should mean publicly available, I mean that's the first thing to say and I think the US adopts that policy, we have not in Europe adopted that policy. One manifestation of this that I'm particularly familiar with is that the commercial business based on weather forecasting is 10 times bigger in the US than it is in Europe because in Europe we operate meteorological cartel, it is actually a cartel and possibly illegal but they get away with it, in which data is sold. So that completely suppresses small, medium enterprises to develop innovative services and I think exactly the same thing has happened from space, who on earth can pay for satellite imagery at any reasonable cost?
	One other thing about...the interesting dynamic that's now happening with data, and again this might sound a little bit simplistic and it won't work all the time, is that people used to think at some time we hang on to the data and we can try and sell it. Well it's not the data that's got value, it's the information content and even some big industries that are actually competing with each other and now increasingly seeing the need to pool their data resources, to think about where the innovation comes for that and of course at some point they will retreat from each other and then look for commercial advantage. But the point at which that retreat takes place is further downstream than it used to be in the past. So I think there's an interesting dynamic that's starting when the data themselves are valueless without the information content and often involving pooling resources from different places.
MK:	Can I just bring one particular experience? We have just bought some databases on sustainability and looking at which part of supply chain can use more water or can use more CO2 or do more wastage and when we actually start looking at this database again it's the problem with aggregated form. So in one particular primary position one it just aggregates it. When it aggregates it what happens we exactly don't know why it's happening and where it's happening, what is going to do what. Because in supply chain when we look at processes in one process level, in one node level, there could be eight processes which is going through, product is going through in transformation and some of these one or two processes are more critical and unless and until we don't identify those critical points how people can think about solutions as well.
	Coming back to your Google data and thinking about how we can know the CO2 emission because of that, and let's take an example, a real example of BMW currently actually is in the news, Volkswagen sorry, not BMW, Volkswagen.
TM:	BMW is next week.
MK:	So what if you put a [inaudible 1:55:26] that each car, in this kind of car is just following 0.5 number but it is actually not. How do we know when the car gets older it is actually producing that particular kind of amount of CO2 although you have a particular nice data, but in my opinion how I can believe it?
	So these are the big issues that we have to...when we deal with the data it's very big.
MP:	Yes, we haven't touched on the place of malice in this as well as incompetence. Kirsten you had a question?
KVF:	So I was wondering to what extent fear drives the way we share data and think about evaluating the data that we have, because a lot of this data can drive major decisions and then just thinking about what are the protections that are in place and are they creating barriers for sharing data and what are the protections that need to be in place. This is kind of inspired by 23andMe, are you familiar with 23andMe? Where they started to share genetic data with people who were evaluated and then turned out they were sharing a bit

	too much.
MP:	Thoughts?
SP:	Luckily in my field I don't think we have too many areas where that sort of data sensitivity really becomes directly an issue, other than around...there's a lot of fear about the sharing of information about illegal resource use, poaching in particular, and the argument goes something like if you start putting out maps where you see vulnerable endangered species, which could be used for food, I'm not just talking about rhino and elephant, but gazelle, doica [sounds like 1:57:21], whatever, that are used quite often sustainably as a food resource, that then suddenly they will become more vulnerable than they already are. I think the answer there is that they are already actually incredibly vulnerable and people that want to go poaching know exactly where they want to go without going on a website and looking at an online map and deciding how they're going to do it.
	So I think there's an implicit fear, there's an implicit...also to underline the point that I made was that this implicit perception that your data has some value when they often don't and the structure for selling that data is more costly than just giving it away.
	But yeah, I mean I think luckily we're not too involved in very, very sensitive data but there are some issues around particular species and so on.
MK:	For our company level research, when we deal with company I think there's lots of sensitivity is involved, it's linked to their competitive position in the market. Most of the risk data that we capture we even can't talk about it most of the time because it will affect their sale price in the market. So there's lots of issues that we deal with, these issues, even though now the University has a policy of open...making the data are available, but in our research area we won't be able to make real data available to anyone unless we desensitise that data and make it some kind of generalised understanding.
	So this is the big problem at company level, when we look at supply chain resilience this is one of the barriers that we will face when we start looking at product processes in companies.
MP:	There is quite a history isn't there of companies nonetheless banding together to share data, say marketing data companies which are looking at market share and things like that, but doing so under quite tightly controlled conditions. So people can sign up to exchange things they wouldn't dream of normally talking about in order to get that added value. I wonder whether there is a model there you could expand on.
MK:	I think we can think about it. Some of the data, Carbon Disclosure Project captures it, but I find those data completely useless, the reason being is when we actually go and see the companies there is a big wide gap you see, and the data that we need to analyse it's not there at all.
MR:	There's also sensitivity about particularly EU legislation on competition and a number of major companies have been trapped by collaborating and sharing data on...so that's a good example.
MK:	There is one nice example I want to bring out here because that's my personal observation and I don't have too much experience also. If you look at life-cycle analysis, I think some of you might be [inaudible 2:00:24], I've seen two or three companies' life-cycle analysis and what they're saying, the impact on their company [inaudible 2:00:30] we are creating very less environmental impact, let's see here: this is the supplier and see this big bubble and see this customer who is using it is creating big bubble, we need to focus there, not on us, the problem is this aggregated data form. Because what happens here in supply chain you have thousands supplying and you are aggregated, it becomes huge impact it looks like to me. Here is customer also who are so many customers and you pack it together it looks huge impact. Especially in the car industry, you start looking at why car manufacturer says "We have to look at car in use phase, carbon emission in



	<p>use phase, because in our plants are better. Carbon use phase when you look at tenuous data what this car is emitting it looks so big so why are you focusing on us? Why are you focusing on my plant?" Completely I find it a little bit ridiculous because there are two other supply chains going on. If you look at first time car buyer how many years he is keeping that car, maybe three to four years and then there is separate supply chain is going on which is called second-hand car market, that data they have to cut it off because if you make it from 10 years to three years or four years you will start seeing that impact in this manufacturing plant and supply plant is much bigger than what is actually happening in real life.</p>
	<p>It's all about...you have data but how are you going to use it, this aggregated form maybe it's misleading people and that's the thing that we need to be a little bit careful how we structure it and how we analyse the data.</p>
IH:	<p>This is probably naïve. Would it be naïve to think that we could have trusted data users? I guess a university in a way fills a role a bit like that where you're saying that yes, you get access to certain sorts of data but perhaps other organisations wouldn't do. I just wonder whether there is some system whereby you'd have an arrangement, an institution of some sort that would hold data and maybe use data and would not publish stuff that would be...where you could identify individuals and so on, but would nevertheless be able to combine different datasets. So one issue that I guess I'm slightly involved with is the Farm Business Survey, we go out and we talk to farmers individually and collect huge datasets about each individual farmer but it's done voluntarily and the farmers want to absolutely guarantee that they can't be identified from the data. Now clearly in principle we know...actually we don't know, even Defra doesn't know quite where these farmers are, but the person doing the survey knows, if you've got a postcode you could identify it quite specifically to a place and then in principle you could link that to all sorts of other datasets. But the issue of confidentiality actually prevents that because not unreasonably if you're going to persuade people to give the data on a voluntary basis, it's quite intrusive, or it's very intrusive and actually requires time and effort and so on, then they want to be guaranteed that there is an absolute guarantee that they won't be identified.</p>
	<p>So whether there was some sort of intermediate position where you say well actually there is a sort of a neutral, a trusted data holder. Now I'm not sure that any institutions actually nowadays can be trusted, but just imagine that it was possible. Then you could say well actually they will do the analysis, they will produce some...it would have to be reasonably generic outcomes, or maybe they could produce datasets from which it's not possible to identify people in some way or other. Is that naïve?</p>
TM:	<p>It happens, some of us do that quite...</p>
SO:	<p>Yes, I mean I think it does happen but there is also...I mean one thinks of Climategate for example and what happened to the UEA's survey, so even if we trust the trusted data holders which in itself has some question marks over it because even trusted data holders can have rogue employees, rogue individuals, the ones that go off with it all on their laptops, or even just leave it in the pub, it doesn't have to be malicious but things happen a lot. But there is also now the issue of hacking into datasets and whether people's firewalls, the trusted data holder would have to have incredibly impregnable firewalls.</p>
IH:	<p>Well they're not connected.</p>
SP:	<p>But isn't that back to your argument about depoliticising? You can probably hack into anything but you're going to hack into the things that are politically hot, you're not going to hack into the things that are very technical and just happen anyway. So everybody is vulnerable but certain people are more targeted than others.</p>
SO:	<p>I wouldn't be so confident about the distinction between technical and ability.</p>
SP:	<p>No, but I mean hackers have limited resources, they won't hack everything so they make</p>



	a decision what they're going to go for.
SO:	Yeah, which is why they went for the UEA.
SP:	Yeah, and why they went for Madison whatever it was at the dating site and why they go for...
SO:	But that's the needle in a haystack argument which has quite a lot of validity but it's limited I think. I remember some people are saying it's like looking for hay in a haystack, oxymoron, but anyway I don't know what the answer to it [inaudible 2:06:17].
DR:	I'm just going to make three points and Mukesh might [inaudible 2:06:22], but on this point I think we should all just agree that whatever data is out there could be seen by anyone, make that assumption at all times. So the idea that it isn't that's just not correct. So we have to get used to that. So I'm sympathetic to us trying to do things better but in the end it will be available if someone wants to really see it, it's like stealing my bicycle. So that's the attitude I take to it. It doesn't mean I don't think we should use it by the way, but I think we have to use it knowing that there will be breaches, there will be breaches that will be more frequent.
	The two points I want to come back to and I've kind of waited because Mukesh and I are intellectually rather more joined up than my previous question would have indicated. Mukesh mentioned two things that I want to repeat, one was the idea of resilience of the short-term and long-term and the other was why don't we let our questions drive our search for data instead of the other way round.
	Now if I start with the second one my point is that in a group like this, I don't want to be ethically or ideologically excluding and information theorist or a computer scientist and somebody who just loves the idea of what can one do with data that one hasn't seen before. For example I think we need automated methods to do heterogeneous distributed data gathering for us because we can't do it ourselves basically. So I'd love to have those people studying that but in this conversation I think it's a heck of a lot more important to ask ourselves what are the questions that are the right questions and two or three things that Mukesh said come up over and over and over again in the risk centre. The quality of data, the availability of data on one hand, but that does not make the question go away so what we are always dealing with is we refuse therefore we have to sometimes do bad science, we refuse not to answer a question because the data is not available. So you're always looking for surrogates, you're looking for alternative models, you're looking for comparatives and that's a much more I think fruitful space I'm proposing for this kind of group than 'Oh wouldn't it be wonderful if we had more data to put in the bath and mix around with a high-speed blender.' But I'm sure we'll have a chance to come back to that sort of view of things in other things.
	And the resilience one, the only reason I mentioned that is because life is about complex systems, if it was about simple systems we wouldn't be here. So trying to take that view also takes a particular...you have to somehow understand short-term effects and mobile phones and whatever and then you're starting to look for the longer term effects which are incredibly hard to tease out. But I think if you don't have that second ultimately we're trying to understand the system that we are living in then you're going to get very excited about the arsenic filtering system and meanwhile my family dies. The grapes are fantastic but all the farmers are dead.
	So anyway, those are my two kind of philosophical pleas, I'm hoping that we can return to this in future conversations.
	Thank you very much to our three guests, you've obviously sparked off a lot of thinking and we've ranged extremely widely I note in all this which is exactly what we were hoping for, so thank you very much indeed. Let us offer you a drink now.



Discussion Over Dinner	
MP:	...in the context of that data and one big question from a policymaker's point of view is how does that get translated into things that policymakers can actually use, especially in the identification of risk or practice that might help define resilience and response. So that's one chunk we might look at.
	The second was around the wonderful acronym that Steve introduced of BAD, best available data means there's often great gaps in the some of the...and all the rest of it and that obviously itself holds risks when you come to think of response to events and disasters and so on. So I'm chucking those out as two items we might talk on, if there's other issues people think we should get into please raise them but with that said let me just open up, I don't want to dump all the talking duties onto our three guests but I will ask you as equals to come in on this.
	Would anybody like to pick up any of those issues?
DC-B:	Yeah I might take the big data one because in epidemiology we have this problem of the more data you get the more likelihood that there is that you will get just false positives that just pop up all over the place and the big data thing does raise the issue of will you in fact simply start getting a lot of false positives, or false negatives, it doesn't matter which one, we can start getting a lot of false positives because you're analysing data in all sorts of directions. Now you're wincing at that.
JH:	Yeah, there's lots of techniques for reducing that when you're looking at large data, whether you lose one for only [inaudible 0:01:51], if you do it badly then you find lots of...actually you find loads and loads and loads of false positives.
DC-B:	Well it depends on the rate of misclassification in the datasets and there are no ways to deal with randomised misclassification errors that occur. So you will get if you look...I don't mean because you've got a large dataset, I mean it allows you to then look at hundreds of things at the same time and if you had no structure whatsoever to the data, in the sense that there was no causal relationship whatsoever between any two variables, if you analyse hundreds of them you will get 5% to 10% that will be popping up as positives.
JH:	Unless you do various well-known statistical corrections.
DC-B:	But that will not deal with that problem if there is no real correlation. You're thinking about controlling for confounding and so forth, no?
JH:	No I'm not, no, no, no. Bonferroni correction and there's various other variants. I used to work on genomics where you're doing things where you're testing many, many thousands of genes for many sorts of things and there are very specific ways. Essentially to cut a long story short you divide the D-value you want, if you believe in D-values, by the number of tests you're doing and so you're then saying if I'm doing 10,000 tests I don't need to find 0.05 because then you're right, you'd find a 20 th of your things randomly. You now say I need whatever number I said divided by 20 and that way you...the problem is actually you often miss things too much if you do that particular correction, but there are techniques for doing this. You're right though that most people don't bother.
RA:	But you're talking about open data and open analysis as well, you're talking about...
JH:	No, not necessarily.
RA:	Well no, some people were talking about earlier on was opening out datasets for experts, non-experts, companies to analyse.
DC-B:	Okay, well point well taken from Julian there, the fact is that people don't in fact apply those statistical techniques.
JH:	That's right, that's the point.



AO:	It's very interesting that we're actually talking about the intricacies of sort of the mathematics of data size but I think you're absolutely right and I think there will always be a situation where - we can't control it of course - where people will read as it were literally and metaphorically different things into different data and what one is looking for is the best scientific mathematical underpinning to do exactly what Julian is actually saying to understand what can be trusted and what can't and indeed most of these decisions are probabilistic anyway rather than completely deterministic and a firm line of separation and that's the kind of big science that we're now coming into. It is a scientific endeavour, that's why we call it data science. But it's not...we're not...we have fundamental principles that we can work with, so we're not...I'm not only saying that dismissing what you said because it is a big issue but it is a challenging issue for research which hopefully a university like this can get stuck into.
TM:	But I think also, sorry, just you speak on the stuff called Bonferroni, often one is looking at huge datasets to generate hypotheses, it's not about testing hypotheses until you get daft correlations. So for instance in the Facebook dataset there is a correlation between IQ and eating particular kinds of curly chips. Well, you know, it's...you have a witness and so you wouldn't think that that is a causal connection, so one is looking at the data with a different mindset if you like to the very important issue that you're...
JH:	I mean there is a brilliant xkcd cartoon that illustrates this where he tests whether jellybeans cause cancer and finds no they don't and tries each different colour and they test enough colours that one of them does which is a nice illustration.
MP:	Which raises in part the problem for the political decision maker faced with multiple possibilities of interpretation of this gorgeous cornucopia of data. Are there ways that we can actually make it more tractable for decision-makers to actually understand and use?
AO:	Or is there a short cut to saying actually what you then need to do is to go and design some research that actually will test the hypothesis that has been generated from this sort of inductive approach.
TM:	Exactly, exactly.
AO:	So actually you need to spend some money on...
SO:	But isn't that as well a little bit...I mean there's always the drunk looking for the lost keys under the lamppost analogy where you are looking...there will be I imagine in any community of researchers some preconception, some notions of what patterns there might be and therefore there is a tendency sometimes to find what you're looking for or not, if it's me looking for my keys but I mean, you know...
	It brings me back to something that we discussed before dinner which was this issue of whether you collect data...I mean set aside for now the question of kind of pure research which I'm absolutely supportive of, but there is a question of whether you collect lots of data or whether you try to formulate questions and then look for the data that might help you address those questions. The trouble is that in almost every controversial issue, I know there's lots of...as Julian was saying earlier, lots of routine things where there aren't particular problems but in every controversy the definition of the question is part of the problem, not part of the solution. So most of our deepest controversies involve a fundamental disagreement about what the problem is, what the question is. So the idea that we can just set a lot of exam questions and go out and find the answers in the data also seems to me to be quite problematic.
AO:	I think it's a bit of both. I think it would be very difficult to be on one side or the other. I mean one example which I don't know how pertinent it is to the point you were making, not far from here was a scientist who spent 20 or 30 years of his career in Antarctica looking at ozone concentration over Halley Bay for no point whatsoever according to his director or the funding agency until the ozone hole was discovered, there was no hypothesis being tested. I would want to say that's a paradigm for how we should behave

	<p>but it just shows that there are occasions when the surprise in the data is the big surprise completely outside our understanding. But of course I wouldn't go away as a physical scientist anyway from the notion that where we can frame hypotheses and therefore be more efficient in getting data we should do that of course, but it's not one or the other I think. Increasingly in a data rich environment there are different ways of behaving with data and doing science than perhaps we've been used to, at least in some fields in the past.</p>
SO:	<p>So I was intrigued by the graphs that you held up and said "Look, there are all these things increasing."</p>
AO:	<p>Well chiefly, yeah.</p>
SO:	<p>But we knew that in 1972 and probably before.</p>
AO:	<p>Absolutely.</p>
SO:	<p>And it's arguable that the reason that those trends are still there is not because people don't know, it's because they don't actually care and providing more information may not make people change those graphs.</p>
MP:	<p>I think you were touching on a similar point at that point Steve.</p>
SP:	<p>Well I guess because we're being now driven more by policy needs as an institution and that's been a proactive thing for the last probably five to 10 years, that we're all having to accept compromise in the data that we use and the results that we give out and that's okay for some people but not for others. Some of my colleagues find that quite a hard transition to make. I think the JRC in particular has been in quite a state of flux over the last few years over this and six or seven years ago very much it was about everybody had a target of peer-reviewed publications and it was all about the scientific merit of the work that we put out. Now it's about policy impact and that trickles down into your career review, your performance measurements, the incentives you have to do certain things or whatever and that's coming from on high and now we're very much into that area of just run the numbers, get a result and then we'll see where that goes. That's the reality but I think also if you look at the opportunity of the technologies that are available and learn from that, and it's early days for us, we are finding our way in what it means in terms of how we respond to what the technology will allow us to do.</p>
DR:	<p>Could I [inaudible 0:11:11] something? So I was trained as a sort of hard scientist or whatever you want to call it and my first business school experience was coming to Cambridge and one of the things I learnt fairly quickly was that mathematical models are only good at representations or let's say communication devices even though you might think of mathematics as good for communication. When you address problems in business where you're lacking data and particularly you're lacking a crystal ball, does the environment of the teacher actually know radically apart from the environment of the past. So in the business school and I have to be careful not to impute too much about other departments, one of the things we're trying to do is engage to the point where our research agenda is being driven by questions that we receive from outside agencies. Now you don't want to make too much of that because outside agencies want to do evil and horrible things and that's what's around your research agenda, but what I'm trying to get to is the following: are we reaching...? If I look at my sort of pure discipline I've noticed...and I don't know whether this just happens because [inaudible 0:12:16] which may be the case, but I've noticed that it has less and less value as a pure discipline and more and more value as a connecting discipline and I sort of know the direction I'm going in, I'm sort of asking agencies, universities and so on and so forth are we all on a transition that is much more about trying to understand the planet that we're on and addressing those kind of issues abroad and less about what we used to call fundamental research and it's a very difficult thing because... It's not meant to be a religious viewpoint, right? Because it depends...understanding can come back to the individual and the</p>



	institution, but when it comes to this question of what should we be doing and what should drive it and what was the example Dougie gave? GMAP?
DC-B:	Oh EMAP.
DR:	EMAP, sorry, EMAP which has no relationship between policy interventions and the underlying things. Maybe that society has changed...
DC-B:	In the United States, I mean Julian pointed out a classic example where you can in fact from satellite images see that Haiti's and Dominican Republic's different policies.
DR:	I'm just pointing out that there is noise on both sides of the equation here. So one of the things that I know to do in risk analysis is we often give up on measuring outcomes because it's literally too hard, there are too many confounding factors or it takes too long for some of these things to flow through, so you use process changes which is a little bit like peer reviews to steer things in the hope that - it may take 20 years or 50 years - you will know better over time because you've tried a few things. So that's a very long and rambling point but what I'm trying to get to really is how does one reflect on one's own role in this process is really what I'm trying to get to and it isn't...we're obliged to follow the instructions of my department head or Cambridge University or the Research Councils and so on, I get all that, but maybe there is a more fundamental change which is pushing us to look at this whole question a little bit differently, that value, we recognise value as we've mentioned today is simply a transient... We live with it, we deal with it, but we know that in 20 years' time we may look at it entirely differently and that this is a moving feast actually.
	So that's not a [inaudible 0:14:34] question, it's just a vague commentary.
MP:	But how then do you cope with a Treasury that says "We'll only spend money when you can prove in a cost benefit analysis that this money will be well spent"?
DR:	Look at the debate we had recently over flooding. So you had local people saying the obvious solution was to dredge the river and in fact they were pointing the finger at the Environment Agency saying you didn't do your job properly, but if you dredge the river imagine the economic havoc that would have caused downstream. So another part of what we're getting to here is that our job isn't simply to do our job properly, it is to equip other people to explain. And if I come back to systemic because I'm obliged to, politicians need to somehow get across to society that it's a trade-off. Take electricity as an example, should I be able to rely 100% on that lightbulb going on, I have up to now and it almost always has but if it went off tonight and fortunately my dinner is cooked, so the candles would see me out the door and I'd be fine. But that's the kind of discussion that we need to have, what things are critical and what things aren't and how much should I be prepared to give up. There is a convenience factor in the [inaudible 0:15:47], I know that and in a hospital it's more than a convenience factor but domestically it is a convenience factor to a large degree and that's the kind of conversation we can have at societal level but there are some risks that will always be with us, we can't rely on someone to always be the lender of last resort for a physical resource management or financial or something else. We actually have a role to play in that is what I'm trying to get to, instead of just outsourcing that decision to the all-powerful government who keeps the lights on, but do I even know the cost of that? Well not really because no one's had the discussion.
SO:	When you say 'we' who do you mean?
DR:	I literally mean society at large although I happen to believe that it isn't entirely different from my action as a microscopic actor in all that.
SO:	But society at large is a bit of a myth, I mean society is made up of groups with very different sorts of values, beliefs and so on.
DR:	Absolutely, which means you have to communicate to those groups.



SO:	Who has to communicate?
DR:	All of us.
SO:	Well, no, who, who is us?
DR:	Okay, let me give you some examples, what does the Chief Scientific Officer for the UK actually do? What's their job?
TM:	Danny, it think there's some very interesting datasets being generated as was speak led by very smart economists in Biz creating huge spreadsheets with comprehensive spending review, so where is [inaudible 0:17:10] data for and what they're looking at is amongst other things return on investment on the kind of things that we're doing and I don't know if that will ever see the light of day but it's absolutely fascinating to know the values that go into that. Can we have FOI to get that spreadsheet out of them after the 25 th of November?
JH:	I love the idea that it's all done very rationally and the question about what is the purpose of funding science is a good one and if any of you are free on Monday evening there's a rally in London which you can come to, tickets are £5, there are much more exciting speakers than me, trying to get across that idea. But there is an issue about every million pounds that we say should be spent on research is a million pounds that's not being spent on tax breaks, that is not being spent on all sorts of other things, there is a trade-off and we need to... For example we haven't really made the case but I love the idea that there is this spreadsheet that does it all because in 2010 I know on the Sunday evening before the CSR, the £4.6 billion a year science research budget was going to have a £200 million a year cut. And the quad were having dinner at Chequers, so that's Cameron, Osborne, Clegg and Alexander and while they were having dinner the phone went and it was somebody from the Treasury saying "We've re-run the numbers, there's £200 million spare, what shall we do with it?" and Nick said "Let's put it in science" and they said "Yeah, fine" and that's why the science budget went back up again. Now I've multiply verified the fact the science budget went up by £200 million in the space of half an hour, that is definitely right. So Nick is the one who tells me, it was Nick who said it, I don't know [inaudible 0:18:48], but there's no rational allocation of resources model that would lead me to conclude that we have an extra £200 million and it all just goes into research, it clearly isn't a [inaudible 0:18:58] approach. So there is a lot of work like that. I think part of the problem is that we haven't...this is not quite the subject for now, but we haven't really got across the points to government of why you invest in this some of this stuff.
SO:	Well it's not a zero-sum game is it? So when you say there's an opportunity cost that misses out the notion that investing in science will generate...
JH:	Indeed, sorry, don't get me wrong, I'm not...I have argued strongly for more money to go in science but we haven't made the case all that well about that, so we tend to say every pound you put in and you get a different figure for different disciplines but it doesn't really feel all that plausible. I think the plan for medical investment is I think 20 pence ongoing a year and it doesn't feel quite right that when the MRC give out a grant of £1 million that you're generating £200,000 a year from it doesn't feel plausible. And there have been some detailed economic analyses, sorry I'm going on too much, where the chemists commissioned one and the physicists commissioned one and various disciplines did, I launched various of them, and the problem was I think if you took chemistry, physics and maths that was responsible for something like 120% of the GDP and then the biologists come up with their chunk. And so I just don't think we've made that case and I think it is there to be made in economic terms as well as pure advancement of knowledge terms, but actually I don't think we've made it all that strongly. I'll shut up.
MP:	I was going to say that we're getting a long way off the original topic of conversation fascinating though that was. Mukesh, were you...?



MK:	Basically I was thinking more in terms of...when he was talking about the funding it's very difficult to even evaluate that. A medical MRI machine that lived here, nobody used it and it just said "I'm not going to take it" and it's gone to US, the GDP is the biggest player, capture more value there, but how are you going to do something pure fundamental science 20, 40, 50 years, 60 years, later on you will get the value then you will get that 20 pence, that's the big question. Anyway, I'm not going to go to that particular discussion because that's almost drifting what we are trying to do.
	I'm going back to actually on the damage comment and your comment on like who will talk to the people. Ultimately all the funding that the university gets, especially research class is paid by taxpayer if I understand correctly in the UK and if it's paid by the taxpayer why not common people are made to understand if you paid for this much what you're getting. Isn't it the responsibility of researchers, policymakers who are giving the money, is to make people aware that okay you gave us the money, now you understand this thing or you get this thing. At least maybe try to publish in papers and we think our responsibility is finished and I don't think the responsibility is finished, especially in the case of risk and resilience because that's...I don't know about other field and can't talk about it but in risk and resilience, informing people what are the risks that they are exposed to, if this light won't happen you won't be able to cook food and no restaurant will serve your food and your child will sleep without eating food how it will feel.
SO:	But what you've just outlined is the so-called information deficit model and it doesn't work.
MK:	Whether it works or not but somebody has to try but somebody has to try to achieve to do that.
SO:	Well it doesn't. No, no, it's just the wrong approach, it really...I think we know after a lot of social science research that that model...I mean Theresa knows more about this than anyone, but I just don't think the...
MP:	Can I throw that back Sue, because one of the things we're trying to look at is avenues that would help here. If the deficit model doesn't work what sort of avenues could we pursue that would help us get this extraordinary wealth of data into a usable place which would actually influence policy.
SO:	Well I think there is quite...I mean if you take the risk arena for example there is a vast array of research and understanding of how people think about risk, why just sometimes called the information deficit, sometimes the hypodermic model, if you keep pumping them full of information they'll think correctly and there is a lot of work. What I don't understand is why people including myself who are involved in that sort of work are so pathetic getting it into any kind of public domain because information deficit is a very powerful concept that survives despite having been undermined.
MK:	But is it really true that information that science produces people don't use it? If we really take a BBC weather report aren't we actually seeing those weathers and making our holidays plan when I'm seeing it. I think a hundred person [inaudible 0:24:07] a particular responsibility I think I also find it is not correct, we need to take a much more proactive approach and especially again I'm going to talk about risk and resilience area, this is really, really important to at least let the person, the individual to make their own decision. If the individual wants to stay in Syria and get killed by bomb it's fine, but at least he knows that the bomb will come and he might get killed, if I have the time I will take a decision to run away to Europe or somewhere else. That's the idea that I want to say, that individual and risk research. Again coming back to the data question, we need to have multiple approaches on big data, big data is not about just volume of the data, there is a variety and the nature of the variety of the data is there and we need to understand how it can be tackled through various disciplines and methodology, mathematics could be one of them. But at the same time if it generates the hypothesis I've been suggesting then can we test that hypothesis with different methodologies? Maybe a much more grounded approach we can take. Some of the study that I do I don't like it because you can't



	<p>generalise with it, such as case study based research. Can we use in our big data to generalise those findings or maybe try to test those things that we are trying to find out, I think those are the merits and these days funding bodies, I don't think so these days, since the beginning maybe, these matching the methodologies, using multiple methodologies are completely ignored, are completely considered a sin and I think we need to go towards that and do have a funding body that will believe and take that approach.</p>
MP:	<p>It will fall neatly between several bodies, that's what always happens.</p>
JH:	<p>Yes, absolutely, yeah.</p>
TM:	<p>I just wanted to talk about the magical belief in information, who is against it and partly the two things I would say is it feeds into what psychologists describe as the fundamental attribution error which we are all prone to which is that somehow we are rational actors, not that we're irrational, but we are rational actors guided by information and if only we could get that information into our fat noodles we would do the right thing. So that's one of the things that drives it. The other thing is we are talking about so many disparate behaviours. If there's a sign up that says 'Crocodiles in the river' in the Cam you wouldn't go in there, but I've been studying people with quite complicated genetic risk information about the chances of them developing diabetes, it doesn't change their behaviour.</p>
	<p>If we think about recent regulation about plastic bags and that is really shifting people's behaviour, whereas the information about the environment isn't and just my final point is people's heads are full of different threats. So if you look at...I find it really fascinating, the Ipsos MORI economist tracker on concerns, so every month they ask I think it's 2,000 people an open-ended question, 'What concerns you most in Britain today?' and you probably know the answer given as the first or the second is migration. 56% of the population now see that as their number one concern. I'm interested in poverty, that's tracking fifth at 15%, the environment is down at 1%. So that partly tells you...and that's another factor, it's not just about the behaviour and different things will influence different behaviours but also where populations are, they are concerned about a whole list of things and what we're interested in may not concern them.</p>
JH:	<p>This data is fascinating, what's even more interesting is they also ask 'Which is the thing which is affecting you and your family?' and migration goes from being one of the top things to 1% or so and it's really interesting...it's affecting lots of other people, I don't quite know who. Which actually does put me onto what I was going to try and say about how you communicate some of these points. I heard a brilliant talk from somebody years ago at the IPCC who described there being sort of three sectors, this was particularly about climate change, and the way she [inaudible 0:28:37] brilliant, I'm trying to copy it, is that there is a grass sector who are the people who fundamentally care and they are people who are worried about Bangladesh [inaudible 0:28:45], they are worried about polar bears, they just care and we've always targeted at those people a lot of messages that we have about biodiversity, the type of people who fundamentally care. There is a much larger set of people who have never been to Bangladesh, they've never met a polar bear, like so what? So there's this code somewhere, okay, whatever and that is a very large set of people we haven't really ever tried pitching...in some areas we have, but in lots of areas we haven't really tried pitching there. So in climate change when you start talking about local flood risk, the consequence of this thing is that your house might flood that might start to [inaudible 0:29:22] people who just don't care.</p>
	<p>She also talked about a third group which is the people who care about things that are fashionable, so in climate change it's people who put up...like David Cameron's mini wind turbine that was to be seen and her example was a friend who was going to put up solar panels on the north facing side of her house because the south facing side couldn't be seen from the road. So part of it is that we often try to communicate assuming that people are internationalist, public spirited, care about the sort of things that we care about and if</p>



	people just don't care, you know, 'I don't care about the Amazon, I've never been there' then no matter how much information you give them it's irrelevant, you can't get change.
MP:	Defra [inaudible 0:30:05] did a very interesting breakdown of population responses to environment and came up with seven groups rather than...it's the same basic story and actually they did very good bits of big, large number crunching and yes, you have to target your messages. Just coming back to risk and resilience though, I'm sorry to keep badgering on about this and I'll let you have your pudding as soon as it arrives, you raised a very interesting issue Mukesh when you were talking about people becoming aware through IT and data spread of opportunities which actually change the resilience of their day-to-day existence, new markets, new ways of farming and so on and you then put it neatly in the context of what the scaled up next range of impacts of that were. So on the one hand people were dealing with an opportunity which was local, on the other hand they were ignoring a risk, the flipside of opportunity, at a larger scale and one of the questions I guess is how again we can use the data that is flowing through to help people identify those sorts of trade-offs. As I said that when they are making a decision of short-term value they are aware that least of the long-term consequences for their own survival, let alone resilience.
TM:	Certainly in the health field that's what people have been trying to do and what they realise is it's the environment is stupid, so you need to set up systems such that the rewards of the longer term are brought into the present.
DR:	Which is interesting so the information deficit doesn't defeat the goal or the achievement of the goal changing things.
TM:	No, absolutely not.
DR:	No, precisely. So there's a difference between information and the value of information or the way I would see the information. So this reminds me of Danker Haan's [sounds like 0:32:20] work, it's the society environment that's stupid, right? So I don't think we should give up on either...I don't think we should give up...
TM:	If nature has a value in and of itself but it doesn't change behaviour in the main...
DR:	Right, so how does one...that's when I was saying with the lights on, if you always expect to have the lights on you can never have the conversation about risk. The reason that I'm interested in this is because risk and resilience are inherently not here and now values, they come basically...so how does one communicate those in a way that the stakeholder can recognise and that turns out to be a much harder problem than some of the other issues that we're dealing with and that's kind of what I was trying to get at before in terms of communication but I didn't do it in a very good way.
KM:	I could probably provide a concrete example to that in the recovery in Christchurch following the earthquakes and around the engineers had proposed to change the wastewater system in some of the areas that were badly affected so that people wouldn't have to use portaloos for six months while the network was reconstructed, but part of that meant...it was called a pressure sewer system and that meant putting pumps and storage on people's properties and that's fine, it's not new technology, it's been used elsewhere but only either in a new subdivision so that when people are buying properties there is a tank on their property and they accept that. But by proposing these systems in Christchurch there was an outcry because it was perceived as a second-rate system and the worst damaged areas happened to be the more poorer and vulnerable areas and so they were saying "Why are you not proposing this for other areas of Christchurch?" And so actually what happened was...because they were trying to implement things really quickly they didn't consult the community in the process, the community fought back, they went to the court and it ended up now that they've actually changed their decision and they've redesigned it and they're just repairing the gravity system. So if there is an earthquake again the systems are going to be damaged again and it was part of not



	communicating with the community and trying to get across the benefits to them, even though inherently what the engineers and the local government were trying to do was get more resilience in the infrastructure so that the wastewater system would work in an earthquake.
MP:	That's a salutary example. Ladies and gentlemen your pudding has arrived, I think I should let you off the hook at this stage. Thank you very much for the various contributions which luckily Roz has been capturing.
END OF AUDIO	