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# ESRC Genomics Scenario Project

## 6. Report on the January 16, 17 Scenario Workshop

A Project for the  
Economic & Social Research Council



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## Introduction

### Origins and Objectives of the Project

This report summarizes the proceedings and results of the Genomics Scenario Workshop, held January 16 and 17 at the London City University. The workshop is a major part of the Project on Scenarios on Genomics and Society: Priorities for Social Science Research for the ESRC. The Project is one aspect of ESRC's exploration of genomics (other aspects include a major national survey of public attitudes and the establishment of a Centre on genomics and society). ESRC commissioned a team led by the Institute for Alternative Futures (IAF) and the Centre for Research on Innovation and Competition (CRIC) to use the futures methodologies of forecasting and scenarios with the group assembled at the January 16 and 17 Workshop. The aim was to provide a view of emerging social research issues and the requirements for social sciences to contribute effectively to the evolution of genomics and associated social processes.

The forecasts and scenarios used at the workshop were developed from several sources. These included:

- a series of interviews with a variety of experts in genomics, social scientists and other stakeholders;
- a December 4 design workshop which identified the key drivers shaping genomics;
- input from IAF and CRIC futurists and additional research.

This led to several documents being produced and circulated to participants in advance of the workshop. These documents form part of the final report of this project delivered to the ESRC.

#### **Note on the term “genomics”**

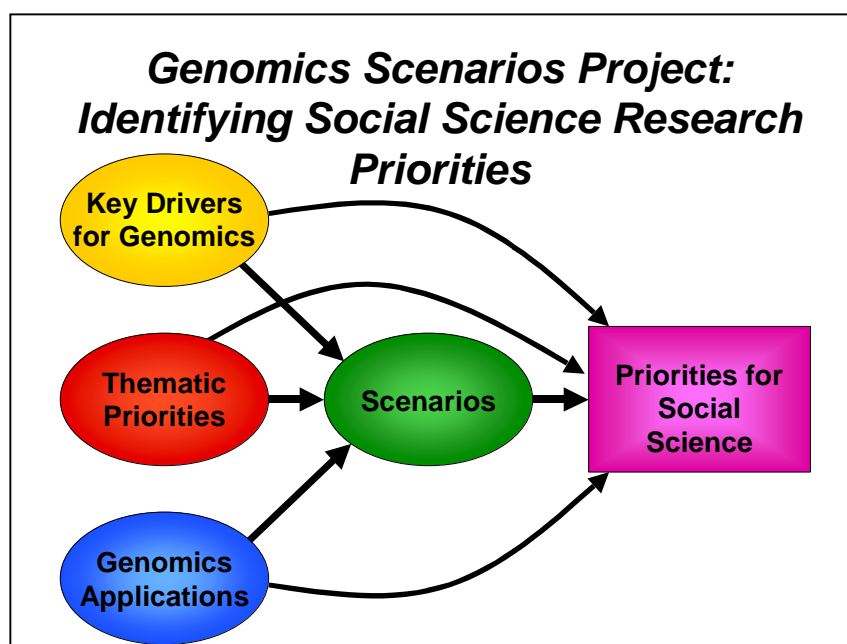
*Consistent with ESRC's broad use of the term genomics, for this Genomics Scenario Project, genomics includes the knowledge of genes, gene sequencing and gene functioning, and also the application of that knowledge. Some experts feel that genomics only refers to the understanding of the genome (i.e. to the science), not its applications (often referred to as “the new biotechnology”). In contrast, some talk about our already entering a “post-genomics” era, where many critical developments depend upon further steps in knowledge and applications (e.g. proteomics, metabolomics). We will be using genomics in this report to include biotechnology applications informed by knowledge of gene sequence and/or functioning.*

## Approach of the Workshop

Twenty-four participants took part in some or all of the Workshop. They are listed below. For the workshop four reports were prepared and pre-circulated, as mentioned above:

- **Key Drivers of Genomics: Forecasts to 2015** – Ten drivers affecting the development of genomics and its applications and modes of application were chosen. Three forecasts were developed for each of these: an extrapolative forecast, a challenging or “hard times” forecast, and a “successful” visionary forecast.
- **Genomics and Social Science** – Using the ESRC Thematic Priorities, CRIC developed a series of questions and forecasts related to genomics, highlighting the issues that this raised for social science.
- **Genomics and Society: Four Scenarios for 2015** – Based on various material prepared for the project, four scenarios were developed which explored the interaction of the various drivers along four different pathways to 2015.
- **Overview and Forecasts of the Applications of Genomics** – While not strictly part of the Project tasks, a report prepared by IAF as background for the project, particularly for those less familiar with genomics, was also made available. This identified, and provided forecasts for, agricultural, human health and other applications of genomics.

The Workshop used the reports on Key Drivers, Thematic Priority areas, and Scenarios for Genomics and Society to consider how social science research could make its greatest contribution to the evolution of genomics. The chart below reflects this process.



At the workshop, participants, some of whom were unfamiliar with genomics, a few of whom were unfamiliar with the range of social sciences as practiced in the UK at present, and many of whom were unfamiliar with futures techniques, were asked to move rapidly through a series of exercises, which typically resulted in their providing answers either as individuals or as members of break-out groups, to a number of questions. This process was aided by the use of COUNCIL, state-of-the-art groupware provided and implemented at the workshop by the Co-Vision Company. Co-Vision set up a wireless network of lap top computers in the meeting facility for the two days of the Workshop: these allowed the material input by groups and individuals to be rapidly displayed to each participant, and for this material to then be reflected on and articulated further by the workshop.

### **Notes Concerning the Process**

Inevitably the output and achievements of a process such as this are heavily influenced by the nature of the participants. The workshop had to be arranged and implemented within a short timescale, to meet ESRC deadlines. In this time the project team was able to identify and contact a large pool of potential contributors. A refreshingly high proportion of these were keen to participate. However, many people were not able to rearrange their busy schedules to make the workshop – and in particular, some of the policy and natural science constituency whom we hoped to recruit were already committed to another meeting that overlapped with ours. It would be desirable to repeat an exercise of the present kind at some point in the not-too-distant future, with more advance notice built into it. Additionally, it is likely that the rapidly evolving nature of the scientific and technological fields, and of associated policy debates and social research, would make it useful to revisit the conclusions of this workshop on a regular basis.

The range of participants at the workshop was nevertheless a wide one, even if there are various lines of expertise and experience underrepresented. As a consequence of this broad range, it is arguable that the broad tenor of its conclusions is liable to be reflected by other workshops, even if some of the details and the relative weight placed on various points would differ.

Genomics is a very complex topic, as are the ten drivers the project identified as shaping genomics. A significant amount of background material (the four reports listed above) was developed and used for the Workshop. Various comments on this material were collected and will be used in preparing final drafts of these reports.

The workshop exercises used several different “lenses” by which to examine the question of priority areas for social research. The question of what contributions social science might make to the area was visited by way of the drivers, the thematic priorities, and the scenarios. Each time rich debate was generated, and for the first two of these “lenses”, the material was entered

back into the process. The discussion stimulated by the scenarios was partly worked through in this way. The full group did discuss the research implications of alternative futures, provided by the small groups as well as identifying and adding missing issues, and discussing a synthesis of the areas where social science research could make its greatest contributions. The full group also discussed the implications of the scenarios for how social research should be conducted and used. While that information was used in formulating the last set of choices for priority setting, there was less opportunity for collective reflection. The results of the scenario discussion are, thus, closer to being an aggregation of small group and individual opinions than a statement of consensual judgments.

There was small group and full group discussion of:

- Priorities related to the Drivers
- The relative importance and uncertainty of the Drivers
- Priorities related to the Thematic priorities
- Priorities related to the Scenarios.

Some text was provided by individual input: This includes the list of events (in the Appendix of this Report) that might shape the evolution of genomics and its social relations; also project after thoughts are necessarily individual.

For the final priority setting for social science research, the group began with the priorities established up to that point by the group processes. Individuals were allowed to add to, and then vote on the whole list. After the Workshop ended, Ian Miles then grouped this material and provided the final list of priorities. Participants had the opportunity to comment on the final priorities (as well as the whole summary). These comments have been incorporated into this report. And while some comments were made on some of the priority areas no participant disagreed with any of the 16 priority areas (5 on research process, 11 on the content of research) nor their rough, relative ranking.

Thus the insights and results here are suggestive rather than definitive. Since they are based upon an intensive process of reflection, from a wide range of expertise, the points raised and the stress placed upon different issues should be of general significance. The workshop examined the areas of greatest contribution of social science related to genomics, in the context of the next 15 years. We would suggest that the highest degree of shared insight and closest approach to consensus in these results involves those derived from parts of the process where the full group discussed the work of the small groups, or voted on themes pinpointed for the full group sessions of the workshop (the priorities related to the drivers, the relative importance and uncertainty of the drivers, priorities related to the Thematic priorities, priorities related to the Scenarios), and with the post meeting review for the ranked and group final priorities.

## Drivers of Genomics and Related Social Research Priorities

### Forecasts of Drivers of Genomics

The initial exercise involving the drivers of genomics began with a brief overview of the 10 drivers of genomics and the “alpha”, “beta” and “delta” forecasts for each driver that had previously been identified. The initial list of 10 drivers, developed in the December 4th Design Workshop and in the course of preparatory research by the study team, included:

- Social Attitudes
- Social Mobilization
- Demand
- Functionality of Genomics Applications
- Environment
- Regulation of Genomics
- Risk
- Governance of Knowledge
- Geo-Politics
- Business Forces

During initial discussion, some respondents expressed some concerns that genomics had been defined too broadly (as described earlier); however, the input from other participants here and later in the workshop tended to push for an even wider definition (e.g. seeing genomics” as including the constituency of researchers and innovators working with the science and technology, not just the knowledge and artifacts themselves). Another comment was that the field of genomics is so wide that it is potentially misleading to talk of it in a way that implies a unity that may not exist – e.g. talk of “public attitudes to genomics” could conceal not just the diversity of attitudes in the population, but also the complex differentiation of attitudes to different types of knowledge and application. Some respondents also noted that there were uncertainties in genomics that were not being fully represented in the drivers. Specific examples of important uncertainties that were mentioned included differential national attitudes towards success in genomics, and differences in progress between structural genomics and functional genomics.

Participants were then given the opportunity to individually comment on each driver. The responses ranged from highlighting specific issues for each driver, reorienting the emphasis of drivers, and the suggestion of additional key drivers. The detailed responses are very rich and included in the full COUNCIL report in the meeting archive. Each of the 10 drivers received multiple comments. These individual comments are abstracted and grouped below:

### **Social Attitudes**

*Religion and Genomics* – how religion shapes ethical debates, the effect of national religious beliefs on genomic development, and the future of the “soul”.

*Culture and Groups* – what happens to “nurture”, potential changes to group identities, the need to explore attitudes of social groups.

### **Social Mobilization**

*Direction of Mobilization* – do social groups mobilize in opposition to perceived threats, or in order to make positive change?

### **Demand**

*The Construction of Demand* – are “defective” genes a cultural construction, the taking for granted of health and agricultural services, is the “status quo” of demand itself negotiable.

*Demand Differentials* – important distinctions between demand in agricultural and health genomics, and between public and private healthcare.

### **Functionality of Genomics**

*Complexity* – range of genomics technologies, difficulties in clinical testing, future availability of experts, differences between the possible and the practical.

*Technology Interactions* – potential impacts of new materials and information technology on genomics.

*Views of Health* – genomics and psychological perspectives on health, social structures validating certain genotypes, who defines “success” in genomics and with what values.

### **Environment**

*Public Reactions* – potential changes in our conception of “environment,” are the benefits of bioremediation enough to overcome public sensitivity to environmental tampering.

*Broader Framing* – consider the multiple interactions between GM applications and environment: advances in monitoring and sensing, economic changes, impacts on production processes, remediation.

### **Regulation of Genomics Applications**

*Who and How* – the role played by private regulators (insurers and standards committees), differential organizational capacities of regulators, what will happen with transparency, choice, and participation.

## **Risk**

*Problematizing Risk* – where is the line between risk and uncertainty, risks come from applications and are not intrinsic to the technology, but risks to some individuals and groups are an opportunity for others.

*Risk Differentials* – differences between risk and uncertainty, different perceptions and concerns for risk from agricultural and health applications of genomics, and differing risk communication styles.

## **Governance of Knowledge**

*Structures of Intellectual Property* – possibilities for non-patent intellectual property protections, consequences of patents on information exchange.

*Governance Needs* – need for new ethical codes for scientists, and the need for public participation in the governance of science.

## **Geopolitical**

*Politics* – the role of political parties and nations, and the potential for new ideologies arising from genomics.

*International System* – the importance of North and South divides, capabilities of international organizations, governments, and trans-national religious organizations.

## **Business Forces**

*Impact of Costs* – relationship of R&D costs to corporate size and structure, how does individualized medicine work for mass-market companies.

*Corporate Roles* – potential for companies to play a new role in governance and adopt broader social perspectives, larger corporate size increases regulatability as well as political influence.

## **Missed Drivers**

After identifying important issues for each of the 10 drivers, participants were given the opportunity to list any other drivers that they felt they had missed. The points raised were very diverse, some being subsumed within the existing list of drivers, but felt worthy of singling out for attention; others suggesting rather different approaches to organising the list of drivers or, indeed, to thinking about “drivers”. This list included:

- The evolution of military use of genomics. Why should this new technology not be used in a major way in warfare as all other technologies have been in the past?
- Science itself. Science isn't a static thing defining a timeless set of problems and questions but is evolving as fast as any of the other variables being considered and in response to many of them.

- Production of Knowledge: science policy, the links between public and privately-funded science, and the internationalization of genomics science
- Criminal misuse of this new technology, and the potential for a whole range of new designer drugs and criminal activity in the development and production of these new substances.
- Social Science
- Political Parties
- Interaction with technologies including nanotechnology and new materials
- Industrial Relations (Testing and Trade union positions)
- Organized Crime
- Functional Genomics
- Heterogeneity

Participants also suggested several other issues that they felt were missing from the discussion of genomics in the drivers. Beyond missing drivers, these comments explored whether “drivers” was a useful term – the main issue here being that it implied more of a passive role for genomics than was actually the case, especially if “genomics” is understood as the social constituencies involved in developing and promoting the science and its technological applications. Other wide-ranging points included broadening the social science intellectual agenda; whether genomics should be understood in the context of the historical processes of boundary formation in the sciences, and the divergent approaches of ethicists and philosophers, on the one hand (seeking ways of thinking through the fundamental issues raised for concepts of rights, justice, equity, etc.) and social researchers who tend to seek to examine such viewpoints in their social and historical contexts. One more point, articulated strongly, was that the discussion tended to focus on health applications of genomics, while equally pressing issues were raised in agricultural, environmental and other application areas (spanning the extremes of military applications and genetically modified pets).

### **Social Science research priorities through the drivers**

For the next round of discussion, the 10 different drivers were used to frame a discussion of important areas for social science research related to each driver. The participants broke into five different groups, with each group taking two of the drivers and discussing the social science research issues that would be most relevant to each driver.

The following is the list of social science research questions that were identified by these discussion groups, grouped in terms of the drivers. They

represent a mixture of points, from specific areas that are deemed vital to study, to more general arguments about research needs and approaches, or statements about factors that need to be borne in mind in creating a research agenda. At this point in the process, the participants were not seeking to establish a set of priority research themes, but still exploring the field and exchanging views as to the best ways forward:

**Social Attitudes and Social Mobilization:**

- *Social attitudes vary in relation to the position of groups and individuals within society.*
- *What is the impact of developments in neuroscience on attitudes to being human? How will individuals and groups, especially religious ones, react?*

**Demand:**

- *What is the importance of understanding how demand is constructed?*
- *How are markets made and killed?*
- *How is demand constructed across different genomic domains?*
- *Where is choice made?*
- *What is the importance of cross-cultural differences in construction of demand (e.g. epidemiology, US v. Europe v. China)?*
- *Considering that demand is a domain of human health, what will be the needs generated by different health patterns in different geographic and socio-economic spaces?*
- *How do food and pharma demands change in different socio-economic contexts (e.g. golden rice for those that are Vitamin A deficient)?*

**Regulation:**

- *What ability do the less powerful have to shape frameworks of regulation? By what processes do the regulatory institutions develop and shape root assumptions and regulatory frameworks?*
- *How do sociological findings (especially about the role of relative power) get communicated to those in power?*

**Environment:**

- *How different social actors have different constructions of biology and environment? How these constructions and interests are contested, stratified, distributed? The key issues are issues of social power, the distribution of power between the actors.*
- *Assessing the importance of an active search for a plurality of perspectives on environmental risk and alternative approaches to regulation. This search would need to be funded and its independence*

*assured by government. What are the implications of competing regulatory regimes around the world?*

- *The established discussion of genomics implies that the problems of sustainability in agriculture can be fully addressed or solved by genomics, but the opposite is true. The solutions to these problems lie largely outside the area of genomics, and genomics might even worsen unsustainability.*

**Risk:**

- *Clarifying conceptions and varieties of risk, contrasted with and distinguished from uncertainty.*
- *Identifying different conceptions of risk between individuals.*
- *What are the emerging novel kinds of risk that are unique to genomics? (e.g. Modifications to the "stuff of life" and novel organisms).*
- *To what extent will the individualisation of risk ultimately lead to the "elimination of risk" and cause the decline of insurance and the pooling of risk.*
- *What changes to social organisations are necessary to enable transfer of social resources to more vulnerable genetic groups?*

**Governance of Knowledge:**

- *What will be the organisational changes and new institutional forms to deal with genetic injustice and technological change?*
- *Intellectual property and ownership of knowledge.*
- *Privacy rights over your own genome.*
- *Social regulation, which may withdraw the right to know.*

**Geo-Political:**

- *What will shape the complex interactions amongst countries with different levels of scientific expertise, national interests and opportunities to benefit?*
- *What will be the nature of the differences in interests between regions, the North and South, and social groupings within countries?*

**Business Forces**

- *To what extent will Governments and public investment drive developments as much as multi-national private sector investments?*
- *To what extent is there a real potential for profits from identifying individualised variants of standard drugs as opposed to improved production of new blockbusters?*

- *How will uncertainties about product liability shape and constrain the nature and direction of product innovation?*

## Finalizing the List of Key Drivers of Genomics

In order to help identify which of the key drivers were most important, the participants were asked to answer the question: *“What will be the THREE most important DRIVERS shaping GENOMICS (not social science research on genomics)? For each driver be explicit (in 2 or 3 sentences) about how the driver will shape genomics.”*

The participants were able to freely choose the 3 key drivers they felt were most important, with their selections informed by the original list of 10 drivers, the identification of missing drivers, and the identification of social science research priorities related to the 10 drivers.

The clustering of the 60 responses identified two new drivers: Events, and Genomics Itself.

*Events* describes genomics related breakthroughs, accidents, and other wild-card events that could dramatically alter the perception of genomics for good or bad. Futures studies have often examined such factors, either as exogenous wild cards (or “weak signals” that may dramatically alter the course of affairs), or as expressive of particular tendencies that are likely to come to a head in particularly significant, symbolic and dramatic ways. While the latter will typically be results of the (mis) application of genomics science and technology, the former may be events which radically affect the demand for further development of genomics (e.g. major new diseases may stimulate rapid research into and uptake of new types of prevention and cure). (Later in the workshop participants brainstormed a list of genomic related events which social research should be monitoring; see the “Events” section below, and in the Appendix of this Report).

*Genomics Itself* involves the institutions and social dynamics of the genomics field, which can internally influence the course of development for genomics. This reiterates the point that the field has its internal forces – ranging from the ways in which the scientific community defines research problems and key foci for work, to those in which innovators may seek to shape regulation and markets, for example.

Of the responses on the most important drivers shaping genomics, 45 of the 60 total responses broadly fit into the framework of the initial drivers, 8 responses further expanded or shifted the emphasis of existing drivers, and 7 of the responses highlighted the importance of interactions between the drivers.

## Interactions among the Key Drivers

A number of points that were contributed at this stage were very hard to tie down to one or more drivers, since they more or less explicitly dealt with interactions among drivers. The facilitators classified these suggestions as to important interactions into a number of groups as depicted below. (Methodologically, it is possible that more, and possibly different, interactions would have been obtained had we explicitly asked participants to identify the key ones.) After the “headline” for each set of interactions, we reproduce (a slightly edited version of) the text submitted by the workshop members.

*The topics that feature most frequently in these interactions are attitudes, demand, regulation, functionality, and business forces:*

1. *Social Attitudes, Regulation, Social Mobilization:* Social attitudes in a broad sense. This will be influenced by many sources of information including an understanding of the pros and cons of scientific innovations and its risks. The activity of campaigning groups and the attitudes of governments. Transparency of regulations will need a greater maturity in society about how to cope with greater and more open access to knowledge.
2. *Functionality, Attitudes, Demand:* Public attitudes on their own are a latent force. One of the key questions is the extent to which a 'killer application' emerges - which is probably not going to be obvious at the start. In the food sector, it may arise from functional foods or it may arise from a coalition of Third World states threatened by environmental or demographic pressures. In the health sector, it may be some dramatic kind of medication for a 'dread disease'. Bioremediation is an area that may well lead in terms of adoption because there is a discernible benefit and relatively contained risk, especially when this is going to be used to contain other risks.
3. *Attitudes, Demand:* In both an economic and social needs sense. Where markets can be identified, innovation will follow, for example may follow demographic needs, but the latter may be dependant on how demand is constructed in the first place. At present there is fear of GM food among consumers, and expectation about health genomics, but this could change in a weakly regulated environment). Public trust will depend on an inclusive decision-making and regulatory process.
4. *Functionality, Attitudes, Mobilization:* It is important to distinguish between 'drivers of genomics' and 'social processes/structures influenced by genomics', even though the two are also linked. Social research is likely to be more interested in the latter.
5. *Demand, Regulation, Business Plus:* The quantity and qualitative nature of demand for genomic applications will be created through multiple interactions of social processes, ranging from the nature and public

confidence in regulatory frameworks, to the particular market structures that emerge (e.g. across health and food sectors).

6. *Functionality, Demand, Regulation:* The speed of development of applications of research which will be influenced by the technology and decisions by business and regulators and demand from the public
7. *Business Forces, Demand, Attitudes:* The structure of markets may dictate which trajectories are likely to be realised, the role of business in regulation will also have implications for how genomics proceeds. These may be influenced by factors exogenous to science, such as large-scale public opinion.

### Ranking the Final List of Key Drivers

With several of these cross-driver interactions identified, the numbers of points made in respect of each of the final set of key drivers affecting genomics was as displayed below. While the task was not a fully-fledged rating exercise, the participants had been asked to select the three drivers that they considered to be of most importance, so the ranking below gives at least a rough guide as to their views of relative importance of the drivers, as formulated, at this stage of the process. The results are the product of individual choices informed by the group discussion, rather than a consensus ranking of priorities. Most notable is the strong emphasis given to regulation, and the lack of identification of environment as a key driver. It appears that we have some four topics that attract numerous references, and a long tail of those attracting moderate or few mentions in this exercise.

<b><i>Driver</i></b>	<b><i>Number of responses</i></b>
Regulation	10
Functionality of Genomics	8
Business Forces and Beyond	8 (5 plus 3 additional comments)
Social Attitudes and Beyond	7 (5 plus 2 additional comments)
Politics and Geopolitics	5
Events	4
Demand	4 (1 plus 3 additional comments)
Governance of Knowledge	3
Genomics Itself	2
Social Mobilization	2
Risk	1
Environment	0

## Assessing the Relative Importance and Uncertainty of the Key Drivers

### Ranking Importance:

With the revised set of 12 drivers, the participants were asked to rank each driver in terms of its importance in shaping genomics from a scale of 1 to 10. (1=very uncertain, 10=very certain). It is striking that the first three of this list are also the top three of the preceding list, and the bottom two likewise occupy the same place, though there are differences in detail (note the prominence of functionality over regulation):

<b>Importance</b>	
Functionality of Genomics	8.00
Regulation of Genomics	7.67
Business Forces and Beyond	7.52
Genomics Itself	7.29
Politics and Geopolitics	6.81
Demand	6.76
Social Attitudes	6.71
Social Mobilization	6.71
Governance of Knowledge	6.00
Events	5.95
Risk	5.71
Environment	5.05

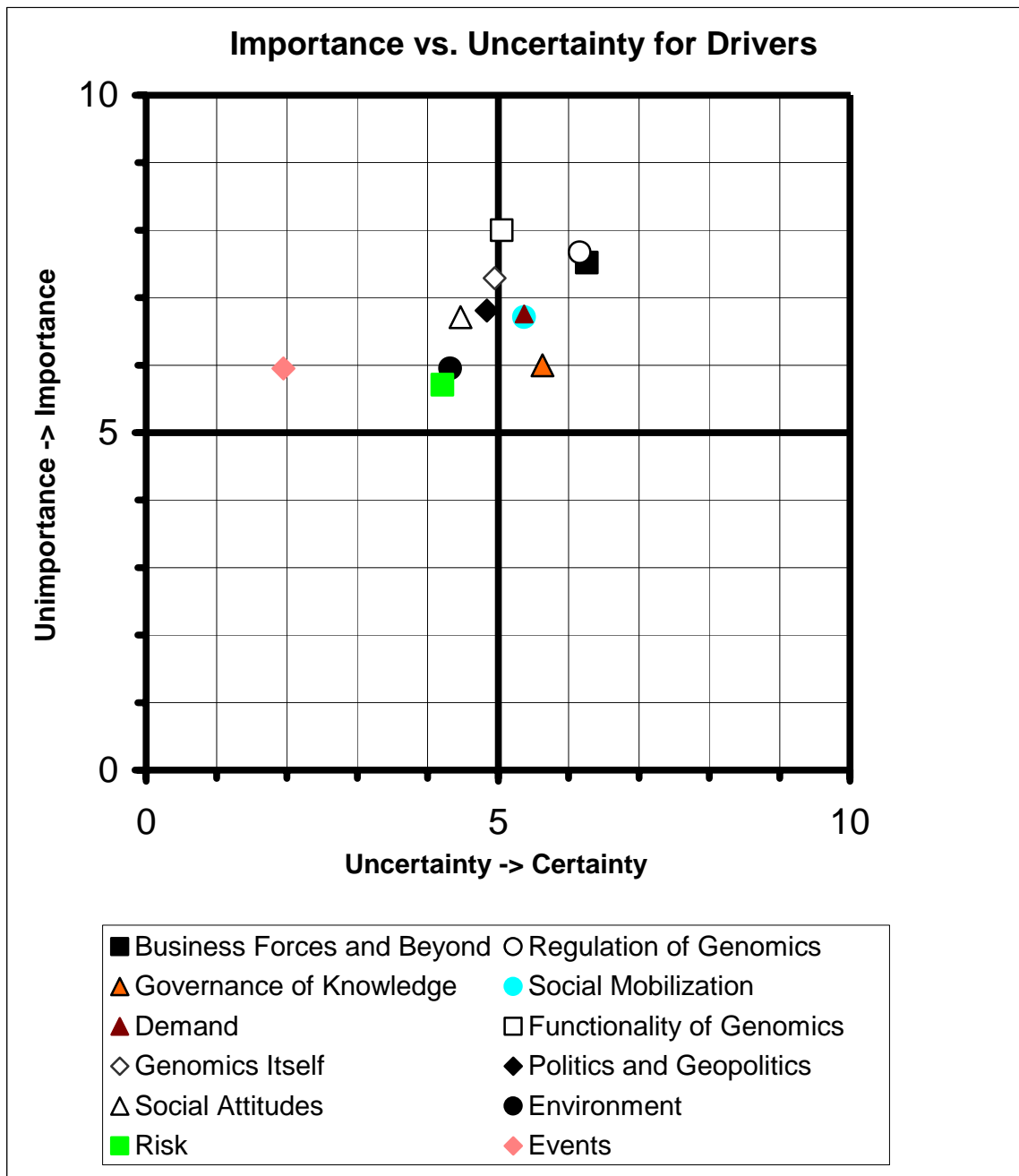
### Ranking Uncertainty:

Participants were finally asked to rank each driver in terms of its degree of future uncertainty on a scale of 1 to 10. (1=very uncertain, 10=very certain).

<b>Certainty/Uncertainty</b>	
Business Forces and Beyond	6.26
Regulation of Genomics	6.16
Governance of Knowledge	5.63
Social Mobilization	5.37
Demand	5.37
Functionality of Genomics	5.05
Genomics Itself	4.95
Politics and Geopolitics	4.84
Social Attitudes	4.47
Environment	4.32
Risk	4.21
Events	1.95

It should be noted that uncertainty here referred to how uncertain the future development of the driver appeared to be, not how uncertain the respondent was about the topic, or how uncertain they were about the scope for impact.

(Of course, it is possible that some uncertainty about how the driver might develop could reflect perceived variability in its impact – for example, social mobilization *might* have a high impact, though the previous exercise suggested that participants thought that it was unlikely to do so relative to other drivers – and it is a topic whose development is very uncertain.) Methodologically, it would be interesting to differentiate between two classes of uncertainty – uncertainty reflecting lack of ability to predict the interplay between finely balanced, but fairly well understood forces, and uncertainty reflecting lack of knowledge of the dynamics of the forces underpinning the driver. In principle, the latter might seem to call for more fundamental social research, the former for more applied research and work of a monitoring nature. It could be worth seeking to discriminate between such classes of uncertainty in future studies of this sort.



## Interpreting Importance and Uncertainty

The preceding chart, plotting the combined results for the importance and uncertainty assessments, was displayed and discussed with the participants. Functionality of Genomics was the issue of highest importance, while Events was the driver of highest uncertainty. During the discussion it was noted that several of the drivers had grouped together, as shown above, with fairly similar measures for importance and uncertainty. There are three groups of interest:

### *High Importance, Moderate Certainty*

- Functionality of Genomics, Genomics Itself, Social Attitudes, Politics and Geopolitics, Demand, Social Mobilization.

### *High Importance, Moderately High Certainty*

- Regulation of Genomics, Business Forces and Beyond.

### *Moderate Importance, Low Certainty*

- Events

In general, the group averages for the assessments of importance and uncertainty reflect a rough consensus among the participants. However, in some cases the vote distributions indicate that the final averages reflect underlying disagreement between the participants. The full distribution of votes is included in the full COUNCIL report (page 43 Section 7) in the project archive.

Scenario processes often use similar measures of importance and uncertainty to help develop a frame of understanding that can help in developing new strategies for navigating the uncertainties of the future. The use of importance and uncertainty measures in this meeting was not intended to provide an authoritative assessment of the relevance of the drivers of genomics. Instead, its main purpose was to be a useful tool to help widen the perceptions of the participants, and it is presented here more as a snapshot of their views at this point in time than as the polished result of lengthy discussion.

## Thematic Priorities, Genomics and Research Priorities

The first set of discussions, outlined above, considered the Key Drivers of Genomics and the related priorities for social science research. The second set of lenses for considering social science contributions was to use the seven thematic priorities of the ESRC. CRIC had taken the thematic priorities and developed questions and forecasts which genomics raised for each of these: the background paper had been circulated to workshop members. (The full CRIC paper is Section 4). This was a “springboard” for the following exercise. All participants were asked to comment on what the main contributions of social science should be in the specific thematic priority area. In this context they were also requested to include any comments they might wish to make on any of the more than 100 forecasts provided in the CRIC paper. The detailed responses are very rich and included in the COUNCIL report (Section 7) in the meeting archive.

The points that were captured in this process are first presented below in terms of the items reflecting social science research contributions within each thematic priority:

### Social Science Research Contributions by Thematic Priority Area

#### **1. Economic Performance and Development**

- A. *Social science should study what will shape and be the consequences of the development of intellectual property rights.*
- B. *Study global economic processes from the eyes of those in developing nations e.g. greening the desert, Amazon development.*
- C. *Consider future product development and the interest groups that will have a bearing on it.*
- D. *How demand generated by genomic development can be equated with meeting human need.*

#### **2. Environment and Human Behaviour**

- A. *What makes the new technology a paradigm buster in social terms? e.g. in terms of (a) changing the environment and (b) changing attitudes to the self.*
- B. *A role for social science is in challenging the natural sciences power and ability to define the environment and human behaviour.*

- C. *Questioning whether humans are inside or outside the environment. e.g. viewing all life forms as modifiable. Environment viewed as a resource (e.g. will we change from the assumption that everything is there to improve the lot of humans or will we be the opposite).*
- D. *Is this area any different in social terms from any other large-scale, systemic socio-technical change?*
- E. *Will it matter how the science and applications evolve? Where might the paradigm shifts be? How will we recognise one?*
- F. *Genomics does not exist on its own. Therefore, to what extent will the advances made in genomics be driven by the technologies that exist already?*

### **3. Governance and Citizenship**

#### **A. Privacy and data protection**

- 1) *Understanding drivers of waxing and waning public concern, and the distribution of privacy risks that attract particular public attention in different countries, contexts and at different times.*
- 2) *Understanding the organisational capacity of data protection regulators to gather intelligence, set standards and secure compliance with them in relation to personal genetic information.*
- 3) *Understanding the extent, nature and determination of cross-national collaboration and syndication between national data protection regulators.*
- 4) *Understanding how far there will be race to the top or race to the bottom dynamics in data protection regulation in response to corporate decisions about where to locate the processing of databases of personal genetic information*

#### **B. The socialisation of costs arising from genetic inheritance**

- 1) *Understanding how far different polities decide to socialise costs that would otherwise fall to individuals that are deemed to arise as a result of their genetic inheritance, what counts as "direct" or "indirect", what counts as voluntarily aggravating the costs, what impacts this has for personal liability.*

#### **C. Right to know, duty to know, duty to find out**

- 1) *How will polities decide, and how will their decisions differ, in the regulation of citizens' obligations to find out about their genetic risk profile before making decisions about e.g. what work to seek, what leisure activities to undertake, what countries to visit?*
- 2) *How will decisions of this kind actually be enforced?*
- 3) *How far will settlement or consensus be possible on these issues?*

#### **D. Duty to reveal, especially in employment and insurance contexts**

- 1) *Under what circumstances will countries decide, and why, that individuals must reveal genetic information about themselves to employers and insurers, and what differences will there be in regulation of the decisions that employers and insurers can make using this information?*
- 2) *What will be the relationship between duty to reveal regulation and anti-discrimination regulation? When, how and why will the definition of what counts as a disability change?*

**E. Tort law**

- 1) *When will individuals be held liable for their acts or omissions that cause harm to others, as a consequences of their or the other's genetic characteristics?*
- 2) *Will different sections of the public react to these decisions?*
- 3) *Will US law lead the world in this area, or will there be continued divergence between countries?*

**4. Knowledge, Communication, and Learning**

- A. *Understanding the changing nature of the scientific activity producing the genomics revolution.*
- B. *Mapping the changing disciplinary boundaries in science/social science.*
- C. *Researching the multiple publics and multiple understandings of the genomics revolution and how these are produced.*
- D. *Generating the capacity for rapid real time research of key issues (environmental scanning).*
- E. *Finding means of educating scientists about relevant social science (and the reverse).*
- F. *Researching the implications of genomics for education schooling and other forms of learning.*

**5. Lifecourse, Lifestyles, and Health**

- A. *Reconceptualisation of health*
  - *How individuals and society understand health.*
- B. *The social organisation of healthcare provision*
  - *Across public and private.*
  - *Preventative and therapeutic healthcare.*
  - *Relationships between health providers and other sources of health and well being, such as supermarkets, also the customer as the market for health vs. disease etc.*

*C. Reprofessionalisation of the new genetics in health, - new therapies and control by the health profession, or by new professions such as counselling, who will take ownership of these issues?*

*D. Behavioural change*

- How new genetic knowledge will engender behavioural change or not.*
- How will we modify life-styles or will choices be affected by better personal knowledge.*

## **6. Social Stability and Exclusion**

*A. What does 'exclusion from opportunity' mean? Does genomics affect the definition of 'opportunity' and 'exclusion' by government, employers and other major social institutions?*

*B. How could a society decide which aspects of a genotype to use in allocating opportunities? What would be the costs and benefits of such decisions?*

*C. If genetic information has implications for the insurability of individuals, what are the consequences for the arguments over state versus insurance-based provision of welfare in times of personal misfortune?*

*D. How can individuals' rights of access to personal information, including their genotype, be reconciled with the socially destabilizing implications of action based on this information?*

*E. Need for baseline information on the social distribution of genotypes, possibly in association with the NHS/Wellcome/MRC Biobank project. Social information must be collected alongside genetic information and be linkable to it.*

*F. Does genomics lead to new forms of social coercion or a need for new kinds of protection or does it just mean some minor adjustments (inclusive and exclusive) of established patterns?*

*H. Need for theoretical work in several social sciences (anthropology, sociology, politics, economics) about the interaction between social, cultural and biological influences on human behaviour and social organization and about the implications of genetic knowledge for traditional thinking about the basis of social order.*

## **7. Work and Organisation**

*A. What - Need to study the way that genomics will transform industrial organisation, employment patterns, skill, in different geographical regions and in different areas of genomic science and technology.*

*Why - can assume genomics will lead to major transformations across many sectors of the economy*

*B. What - need to understand different relationships between public and private science and the relationships between different organisations in the innovation process. How is this modulated by different regulations governing IP?*

*Why - questions of the social rights to knowledge and knowledge appropriation. Questions of efficient production of knowledge and fruitful or inhibiting interactions between different types of organisation.*

*C. What - the need to develop new ways of researching the above comparatively, and in a global perspective.*

*Why - genomics cannot be kept in the bottle of the nation state, and in specific ways.*

*D. What - there needs to be study of the particular ways in which genomics and bioinformatics contributes to creating the 'knowledge economy' and thereby the nature of work.*

*Why - There is a lot of non-specific talk about the knowledge economy.*

## **Regrouping of Social Science Research Contributions Related to the Thematic Priorities**

It was felt helpful to step beyond the specific thematic priorities, to regroup the social science research contributions by their core subject or focus. The following grouping was presented to the workshop, and helped stimulate further discussion of issues arising and areas covered or neglected. (The numbers attached to the items indicate which of the seven thematic priority areas they originated in.) Quite a few of the topics do still fall readily into one or other of the thematic priorities, though many of them span several of the ESRC groups. One notable feature of this grouping is the volume of suggestions concerning issues of the dynamics of socio-technical change, and the specificities (or otherwise) of genomics, that might need more systematic consideration and research. Additionally, several other themes suggested the need for work on the cultural dimensions of socio-technical change and new scientific knowledge.

(Note: the numbers below correspond to those used for the forecasts and questions in Section 4. CRIC Report on Genomics and Social Science.)

### **Specificities of Genomics**

*2A. What makes the new technology a paradigm buster in social terms? E.g. in terms of (a) changing the environment and (b) changing attitudes to the self.*

- 2D. *Is this area any different in social terms from any other large-scale, systemic socio-technical change?*
- 4A. *Understanding the changing nature of the scientific activity producing the genomics revolution.*
- 7D. *What - there needs to be study of the particular ways in which genomics and bioinformatics contributes to creating the 'knowledge economy' and thereby the nature of work. Why? There is a lot of non-specific talk about the knowledge economy.*

### **Science and Technology Knowledge**

- 1A *Social science should study what will shape and be the consequences of the development of intellectual property rights.*
- 2E. *Will it matter how the science and applications evolve? Where might the paradigm shifts be? How will we recognise one?*
- 2F. *Genomics does not exist on its own. Therefore, to what extent will the advances made in genomics be driven by the technologies that exist already?*
- 4D. *Generating the capacity for rapid real time research of key issues (environmental scanning).*
- 4F. *Researching the implications of genomics for education schooling and other forms of learning.*
- 7B. *What - need to understand different relationships between public and private science and the relationships between different organisations in the innovation process. How is this modulated by different regulations governing IP? Why - questions of the social rights to knowledge and knowledge appropriation; Questions of efficient production of knowledge and fruitful or inhibiting interactions between different types of organisation.*
- 7C. *What - the need to develop new ways of researching the above comparatively, and in a global perspective. Why - genomics cannot be kept in the bottle of the nation state, and in specific ways.*

### **Regulatory Issues re Personal Data**

#### **3 -1. Privacy and data protection:**

- a. *Understanding drivers of waxing and waning public concern, and the distribution of privacy risks that attract particular public attention in different countries, contexts and at different times.*
- b. *Understanding the organisational capacity of data protection regulators to gather intelligence, set standards and secure compliance with them in relation to personal genetic information.*
- c. *Understanding the extent, nature and determination of cross-national collaboration and syndication between national data protection regulators.*

*d. Understanding how far there will be race to the top or race to the bottom dynamics in data protection regulation in response to corporate decisions about where to locate the processing of databases of personal genetic information*

*3-3. Right to know, duty to know, duty to find out*

*a. How will polities decide, and how will their decisions differ, in the regulation of citizens' obligations to find out about their genetic risk profile before making decisions about e.g. what work to seek, what leisure activities to undertake, what countries to visit?*

*b. How will decisions of this kind actually be enforced?*

*c. How far will settlement or consensus be possible on these issues?*

*3-4. Duty to reveal, esp. in employment and insurance contexts:*

*a. Under what circumstances will countries decide, and why, that individuals must reveal genetic information about themselves to employers and insurers, and what differences will there be in regulation of the decisions that employers and insurers can make using this information?*

*b. What will be the relationship between duty to reveal regulation and anti-discrimination regulation? When and how and why will the definition of what counts as a disability change?*

*5C. Reprofessionalisation of the new genetics in health, - new therapies and control by the health profession, or by new professions? Such as counselling, who will take ownership of these issues.*

*6D. How can individuals' rights of access to personal information, including their genotype, be reconciled with the socially destabilizing implications of action based on this information?*

*6E. Need for baseline information on the social distribution of genotypes, possibly in association with the NHS/Wellcome/MRC Biobank project. Social information must be collected alongside genetic information and be linkable to it.*

### **Social and Health Policy Challenges**

*3 -2. The socialisation of costs arising from genetic inheritance - a. understanding how far different polities decide to socialise costs that would otherwise fall to individuals that are deemed to arise as a result of their genetic inheritance, what counts as "direct" or "indirect", what counts as voluntarily aggravating the costs, what impacts this has for personal liability.*

*5C. Insurability, state versus insurance-based provision of welfare.*

### **Interfaces Between Disciplines**

*4B. Mapping the changing disciplinary boundaries in science/social science.*

*4E. Finding means of educating scientists about relevant social science (and the reverse).*

### ***Innovation, Market and Industry Structures, and Consumption***

- 1C. Consider future product development and the interest groups that will have a bearing on it.
- 1D. How demand generated by genomic development can be equated with meeting human need.
- 6H. Need for theoretical work in several social sciences (anthropology, sociology, politics, economics) about the interaction between social, cultural and biological influences on human behaviour and social organization and about the implications of genetic knowledge for traditional thinking about the basis of social order.
- 5B. The social organisation of healthcare provision –  
*Across public and private; - preventative and therapeutic healthcare; - relationships between health providers and other sources of health and well-being, such as supermarkets, also the customer as the market for health vs. disease etc.*
- 7A. What - Need to study the way that genomics will transform industrial organisation, employment patterns, skill, in different geographical regions and in different areas of genomic science and technology.  
*Why - can assume genomics will lead to major transformations across many sectors of the economy.*

### ***Cultural Implications and Institutional Responses***

- 2A. What makes the new technology a paradigm buster in social terms? e.g. in terms of (a) changing the environment and (b) changing attitudes to the self.
- 2B. A role for social science is in challenging the natural sciences power and ability to define the environment and human behaviour.
- 2C. Questioning whether humans are inside or outside the environment. e.g. viewing all life forms as modifiable. Environment viewed as a resource (e.g. will we change from the assumption that everything is there to improve the lot of humans or will we be the opposite).
- 4C. Researching the multiple publics and multiple understandings of the genomics revolution and how these are produced.
- 5A. Reconceptualisation of health - how individuals and society understand health.  
*In addition when and how and why will the definition of what counts as a disability change?*
- 3-5. Tort law: a. When will individuals be held liable for their acts or omissions that cause harm to others, as a consequences of their or the other's genetic characteristics? b. Will different sections of the public react to these decisions? c. Will US law lead the world in this area, or will there be continued divergence between countries?

6A. *What does 'exclusion from opportunity' mean? Does genomics affect the definition of 'opportunity' and 'exclusion' by government, employers and other major social institutions?*

***Additional items not immediately classifiable within any of those above:***

5D. *Behavioural change - How new genetic knowledge will engender behavioural change or not. - How will we modify life-styles or will choices be affected by better personal knowledge.*

1B. *Study global economic processes from the eyes of those in developing nations. (E.g. greening the desert, Amazon development).*

6F. *Does genomics lead to new forms of social coercion or a need for new kinds of protection or does it just mean some minor adjustments (inclusive and exclusive) of established patterns?*

## Scenarios of Genomics and Society 2015: Social Research Priorities

In the next exercise, another lens was used to examine where social research might make major contributions. Participants broke into four groups, each exploring one of the scenarios (Genomics, Inc.; Broken Promises; Out of Our Control; and Genomics for All). Each group was requested to discuss the scenario, but in particular to orient its discussion toward, and answering two questions:

- A. Assuming this scenario will occur, what is the optimal contribution of social science research can make (your 3 to 5 top priorities)?
- B. Signposts: What would indicate movement toward this particular scenario, expressed, for example, as headlines in the media?

The scenario teams also undertook some critique of the scenarios, suggesting editorial revisions and points for further reflection. These will be considered in the course of revision of the scenarios. Below we present a very brief account of each scenario, a listing of key contributions identified by the groups, and some suggestions as to signposts relevant to the development of the scenario (some of these collected from participants after the workshop).

### Scenario 1: GENOMICS, Inc.

The small group assigned to this scenario concluded that while society has been fortunate in this scenario – genomics has worked up to 2015, side effects are few, and though benefits are not equitably distributed, there are sufficient fault lines ready to raise major problems. The task of social research should be preparing for those problems.

#### **Key areas for contributions of social science research would include:**

1. Research on current and historical developments that critiques the developments, identifies the impacts on various parts of society, stimulates the interactions between social and other sciences, and explores key aspects of history of regulation (e.g. corruption agenda).
2. Research into the big issues about what is it all for and changing concepts about well-being and what will be the new ethical debates in this world. This would include the meaning of well-being, ethics and developing countries, and the use of genomics and related information in the NHS.
3. Analysing what this new economic and industrial structure will be, how it will work, and how industry can maximize its potential (particularly in the context of an inherently fragile industrial structure). This would include the implications of the changing structure of industry, intellectual property

rights, and innovation in large corporations (i.e. how will innovation proceed with when all the players are very large).

4. Analysing growing divides, including social inequality, ecosystem effects and other specific environmental impacts, as well as understanding new lifestyle groups and their polarisation as well as ethics and the reasons why people choose to be in pro genomic and anti genomic camps.

**Signposts indicating movement toward this scenario would include:**

- mergers and take-overs of biotech companies
- new inequalities emerge, e.g. food consumption and healthcare, well-being aspirations not met, films of good life unreal for many
- high profits, cartels immune from regulation, more regulators appointed with industry background
- many patents granted and law suits about them
- contribution to national debts identified, polarisation due to genomics effects on indicators of imports and exports
- disaffection with unequal access to the benefits of this new world being shaped by genomics
- increase in public/private sector divide

The discussion of GENOMICS, Inc. in the full group raised questions about the need for social science to be able to create pictures of the future, and contribute to the discussion of what the future should be. Given the uncertainty of the future, social science will also need to enable learning from the past. In discussing the meaning of well-being there was concern about a mechanistic conception of well-being in this scenario. Finally there was a call for considering the displacement effects; particularly what is lost in the social ordering of relationships, that might result as genomics is embedded in society and the economy.

## **Scenario 2: BROKEN PROMISES**

This scenario describes a positive set of steps taken in the face of the failure of genomics. Technical challenges delay the introduction of genomics applications, and genomic-related accidents play an important role in turning public opinion against genomic technologies. Genomics solutions to health and agricultural needs are rejected in favor of alternative solutions developed out of non-genomic technologies. In this context the first task of social science is to provide research on positive alternative lifestyles (to meet the needs that genomics has not met).

**There are four major areas contributions for social science research in this Scenario:**

1. Re-evaluation of the notion of progress in relation to economics, science, and lifestyles, (among other factors). Specifics could include organic production, local production and distribution of food, homeopathic

medicine, preventative medicine, changing lifestyles, and reflexive social science.

2. Geopolitics – understanding could lead to a re-alignment of political forces. Social research should consider how these issues become part of the political process and how they inform radical but not revolutionary change. The rise or decline of political parties, including the green parties in Europe and the US are important to understand.
3. Inevitability of normal disasters. Informing the public, helping prepare them for the accidents that will happen as a consequence of genomics and motivating the public to adopt and support policies that will move away from more 'risky' approaches. This will lead to a reconceptualising of risk: untoward effects are normal, rather than accidental, part of the effects of often not fully controllable application of genomics. Social research into processes of risk aversion and risk acceptance in the public perception will be important; as well as into who will be the moral entrepreneurs who instigate and carry this process forward? This will include research into accountability, between different mutual groups in society (scientists accountable to the public).
4. Study of conflict at multiple levels, including when scientists and major economic players (such as pharmaceutical MNCs) lose their authority to government regulation and public opinion.

**Signposts for the emergence of the BROKEN PROMISES future include:**

- Greens win Tunbridge Wells
- Monsanto goes bust: second largest corporate failure in US history
- Moratorium on all human genomic experimentation
- First sign of reversal of global warming
- Corporate donations limited to \$1000 in USA
- Collapse of market confidence in genomics companies
- Rural communities in mid-West USA create new local trading arrangements
- Tesco goes bust
- India burns Golden Rice after concerns about unforeseen side-effects
- USA leads way to biological weapons protocol
- USA opens all laboratories to international inspections and becomes model for accountability of science

In the full group discussion of BROKEN PROMISES it was noted that reflexive social science would be needed to adequately explore (and indeed to enhance) the interactions between social science and wider society. Social science would contribute by identifying risks and opportunities and would support the demands for a more radical perspective.

### **Scenario 3: OUT OF OUR CONTROL**

In this scenario partial regulation in developed countries leads China to take the lead in agricultural and human applications – both the applications and the ability for global regulation of genomics periodically spin out of control – often with major negative consequences.

#### **The optimal contribution of social science research would include answering these questions:**

1. What are the sources of comparative advantage and disadvantage for states in this laissez faire order?
2. What is the nature of interaction between states and MNCs in this type of world order?
3. How are states acting to promote technological innovation in this new world order? What are the processes of technology transfer between countries and between companies and countries?
4. How has the pattern of innovation been shaped by the global organisation of regulation and economic activity?
5. How have processes of de-mobilization and re-mobilization impacted on innovation (how mobilization to halt GM is countered by mobilization for GM given that protest 'against' is more common than protest 'for').

#### **Signposts indicating movement towards this OUT OF OUR CONTROL scenario include:**

- Monsanto bought by Chinese government
- Protesters burn down Greenpeace headquarters and riot in Brussels over access to GM products
- President in 2013 endorses stem cell technology for repairing alcohol related brain damage

In the small group discussion of OUT OF OUR CONTROL, it was noted that an alternative and perhaps more appropriate name for this scenario would be “The Triumph of Laissez Faire”. As originally defined, it assumed that there was something wrong with a lack of international control. However, it was recognized that a significant body of social scientists would consider that a scenario of minimal international regulation was entirely reasonable, providing for competition among states to establish regulatory regimes. Social scientists would then study the results of this competition and the varying success of different countries, offering a range of natural experiments in regulation. They would be less directly concerned with normative issues than with the evaluation of the various attempts to reconcile conflicting internal and trans-national interests. It was noted that the more visible social mobilization in this scenario, rather than anti-GMO, is turned against Greenpeace. Participants

suggested changing the original name of this scenario “Out of Control” to “Out of Our Control”, where “our” reflects the developed nations of the North.

## **Scenario 4: GENOMICS FOR ALL**

Genomics works for many health and agricultural applications – but also for bio weapons. Changing societal support for equity and sustainability, accelerated by terrorist use of bioweapons leads to global regulation of genomics uses, development of genomics products will lessen, rather than increase disparities; and consumer behaviour in the marketplace that punishes companies and countries that don’t comply.

### **The optimal contribution of social science research in this scenario would include:**

1. Exploration of how ethics emerge, particularly how a new political ethic would emerge in Europe outside of and in resistance to existing powers, and how this ethic would be operationalized; and in relation to natural or terrorist instigated disasters.
2. Comparative analysis of scientific and political change; comparing ICTs as a model; identifying historical examples of the establishment of new international institutions; understanding institutional shifts in power.
3. Exploration of how “cultural creatives” (the 90 million Europeans identified as having values closer to those emerging in this scenario) come together in Europe; how do they move big business and government.
4. Playing an activist role in the emergence and definition of new political theory (cf. Third Way, only more effective).
5. Understanding the maturing of sustainability theory, leading to a new discussion about distribution of rights.
6. Understanding of the optimal formal and informal evaluation of new technologies, for example, a shift to value impact assessment.

### **Signposts indicating movement towards this GENOMICS FOR ALL scenario include:**

- US agrees to two tier IP rights that favour developing countries
- Genomics corporations agree to EC controls
- Genomics gives orphan drugs new life
- Anti-discrimination suit wins in battle over new eugenics
- New global risk group given statutory powers
- World Ethics Directive meets US approval

- China offers leadership in Asia's precautionary line

In the full group discussion of GENOMICS FOR ALL, a precondition would be the dramatic loss of relative power of the US and possibly its break-up. Social science can compare the evolution of ICTs and their effect on rights, ethics, and values. It was pointed out that another mobilizing negative event could involve a more potent GM influenza virus causing an international pandemic. On a more positive note, participants pointed out that social science would need to play a role in understanding the transformational changes occurring in society.

### **Thinking across the scenarios:**

After these issues were presented and discussed in the plenary, the facilitators made a first attempt at grouping the issues. They did so by categorising the various points that were cited under a set of headings representing the areas where greatest contribution from social research might be made:

- Research Stances and Styles
  - Critical
  - Visionary
  - Historically informed
- Research probing critical political and moral constructs
  - What do we mean by development, well-being, etc.
  - Fundamental conceptual constructs being used with Genomics
  - Risk as normal, risk
- Innovation studies
  - Global issues
  - States, Politics and MNC's
    - Research changing industrial structures
  - Social Ecology
    - Ecosystem impacts of genomics
    - Public processing of ecological knowledge
  - Publics and Genomics – consumers and citizens
    - Demobilization and remobilization
    - Conflict when scientists and companies lose their authority to regulation and public opinion
  - Social Intelligence Role
    - To inform the public and prepare them for risks and problems
    - Motivate the public to avoid risky policies

Given this list, the full group considered what topics appeared in two or more of the group reports (this is a variant of a common use of scenarios – the “robustness” test for a strategy – which measures the range and number of scenarios in which the strategy is successful). The topics included industrial structure, ethics, changing institutions (political and corporate), changing technologies, changing conventions or understandings, the role of States, the

reconceptualisation of risk, and the problematizing of economic order, sustainability and governance.

### **Beyond the scenario exercise:**

In considering what was not included in the scenarios, or not discussed by the small groups in using the scenarios, it was noted that several topics had not been explicitly identified as areas of contribution for social science research, including:

- The environment (again – suggesting that the topic really is of low salience here, or that the workshop perhaps underrepresented specialist knowledge in this field)
- The evolution of legal structure, nationally and internationally
- Practices displaced by genomics
- The conflicts and disparities rife in the world, e.g. The West seen as draining resources out of the developing world
- More detail on North/South Relations

### **How can we frame social science for best advantage:**

The scenarios and the questions for the small groups focused on the environment for social science research, and on the topic areas where social science could make its greatest contributions. The full group was asked to consider, in the context of our discussions, what are priorities for how social research is conducted and used. This discussion identified the following topics:

- Social science needs to work with the Natural Sciences, but the Social Science priorities don't appear to require or rely on specialized scientific knowledge focused on genomics.
- Social science needs to examine the ethical stances of researchers.
- Social science "research," related to genomics could take multiple forms and forums, including creating new forums for developing interdisciplinary research.
- Being explicit about the vast number of ways in which social science research can make a contribution, besides only writing papers.
- The organization and training of social scientists.
- Development of tools and decision aids for social science research.
- Collaborative relationships among social scientists and other scientists.
- The possibilities for international exchange and collaboration among social scientists.

### **Discussing the scenario process:**

The full group considered the scenario process that had been employed. The scenarios used IAF's approach, which focuses on "aspiration" or the dimension of intention, of vision as a factor in developing scenarios. (A similar notion of "success scenarios" has also been developed by CRIC in studies attempting to inform natural science research priorities.)

Some participants felt that the four genomics scenarios for this Project can be arrayed by putting BROKEN PROMISES at one end and GENOMICS FOR ALL at the other, with the other two scenarios falling in between.

### **Events Influencing the Development of Genomics:**

Participants were asked to suggest future events that could have a major influence on the development of genomics and its social role. These events could range from the likely and important to improbable - but not impossible - "wild card" events of very high impact. The participants came up with their proposed events on their own, and contributed over 60 different events distributed across a wide range of likelihood. The entire list was briefly reviewed and discussed by the participants, before moving onto the next exercise. Though the events were not themed during the meeting, the events effecting Genomics can be clustered into 12 broad categories:

#### **Categories for Events Influencing Genomics**

- Benefits from Genomics 13 entries
- Genomic Breakthroughs 13 entries
- Political Shifts 11 entries
- Medical Crises 7 entries
- Geopolitical Conflicts 9 entries
- Problems from Genomics 7 entries
- Changes in Genomics Itself 7 entries
- Environmental Problems 7 entries
- Genomics Eclipsed 3 entries
- Spiritual Changes 2 entries
- Economic Declines 2 entries
- Other Issues 2 entries

In general, the majority of the events focused on potential benefits and harms from genomics applications. Interestingly, even though the environment had the lowest importance in the driver ranking exercise, participants listed at least seven events related to environmental problems during this exercise. During previous discussions in the driver ranking exercise, one participant remarked that it was interesting that environment was ranked so low on the list of drivers, and found it an interesting question why that was the case.

Given the results of this exercise for events, one potential explanation could be that it may be easier to consider the impact of the environment on genomics from an “events” context rather than from a “driver” context.

The appendix contains the list of events suggested by individual participants, sorted by category.

## Top Priorities for Social Science Research

This step in the workshop process requested the workshop participants to press further in identifying and assessing the importance of different features and foci for social research on genomics. The four scenario groups were asked to identify the areas where social science could be hoped to make major contributions in their scenarios. This led to a set of 25 items (two of these were actually very similar).

The set of items was discussed by the workshop, with members of the scenario groups explaining what each item meant and why it had been selected. While this was taking place a first effort to sort the topics was being made, and was then fed back to the plenary. The items, grouped in terms of this classification framework, were:

### **Research Stances and Styles:**

- Critical and visionary social research
- Historically informed research, esp. where dealing with institutional agendas
- Interactions with social science and others
- Futures-orientation

### **Research probing critical political and moral constructs:**

- Ethical debates and issues, concepts of well-being etc.
- Re-evaluation of the notion of progress: economic, scientific, lifestyle etc.
- Sources and formation of attitudes.
- Reconceptualisation of risk as normal, research into processes of risk aversion and risk acceptance, moral entrepreneurs; into accountability between different stakeholders
- Geopolitics that re-align political forces - how issues become part of the political process and inform radical but not revolutionary change.

### **Innovation Studies**

- IPR
- Innovation processes in large firms
- How States act to promote technological innovation
- Processes of technology transfer between countries and between companies and countries
- Innovation shaped by the global organisation of regulation and economic activity

### **States, Politics, and Multinational Corporations (MNCs)**

- The sources of comparative advantage and disadvantage for states
- Interaction between states and MNCs
- Changing structure of industry and implications
- Changing industrial structures

### **Social Ecology**

- Ecosystem impacts of genomics

### **Publics and Genomics – consumers and citizens**

- De-mobilization and re-mobilization and innovation
- Conflict when scientists and major social players (such as pharmaceutical MNCs) lose their authority to government regulation and public opinion.
- Divides and inequality
- New lifestyle groupings

### **Social intelligence role**

- To inform the public and prepare them for the accidents that will happen as a consequence of genomics.
- To motivate the public to adopt policies which will move away from policies that are 'risky'.

These items were then added to a process of plenary discussion, aimed at identifying gaps in these groups' outputs: eventually 58 items were generated (though some of the new additions were much more specific than those generated through the scenario group process). These were used for computer-assisted voting, in which the workshop participants evaluated this list of options with the instructions:

*“Please place a check by the top 15 priorities for social science research related to genomics.”*

The workshop participants were each given 15 votes to allocate. Following discussion as to being able to emphasize specific points, they were allowed to place multiple checks against individual items, but no more than 3 checks per item.

The raw results are displayed below. The item titles are the “headlines” that the groups were able to see when they voted; the content had been discussed more thoroughly earlier, as explained.

## Social Science Priorities Vote Totals

	Item	Votes
	Working with natural scientists	14
	Research in and from the point of view of third world	14
	Ethical debates and issues, concepts of well-being etc	12
	Conflicts/disparities (including North-South)	11
Reconceptualisation of risk as normal, research into processes of risk aversion and risk acceptance, moral entrepreneurs; into accountability, between different stakeholders		9
	Critical and visionary social research	8
	Changing structure of industry and implications	8
	Evolution of legal structures and law (including but beyond IPR)	8
	Current thinking of the groups involved in genomics	8
	Global research	7
	Re-evaluation of the notion of progress: economic, scientific, lifestyle etc.	7
	Sources and formation of attitudes	7
Innovation shaped by the global organisation of regulation and economic activity		7
	Working with Medical Science	7
Genomics studied in relation to related, enabling, and competing technologies e.g. ICT		7
	Sources and attitudes on genomics	7
Historically informed research, esp. where dealing with institutional agendas		6
	Training	6
	De-mobilization and re-mobilization and innovation	6
	Divides and inequality	6
	Religious views on genomics	6
	Economic analysis of genomics industry	6
Geopolitics that re-align political forces - how issues become part of the political process and inform radical but not revolutionary change.		5
	Ecosystem impacts of genomics	5
Conflict when scientists and major social players (such as pharmaceutical MNCs) lose their authority to government regulation and public opinion.		5
	What is displaced in society by genomics	5
	International institutions	5
	More food chain	5
Culture - genomics role in behaviour, leisure behaviour, performance enhancement, recreational drugs		5
	Interactions social science and others	4
	Futures-orientation	4
	IPR	4
Processes of technology transfer between countries and between companies and countries		4
	Research on Ideological and Criminal Opposition	4
	Food chain and Medicine	4
	Global patterns of local and national politics	4
	Work in new fora to enhance dialogue	3
to inform the public and prepare them for the accidents that will happen as a consequence of genomics.		
	Innovation processes in large firms	3
	New lifestyle groupings	3
	International relations, security	3
Economics - how genomics challenges economic principles		3
Social understanding of ecology and the importance of it		3
	Rural Urban Debate	3
	Moral agency	3
	Monitoring Change	3

Media Representation	3
Beyond academic institutions as roadblocks	2
How States act to promote technological innovation	2
The sources of comparative advantage and disadvantage for states	2
Interaction between states and MNCs	2
Corporate attitudes	2
Demographic	1
Applied research	0
Decision aids and other tools	0
to motivate the public to adopt policies which will move away from policies that are 'risky'.	
Caste and genomics	0
Who will go bust?	0

It was pointed out in the plenary discussion of these results that many of the topics overlapped, and in particular that several of the items that had received very few of the votes could often be seen as specific examples of a broader theme stated elsewhere in more general terms as a separate item. Workshop members suggested that while the “raw” results as presented above are themselves useful, it would be valuable to attempt to group the items into some categories that would draw in these more specific items, and thus capture the votes that they received. One participant felt that these priorities, while basically appropriate, do not adequately address issues of the potential for cultural transformations from genomics, as well as transformations of personal identity.

The results of this exercise are displayed below. Two broad types of theme were identified: the larger set is comprised of groups of items that focus on particular topics that require research. The smaller set – many members of which received high numbers of votes – displays more of an emphasis on how research is conducted, its organisation and in particular its social engagement.

### How Research is Conducted

The set focused on how research is conducted consists of the following broad groups (beginning with those who received most votes):

1. INTERDISCIPLINARITY
2. ENGAGED RESEARCH
3. INTERNATIONAL RESEARCH
4. RESEARCH CONFRONTING CONFLICT AND INEQUALITY
5. COMMUNICATION OF RESULTS

Each of these is given a brief characterisation here; the set of points that were grouped under each heading is displayed in full detail later:

**1. Interdisciplinarity** – Social science research must make a contribution to genomics and its interaction with society. Success in this field will require interdisciplinary approaches to research including working with natural scientists regarding both genomics and related ecosystem impacts, and with medical scientists.

**2. Engaged Research** – Social research should be actively oriented to informing social innovation and attempts to envision and create futures. It should be prepared to draw lessons from history, and recognise the rooting of assumptions and practices in historical contexts, be able to move beyond roadblocks posed by academic and other institutions, and determine the training needs that will ensure that social scientists can make their appropriate contribution to genomics.

**3. International Research** – The genomics revolution is inherently global and requires analysis by international teams; the interaction with global divisions (see also the next point) demands research in and from the point of view of the third world.

**4. Research Confronting Conflict and Inequality** – Social research cannot afford to shy away from the conflicts, social divisions, other disparities and genomics' relationship, though it should examine presuppositions of "genomics divides" carefully.

**5. Communication of Results** – Social research should play a significant role in enhancing social dialogues about genomics and related social issues by working in new ways to enhance dialogue, informing and preparing the public to deal with genomic accidents and their consequences, and monitoring change.

### Research Issues

The notes below group the research issues into a number of main categories, and order them in terms of the number of votes that were achieved in aggregate by the issues grouped into each heading.

1. SOCIAL PERCEPTIONS AND ETHICAL STRUCTURES CONCERNING GENOMICS AND RELATED INSTITUTIONS
2. BUSINESS AND ECONOMICS – SHAPING AND BEING SHAPED BY GENOMICS
3. CRITICAL ANALYSIS OF KEY SOCIAL CONSTRUCTS AND THEIR USE
4. INTERNATIONAL POLITICS AND INSTITUTIONS
5. CULTURAL RECEPTION AND CONSUMPTION PRACTICES
6. COEVOLUTION OF LEGAL STRUCTURES AND GENOMICS
7. FOOD AND AGRICULTURAL APPLICATIONS OF GENOMICS
8. MOBILIZATION OF GROUPS TO PURSUE INTERESTS THROUGH, OR CONCERNS ABOUT, GENOMICS
9. INTERRELATIONS BETWEEN TECHNOLOGIES
10. CORPORATIONS, INNOVATION AND TECHNOLOGY TRANSFER
11. GENOMICS INNOVATION AND THE STATE

(Here, especially for the first few, categories, which received most votes, we could have allocated the issues in different ways across topics.) Rather than take the groups below as a definitive specification of areas of concern, we suggest that these categories are used more loosely to inform thinking about

the sorts of topics that form priorities for research – where there are liable to be major contributions from social science directed at these issues.

**1. Social Perceptions and Ethical Structures Concerning Genomics and Related Institutions** – The current nature, sources and formation of social attitudes and perceptions about genomics, and its impacts particularly on the ecology. The role of media representation, religious and corporate views of genomics, conflicts when scientists and major social players lose their authority to government regulation. And moral agency. (This category is the most highly rated of all the combined topics. It reflects the bundling together of several elements: not only attitudes but also aspirations and expectations, and not only on the part of the broad public but also among particular stakeholders; not only the views themselves, but also how they are generated, sustained and challenged, and what social institutions articulate them and how. The issues raised clearly overlap with those touched on elsewhere, particularly in categories 2, 4, 5,6 and 8 below.)

**2. Critical Analysis of Key Social Constructs and Their Use** – Critical examining of major social assumptions and constructs that are deployed in debates and practical decision-making around genomics, including ethical debates, concepts of well-being, conceptions and nature of research on risk, moral entrepreneurs, accountability of different stakeholders, and notions of progress.

**3. Business and Economics – Shaping and Being Shaped By Genomics** – In addition to analysis of the dynamics of investment, innovation, market formation, and industrial structures, these items include the exploration of challenges to conventional economic analyses that may be raised by the wide-reaching emergence of genomics. (This topic contains issues overlapping with those in other groups, especially 10 and 11 below.)

**4. International Politics and Institutions** -- The specifically international dimensions of the political issues associated with genomics ranging from security regimes to regulatory ones, as well as the global patterns of local and national politics. (Relates particularly to groups 6, 8 and 11 below.)

**5. Cultural Reception and Consumption Practices** – Genomics' role in our understandings of human behaviour and responsibilities, including leisure, performance enhancement. Social practices associated with use of genomics applications in everyday life, and the broader implications that this may have for patterns of demand and consumption, new lifestyle groupings, recreational drugs, and understanding what is displaced by genomics. (Rather a heterogeneous category, relating to 8 and 9 below, among others.)

**6. CoEvolution of Laws and Legal Structures and Genomics** – Legal institutions and practices will respond to the availability of new knowledge, the issues it raises about the ownership of such knowledge and the liabilities and rights of owners and users. The attribution of responsibility to individuals with

distinct genetic propensities that may be related to psychological or behavioural attributes and dispositions.

**7. Food and Agricultural Applications of Genomics** – Social science research is needed to understand the impacts of genomics on the food chain, on the food consumption and medicine, and on the rural urban debate.

**8. Mobilization of Groups to Pursue Interests Through Or Concerns About, Genomics** – The formation and organisation of action around genomics by stakeholders other than the original innovators or industries concerned, and the ways in which such processes may impact the development of the field.

**9. Interrelations Between Technologies** – Genomics studied in relation to related, enabling and competing technologies, e.g. ICT.

**10. Corporations, Innovation and Technology Transfer** – Several items above touch on innovation processes, but the focus here is on large firms, and their role in international diffusion of technologies and their relations with countries.

**11. Genomics Innovation and the State** – These items, related to those in geopolitics and industrial structures, call for analysis of the role of states in the global development of genomics, in relation to both other states and to multinational corporations.

Several points should be borne in mind in considering these results. First, the particular groupings here employed are somewhat arbitrary; different categories might have been used, and some items could fall into more than one category. (The “social perceptions” theme could have been split into several subthemes – which would have received relatively few votes in consequence – for example.) Related to this, it should be remembered that all of the items covered appear because a workshop member did consider it important, and almost half of the items are ones that a scenario group had nominated among the most important contributions that social research could be making. A third point is that the process of voting was accomplished under some time pressure, and had the workshop members had a little more time to reflect on the grouping of topics, they might have awarded somewhat different distributions of votes.

But while the precise votes should not be taken too seriously, the general pattern of the results is quite telling. The workshop members were themselves struck, for example, by the stress placed upon rendering social research a more active party in helping to create visions for the use of genomics, in being socially engaged and addressing international inequalities, and the like. And given the opportunity to review the final groupings after the Workshop, some participants made minor adjustments, but none disagreed with the 16 themes nor their rough order.

Research Organisation and Process	Votes	Comments
<b>INTERDISCIPLINARITY</b>		
Working with natural scientists Working with Medical Science Interactions social science and others Ecosystem impacts of genomics	14 7 4 5	<b>Combined points =30</b> <i>The strong requirement for social research in this field to be undertaken in conjunction with experts in the natural and applied sciences is stresses here; work on ecosystem issues is associated with this group because of the inter-disciplinarity that this area presupposes.</i>
<b>ENGAGED RESEARCH</b>		
Critical and visionary social research Futures-orientation Beyond academic institutions as roadblocks Historically informed research, esp. where dealing with institutional agendas Training Applied research Decision aids and other tools	8 4 2 6 6 0 0	<b>Combined points = 26</b> <i>Social research should be actively oriented to informing social innovation and attempts to envision and create futures. It should be prepared to draw lessons from history, and recognise the rooting of assumptions and practices in historical contexts.</i>
<b>INTERNATIONAL RESEARCH</b>		
Research in and from the point of view of third world Global research	14 7	<b>Combined points = 21</b> <i>The genomics revolution is inherently global and requires analysis by international teams; the interaction with global divisions (see also the next point) demands analysis and analysis of this sort.</i>
<b>RESEARCH CONFRONTING CONFLICT AND INEQUALITY</b>		
Conflicts/disparities (including North-South) Divides and inequality Caste and genomics	11 6 0	<b>Combined points = 17</b> <i>Social research cannot afford to shy away from the conflicts and social divisions and genomics' relationship, though it should examine presuppositions of "genomics divides" etc. carefully.</i>
<b>COMMUNICATION OF RESULTS</b>		
Work in new fora to enhance dialogue To inform the public and prepare them for the accidents that will happen as a consequence of genomics. Monitoring Change To motivate the public to adopt policies which will move away from policies that are 'risky'.	3 3 3 0	<b>Combined points = 9</b> <i>Role for social research in enhancing social dialogues about genomics and related social issues.</i>

Research Issues requiring attention	Votes	Comments
<b>SOCIAL PERCEPTIONS AND ETHICAL STRUCTURES CONCERNING GENOMICS AND RELATED INSTITUTIONS</b>		
Current thinking of the groups involved in genomics	8	<p><b>Combined points = 44</b>  <i>This high score reflects the bundling together of several elements here: not only attitudes but also aspirations and expectations, and not only on the part of the broad public but also among particular stakeholders; not only the views themselves, but also how they are generated, sustained and challenged, what social institutions articulate them and how.</i></p>
Sources and formation of attitudes	7	
Sources and attitudes on genomics	7	
Religious views on genomics	6	
Conflict when scientists and major social players (such as pharmaceutical MNCs) lose their authority to government regulation and public opinion.	5	
Corporate attitudes	2	
Moral agency	3	
Media Representation	3	
Social understanding of ecology and the importance of it	3	
<b>BUSINESS AND ECONOMICS – SHAPING AND BEING SHAPED BY GENOMICS</b>		
Innovation shaped by the global organisation of regulation and economic activity	7	<p><b>Combined points = 24</b>  <i>In addition to analysis of the dynamics of investment, market formation, and industrial structures, these items include the exploration of challenges to received economic analyses that may be raised by the wide-reaching emergence of genomics.</i></p>
Changing structure of industry and implications	8	
Economic analysis of genomics industry	6	
Economics - how genomics challenges economic principles	3	
Who will go bust?	0	
<b>CRITICAL ANALYSIS OF KEY SOCIAL CONSTRUCTS AND THEIR USE</b>		
Ethical debates and issues, concepts of wellbeing etc	12	<p><b>Combined points = 28</b>  <i>The score here could have been raised by incorporating relevant elements of other questions: the point is that of critically examining major social assumptions and constructs that are deployed in debates and practical decision-making around genomics.</i></p>
Reconceptualisation of risk as normal, research into processes of risk aversion and risk acceptance, moral entrepreneurs; into accountability, between different stakeholders	9	
Re-evaluation of the notion of progress: economic, scientific, lifestyle	7	
<b>INTERNATIONAL POLITICS AND INSTITUTIONS</b>		
Geopolitics that re-align political forces - how issues become part of the political process and inform radical but not revolutionary change.	5	<p><b>Combined points = 17</b>  <i>The specifically international dimensions of the political issues associated with genomics are identified here, ranging from security regimes to regulatory ones, and on to relations with domestic politics and regimes.</i></p>
Global patterns of local / national politics	4	
International relations, security	3	
International institutions	5	

<b>CULTURAL RECEPTION AND CONSUMPTION PRACTICES</b>		
Culture - genomics role in behaviour, leisure behaviour, performance enhancement, recreational drugs	5	<b>Combined points = 14</b> <i>This combines at least two themes. One, treated also under the next heading, concerns genomics role in our understandings of human behaviour and responsibilities. The other concerns the social practices associated with use of genomics applications in everyday life, and the broader implications that this may have for patterns of demand and consumption.</i>
New lifestyle groupings	3	
What is displaced in society by genomics	5	
Demographic	1	
<b>COEVOLUTION OF LEGAL STRUCTURES AND GENOMICS</b>		
Evolution of legal structures and law (including but beyond IPR)	8	<b>Combined points = 12</b> <i>Legal institutions are among the important bodies and rules of practice that will respond to the availability of new knowledge, the issues it raises about the ownership of such knowledge and the liabilities and rights of owners and users, and more broadly such issues as the attribution of responsibility to individuals with distinct genetic propensities that may be related to psychological or behavioural attributes and dispositions. (see above)</i>
IPR	4	
<b>FOOD AND AGRICULTURAL APPLICATIONS OF GENOMICS</b>		
More food chain	5	<b>Combined points = 12</b> <i>The rationale behind these items is in part that of bringing to the fore the need for social research to examine the important applications of genomics to areas other than human health and biology, specifically agro-industrial applications.</i>
Food chain and Medicine	4	
Rural Urban Debate	3	
<b>MOBILIZATION OF GROUPS TO PURSUE INTERESTS THROUGH, OR CONCERNS ABOUT, GENOMICS</b>		
De-mobilization and re-mobilization and innovation	6	<b>Combined points = 10</b> <i>These two items have been combined since they each deal with research on the formation and organisation of action around genomics by stakeholders other than the original innovators or industries concerned, and the ways in which such processes may impact the development of the field...</i>
Research on Ideological and Criminal Opposition	4	

<b>INTERRELATIONS BETWEEN TECHNOLOGIES</b>		
Genomics studied in relation to related, enabling, and competing technologies eg ICT	7	<b>Combined points = 7</b> <i>This 'orphan' item stresses the need to understand the ways in which the development and use of different technologies are interrelated</i>
<b>CORPORATIONS, INNOVATION AND TECHNOLOGY TRANSFER</b>		
Processes of technology transfer between countries and between companies and countries	4	<b>Combined points = 7</b> <i>Several items touch on innovation processes, but the focus here is on firms, and their role in international diffusion of technologies</i>
Innovation processes in large firms	3	
<b>GENOMICS INNOVATION AND THE STATE</b>		
How States act to promote technological innovation	2	<b>Combined points = 6</b> <i>These items might find a home in the topics on geopolitics or industrial structures, but are distinctive in calling for analysis of the role of states in the global development of genomics.</i>
The sources of comparative advantage and disadvantage for states	2	
Interaction between states and MNCs	2	

**To summarise these complex results:**

There was strong agreement that the challenges presented by genomics to social understanding go well beyond simply specifying a number of issues that social research needs to address. It is necessary for social researchers to be able to:

- Grasp technical issues.
- Deal effectively with issues that extend beyond topics that can be readily contained within traditional disciplinary compartments.
- Interact with researchers and practitioners from a wide range of disciplines, to understand the points that they are raising, and to communicate the (actual or potential) contributions of social research to them.
- Facilitate better communication between experts, practitioners, and social groups of all kinds.
- Articulate not only information about social and economic change, and also help to envision alternative paths of development of the relation between genomics and social affairs.
- Seriously and critically examine received concepts used by institutions for handling issues raised by genomics, and confront the ways in which social conflicts and inequalities are involved in – and changed by – the developments addressed here.

The more specific issues identified by the workshops spanned the disciplines of economics, sociology, political science, etc., and identified needs for macro and micro, qualitative and quantitative modes of research. Research issues included both those centred on attitudes and discourse, in the public at large and in social movements and within institutional frameworks; and action including those actions conventionally recognised as political, and those that are more likely to be seen as a matter of narrow business and financial decisions. The groupings of issues presented above are to some extent arbitrary, since *interactions* among these broad classes of research issues are important, and the research challenges often deal with dynamics shared by several issues.

## Post Script

At the end of the meeting, participants were asked to reflect on the meeting and individually respond to four questions:

*Given the discussion over the last two days, what are the KEY INSIGHTS into Social Science Research in relation to genomics?*

*What KEY LEARNINGS would you recommend for the Social Science Community (particularly ESRC) in relation to genomics?*

*What suggestions would you make for future meetings?*

*What did you like about the last two days?*

## New Insights Gained from the Meeting

There were roughly four categories of responses, related to the divergence of attitudes among scientists, the nature of the futures/scenario process, and a range of specific insights. A fourth group reported achieving no new insights from the Workshop.

### **Group A – Divergence of attitudes and views among social scientists themselves and divergence from other scientists:**

- *Even within a group of this nature there is a wide range of opinions and attitudes about the topic.*
- *How academic boundaries need deconstructing.*
- *A reminder from social scientists that nothing should be taken as given and left unquestioned.*

### **Group B – The nature and value of the futures/scenario process:**

- *How scenario analysis is useful for generating hypotheses.*
- *I learned what futurists do and how futurists work.*
- *How difficult it is to think “out of the box”.*

### **Group C – Specific Insights:**

- *The transformative nature of genomics.*
- *The future preferred world of industry is highly unstable.*
- *Genomics will bring new types of groupings, moving away from the usual genetics underclass debate.*

- *Many substantive questions about the changing structures of social, economic and political relationships – how these may be affected by genomics.*
- *It is not easy to reach strong definitive priorities in this domain.*
- *There are some possible blind spots which the group was able to shake-up but those who have not been here may still have them...e.g. the link with environment, with conflicts, with developing countries.*

#### **Group D - No new insights from the Workshop**

- *None*
- *No radical new insights over and beyond earlier ESRC processes*

### **Key Lessons for ESRC**

The main issues here are ones echoed throughout the workshop: the need for interdisciplinarity and dialogue, for new fora and infrastructure to support these, and the importance of future-oriented perspectives.

#### ***Integration of social science, technology and other fields***

- *The ghettoisation of technology from mainstream social science research (a chronic feature over the past 30 years or so) can't be sustained.*
- *The need to think carefully about how to engage with and work with the genomics community.*
- *The need to create a research infrastructure between research councils that enables strong interactions between natural and social scientists - it won't occur sufficiently without strong multilateral support.*
- *To try and ensure that genomics is studied from a truly interdisciplinary and global perspective and that a wide range of stakeholders are included in the study.*
- *An interdisciplinary approach to social science research work on genomics is essential, not an option.*
- *Identify root conceptual and philosophical questions and issues at the intersection of genomics and social science, as these will be common to most of the research that is being contemplated.*
- *Genomics is a key area which is relevant to and draws on all aspects of social and economic research; But new and more imaginative approaches are needed to address the issues raised, particularly, global issues, political reconfigurations, as well as more traditional sociological research.*

### **Use of futures approach**

- *Social foresight could be more widely deployed in generating new research agenda.*
- *Futures thinking should be routine in deciding research programmes.*
- *A more rigorous use of out-of-the box work like this will be important. This has been a good start and we should involve a wider constituency so we can give more credence to the output*

### **Global Research**

- *The need to create a research infrastructure that meets the priorities of researching genomics in a global, and specifically North/South, scope and ambition.*
- *Be innovative in the way research is carried out. The relation to globalisation, especially third world countries, is vital in research process. Also requires a move away from the conceptualising of progress around economic growth.*
- *Research must reach further than intra-national ON ALL QUESTIONS.*
- *Work in developing countries and from their perspective to understand impact of genomics on them.*

### **Specific Comments**

- *Focus on understanding endogenous change within genomics, then develop critical analysis of this endogenous change as well as supportive analysis.*
- *Don't confuse normative and social science agendas – have a better understanding of the science as a basis for exercises of this kind.*
- *Necessity of seriously interdisciplinary collaboration.*
- *Don't let health applications dominate empirical focus - agrofood is equally important.*
- *Beware of assuming genomic/genetic exceptionalism. There's a danger of being carried away by exaggerated claims and fears, and of assuming therefore that one has to re-invent the social-science wheel.*
- *This may be hidden or assumed in the responses but it is not apparent that there is a readiness to deal with the rapid nature of developments in the field and adopt research approaches that incorporate its dynamic nature.*
- *Must move away from traditional emphasis on social exclusion/inclusion to new lifestyle groupings.*

- *Do not underestimate the negative uses of genomics - criminal or ideological.*
- *Need to study conflicts of power and values raised by genomics, and the dynamics of power shifts between rich and poor countries and between rich and poor people in the same country.*
- *Social sciences are jumping on the bandwagon in order to re-badge their research into biology questions, social science needs to more clearly define genomics and its role.*
- *See the identified priorities for social science research.*

### **Parallels of Genomics (Non-Uniqueness of Genomics)**

- *Some of the issues that have cropped up are not specific to genomics, some are. But we may be able to draw parallels from other sectors on questions like equity etc.*
- *Key thing is trying to identify the specific issues related to genomics. Some of the general themes that came up (i.e. 3rd world) would seem to me to span many areas.*

### **Suggestions for Future Meetings**

Several comments indicated the need to involve more natural scientists in this sort of dialogue. Another point made by several respondents was that there should be more opportunity for lengthy dialogue, which the use of IT may have curtailed.

- *More time for open-ended discussion, allow discussion to run longer.*
- *Before setting up such meetings with this technology, one should check whether participants are comfortable working in this way. My eyesight is bad, and looking at screens for long periods of time and working with these machines is trying.*
- *The absolute necessity of having respectable mainstream scientists participating. The need for a wider spread of social scientists - I couldn't identify any psychologists despite the identification of attitudes as a topic, of anthropologists, of economists or of lawyers. The interaction was very dominated by sociology and political science, even if people were invited under different hats.*
- *Definitely need regular breaks.*
- *Though the technology was useful in a number of ways, I think it would be better to allow a bit more time for free-flowing conversation. I also wasn't convinced that voting on issues was a convincing way of determining research priority.*

- *Review existing work in the field and try to characterise that first, to see where we're starting from and what can be built on.*
- *Have some natural scientists present. And more non-academics.*
- *I would suggest a road map of what was to be done in each session with a reference back to the map at the start of each session - sometimes it was difficult to remember where we were and how we got there as we engaged in the detail.*
- *Although Council is an excellent tool there could have been more general discussion. Perhaps as this was most people's first attempt with it the novelty of the technology took over.*
- *Composition of attendees - more representation from the natural and medical sciences.*
- *A broader spectrum of stakeholders would provide a very different set of priorities.*
- *How can social scientists become more accountable to wider constituencies?*
- *Better representation of the actors affected.*
- *More discussion.*
- *Keep the drivers/uncertainties/scenarios and their construction/deconstruction/reconstruction entirely separate from their use - mixing with social science narrowed perspectives.*
- *More info on what the meeting is for.*
- *Less emphasis on groupings unless the meeting is actually involved in deciding them - rather than reacting to an individual's view.*
- *Less written material in advance, or more time to read it in advance.*
- *More non-social scientists.*
- *More fresh air.*
- *Have a crisper summary of what aspects of the science are included and excluded. To me the banner of genomics was far too broad and the majority of people didn't understand the actual uses of DNA-based technologies.*
- *Description of genomics was offered, but there was no equivalent description of social science. This might have included: what its modes of research are, what the criteria are for successful social science research, what the history of its involvement with genomics has been, etc. It appeared that knowledge of social science was taken for granted, but many participants were not social scientists, yet were being asked to make judgments relating to social science. I personally know more about genomics than social science and have found this imbalance of information frustrating.*

## Good Parts of the Workshop

A large number of positive points were recorded, including those that centered on the general idea of the workshop (important to have such opportunities to meet and exchange views) and those dealing more with the specifics (the technology support and workshop process). Comments included:

- *Use of computer feedback*
- *There were a lot of interesting discussions particularly in small group work. It was very interesting to see what could be done with the 'groupware' technology.*
- *Council*
- *The ICT facilitated rapid and comprehensive summary without forcing us into a false set of consensus items.*
- *The Council software and operation was brilliant.*
- *The opportunity to discuss issues, meet new colleagues and contribute to an important area of debate.*
- *The best part was probably some of the interactions with people whose work I knew but hadn't actually met.*
- *Interacting with people from backgrounds I don't normally get to work with.*
- *Breakout discussions*
- *Good mix of people yet willingness to open dialogue.*
- *To have the opportunity for discussion in smaller groups. It was very stimulating that different academic disciplines exchanged views and ideas.*
- *The conversational opportunities for talking out of one's box was enjoyable and stimulating.*
- *An interesting and quite mixed group of people.*
- *Networking*
- *Meeting different people from different backgrounds.*
- *Working with a wide range of interesting individuals from a number of disciplines and backgrounds.*
- *Widened horizons of thought*
- *Ian's just in time summaries!*
- *Ian's syntheses were helpful and time efficient for the group but at times ran the risk of doing things that the group should have done themselves to feel fully engaged in the result: it was hard to absorb Ian's syntheses by presentation.*
- *Reconceptualising scenario 2 was fun and instructive.*

- *Pace and Focus*
- *I particularly liked the way ideas were communicated. I thought it enabled a pretty fast, free-flowing, non-judgmental expressing of ideas in an area which can be contentious.*
- *Pace kept on*
- *I liked the opportunity for wide ranging discussion of a programme in the making rather than de-construction of something which has already happened.*
- *The conversational opportunities for talking out of one's box was enjoyable and stimulating.*
- *The continued rejigging of boundaries under discussion. I found this particularly stimulating.*
- *Some new futures techniques*
- *The scenarios were pretty good - consistent and fairly challenging.*
- *The getting to grips with the scenarios and drivers.*
- *Dinner*
- *Council*
- *The use of the apples was very helpful though I did miss an ability to review the work as it disappeared off screen.*
- *People were open and had a good chance to exchange views.*

## Appendix

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## List of Events Effecting Genomics

### **Benefits from Genomics**

- *GM brassicas shown to have strong anti-carcinogenic properties.*
- *Well publicised successful gene-based treatment for young child with significant genetic condition.*
- *A major medical genomic-based advance addressing a high visibility disease.*
- *The introduction of a genetically modified crop with widely perceived benefits for health/nutrition.*
- *Broad application of gene therapy for single gene defects.*
- *GM food has no greater risk than 'regular' food.*
- *Previously unsolved crimes, now solved thro' searching individuals gene profiles.*
- *Better diagnosis of diseases and the treatments that are available.*
- *GRID technology in Europe discovers an unsuspected epidemiological basis of breast cancer by combining bio- and medico-informatics.*
- *Significant changes in treatment as well as predictive testing for major genetic diseases.*
- *Adult population screening for major conditions introduced in national health programmes.*
- *Major advances in the treatment of cancer and other conditions based on genetic therapy advance more quickly than anticipated and indicate every chance of minimal side effects.*
- *A major environmental disaster is cleaned up by bioremediation.*

### **Genomic Breakthroughs**

- *Rapid increase in lifespan - common for people in western world to live to 120.*
- *'Cheap' technology that enables all individuals to have their genome sequenced.*
- *Europe swamped by bioengineered recreational drugs - tests indicate that there are no significant health effects.*
- *First human clone.*
- *Creation of the first mutated warrior clone (human-animal hybrid).*
- *Humanised organs transplanted from animals.*
- *First [gm] designer pets launched in US market.*
- *A 'wonder' product that had significant economic, health or environmental implications. But how well the technology works only matters if there is demand; rBST 'worked' well, but there was no demand and indeed this type of commercial was probably harmful to commercialisation of biotechnology in more general.*
- *Some maverick claims to have cloned a human.*
- *Understanding of human genotype leads to development of powerful aphrodisiacs with minimal side effects.*
- *China develops a technology platform for genetic modification of a cancer eliminating nutraceutical.*

- *Brazil develops a generic model of human pathogenicity on the basis of plant pathogenicity.*
- *Genomics produces the first 100% vaccine against malaria. WHO attempts to eradicate the disease by year 2020.*

### **Political Shifts**

- *Contested claims over racial basis for differential educational attainment and employability.*
- *Patents for naturally occurring biological material successfully defended in US courts.*
- *Creation of an International Genomics Convention leading to international regulation with teeth.*
- *Breakup of the US (or other changes which end its current dominant political and economic domination).*
- *Return of national level democratic participation and control.*
- *Genomic issues high on agenda in political parties' manifestos.*
- *High success rate of private companies running schools shifts the public attitude to the role of private sector on delivering key public services. The same happens in the health sector.*
- *In 15 years the UK is celebrating the successful reincarnation of public transport, repeating Guiliani's success with the NY subway system: this rekindles belief in government and in the ability to deliver public goods.*
- *Rise of new ethically based social movements.*
- *Fragmentation of civilised society under impact of new genomics based drug culture/criminals.*
- *Parents who choose to have children against genetic advice are pilloried in the press, abused in the street and their children are not allowed to attend school.*

### **Geopolitical Conflicts**

- *Overthrow of Saudi government by radical Islamic movement drives US into new energy crisis potentially met by biofuels.*
- *Coordinated terrorist bio-attacks on London Underground, Paris Metro etc.*
- *Rogue state supports human cloning.*
- *Western success in developing renewable energy, much derived from genetically modified plants, destabilises Middle East.*
- *Regulation at national and international level: change of approach by US*
- *Geopolitics: bioterror/biowarfare/asymmetric biowar against the west and new forms of biowar by the west/assimilation of genomic based weapons by military systems/transformation of warfare.*
- *Invasion of Afghanistan proves to be the last time the USA and big powers could take law into their own hands. This alters the direction of geopolitics.*
- *Wide availability of geno-technologies which can be used as weapons.*
- *Linking of genomic technologies to one or more large scale wars.*

### **Problems from genomics**

- *Transgenic medical technologies lead to unanticipated catastrophes.*

**6. Report on the January 16, 17 Scenario Workshop**

- *Accidental escape of genetically modified organisms, which raise major concerns that may be real or imaginary.*
- *The first large scale deaths resulting from genomic technologies*
- *Large-scale famine or viral epidemics may accelerate the pace at which genomics contributes to agriculture or pharma, but also increase acceptance.*
- *Genomics/functionality: successes and failures/disasters in medicine and agriculture.*
- *The elimination of many inherited diseases may leave the human race more vulnerable to diseases that we simply can not see at present for the noise, ones which we may not be able to resolve.*
- *Changes to the human food chain that causes unintended biological disruption to human health, cognition, reproduction, etc. If these changes only show up after a time lag, lack of labeling will make epidemiological response and understanding very difficult.*

**Changes in Genomics Itself**

- *Genomic science transformed by increasing recognition of genetic instability.*
- *Genomics itself - and the capacity or failure of involved institutions to enlist relevant resources.*
- *Divisions and differences in such capacities between some areas or domains of genomics would change what counts as viable options in others.*
- *Genomics itself. More information obtainable together with technological developments. In consequence major diseases can be fully eradicated.*
- *Internal technological advances in genomics itself, such as more predictable gene insertion techniques, better methods for analyzing effects holistically, or reliable cloning techniques for higher mammals/humans.*
- *Genomics is a driver of itself, but to some extent it is relative; relative failure or success of other technologies is important i.e. agriculture chemicals or organics.*
- *The concept of a 'gene' is abandoned in a critical paper in Nature.*

**Medical Crises**

- *Xenotransplants release new zoonoses into human populations (like HIV but more easily transmissible).*
- *A new animal virus like HIV spreads through the population following pig heart transplantation.*
- *A highly adverse outcome for an experimental (or approved) medical genomics-based therapy.*
- *Report in the Lancet shows that women born to women who took the pill are more likely to be infertile, makes it very hard to fast-track the use of new medical technologies and lengthens testing times and undermines public confidence in science and medical advances.*
- *Virus used in gene therapy crosses with infective virulent virus and causes massive outbreak of disease in NHS National centre of excellence. Victims also succumb to MRSA, which has become endemic in such institutions.*
- *People with good genetic profiles cease any form of health promotion and suffer worse health than the rest of the population.*

### **Environmental Problems**

- *Climate change diverts Gulf Stream and forces rapid readjustment of European agriculture.*
- *"Environmental meltdowns" induced by genetic manipulation of species -- enhanced species that out-compete natural species, e.g. salmon that grow faster, possibly reducing overall fertility.*
- *Unintended and rapidly propagating changes to soil micro-flora and -fauna that reduce soil fertility.*
- *Widespread changes to bacteria, algae, or fungi that have climate change impacts, e.g. ocean plankton.*
- *Climate engineering projects that go wrong, e.g. seeding iron into the ocean to stimulate plankton growth (although this might not involve genomics directly, it might well implicate biotechnology more generally in the public mind).*
- *An ecological disaster resulting from the release of, or genetic introgression to indigenous organisms, from a GMO.*
- *Engineered plant specimen wipes out a large environmental area.*

### **Genomics Eclipsed**

- *Arrival of new scientific field which makes much of genomics less interesting and relevant.*
- *Entirely 'unrelated' events in the social-economic order which change the context in which genomics operates - for example, developments in other technological domains; in energy use; in global inequalities of various kinds. (i.e. don't forget that the anticipated developments are themselves situated in a wider world).*
- *Advances in nanotechnology lead to sudden loss of interest in genomics as new materials dominate the new research agenda. Machines remain the preferred choice, over changing the genetic makeup of either ourselves or our environment.*

### **Spiritual Changes**

- *Public statement by the Pope that God gave humans the power to develop and use genomics and we have an obligation to use it. Triggers worldwide controversy about it.*
- *Breakthrough research shows that consciousness is not an artifact of brain functioning; rather the brain is a biological consciousness-receptor. This discovery gives new force to religious and spiritual conceptions of life, with major implications for the application of genomics.*

### **Economic Declines**

- *Collapse of world stock markets precipitates declining investment in genomic companies, which forces them to re-orient towards 'saleable' technologies.*
- *Collapse of financial markets and investment in biotech sector.*

***Other Issues***

- *The creep of convention and the accumulation of events might have high impact but with no single event alone being ever seen as such.*
- *Non-events and non-happenings are probably just as important in shaping the social role of genomics.*