Re-Thinking Science: Mode 2 in Societal Context*)

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Introduction

Eight years ago the three authors of this contribution, along with three others, published *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (Gibbons *et al* 1994). Reviews were mixed. Some philosophers, historians and sociologists of science regarded the argument in the book as either simplistic or banal (or perhaps both), while science policy analysts worried about the empirical evidence for the trends identified in the book (or argued that these trends were not new). However, the book sold well. Its broad thesis, that the production of knowledge and the process of research were being radically transformed, struck a chord of recognition among both researchers and policy makers. It seemed to make sense of familiar but disparate policies and practices which they were either encouraging or experiencing.

Of course, like all theses that gain a certain popularity (and notoriety) it was radically simplified, collapsed into a single phrase, almost a slogan - 'Mode 2'. The old paradigm of scientific discovery ('Mode 1') characterised by the hegemony of disciplinary science, with its strong sense of an internal hierarchy between the disciplines and driven by the autonomy of scientists and their host institutions, the universities, was being superseded – although not replaced- by a new paradigm of knowledge production ('Mode 2') which was socially distributed, application-oriented, trans-disciplinary and subject to multiple accountabilities.

Those with most to gain from such a thesis espoused it most warmly - politicians and civil servants struggling to create better mechanisms to link science with innovation, researchers in professional disciplines such as management struggling to wriggle out from under the condescension of more established, and more 'academic', disciplines and researchers in newer universities, other non-university higher education institutions or outside the academic, and scientific, systems strictly defined. Those with most to lose were most sceptical - researchers in those established disciplines and

institutions who feared that the quality of science would be eroded if these levelling ideas gained political currency and that their own autonomy would be curtailed if more explicit links were established between research and innovation.

Both reactions were predictable. A generation ago Thomas Kuhn's *The Structure of Scientific Revolutions* aroused far more interest among social scientists, even humanists, who not only felt a shock of recognition in his account of paradigm shift but also saw that it could enhance the legitimacy of their disciplines, than among natural scientists, who saw Kuhn's companion idea of incommensurability as a threat not only to universal, or 'objective', truth but also to progressive experimentally based research (Kuhn, 1962/1070). His own discipline, physics, was most resistant of all to his ideas.

However, in the case of *The New Production of Knowledge* there was a new twist. The 'Mode 2' thesis, however simplified, was recognisably derived from the argument presented in the book. So as authors we could not object. Our critics may even have regarded us as hoist by our own petard, because inherent in the very notion of 'Mode 2', or socially distributed knowledge, is the idea that it cannot be authoritatively encoded in traditional forms of scholarly publication. If nurse researchers pounced on 'Mode 2' to reduce their subordination to medical research, or if global accountancy companies placed 'Mode 2' at the heart of newly established 'Centres for Business Knowledge', both of which are actual examples, who were we - the authors - to complain?

It was partly to resist this collapse into relativism and over-simplification of the argument presented in *The New Production of Knowledge*, partly to answer the valid criticisms of that argument and partly to develop our broader thesis that the present three authors wrote a second book *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty* (Nowotny, Scott and Gibbons 2001). Yet the difficulty remains - how to describe and defend in traditional academic discourse ('Mode 1' in our own terminology) ideas that attempt to analyse how that discourse is being transcended ('Mode 2'). 'Mode 2' is not only a concept, inherently open to manipulation or exploitation by others (even in ways of which we may disapprove); it is also a project, an example of the social distribution of knowledge which it seeks to describe.

This article hopes to continue the debate about the future of knowledge production. It is divided into three sections: (i) a summary of the arguments first presented in *The New Production of Knowledge;* (ii) a description of trends in the research environment out of which our analysis first arose, and which have intensified in the past eight years; (iii) an account of how these arguments have been extended and elaborated in *Re-Thinking Science*.

The New Production of Knowledge

Both *The New Production of Knowledge* and *Re-Thinking Science* were written as reflective essays rather than empirical studies. Their purpose was as much to address the need to invent a new language of research as to offer a detailed analysis of the trends which will be briefly described in the next section. In the first book *The New Production of Knowledge* the notion of 'Mode 2' knowledge production was introduced – and contrasted with 'Mode 1' research. 'Mode 2' knowledge production has a number of characteristics:

The first characteristic is that 'Mode 2' knowledge is generated within the context of application. This is different from the process of application by which 'pure' science, generated in theoretical / experimental environments, is 'applied; technology is 'transferred'; and knowledge is subsequently 'managed'. The context of application, in contrast, describes the total environment in which scientific problems arise, methodologies are developed, outcomes are disseminated and uses are defined.

The second characteristic is trans-disciplinarity, by which we mean the mobilisation of a range of theoretical perspectives and practical methodologies to solve problems. But, unlike inter- or multi-disciplinarity, it is not necessarily derived from pre-existing disciplines nor does it always contribute to the formation of new disciplines. The creative act lies just as much in the capacity to mobilise and manage these perspectives and methodologies, their 'external' orchestration so-to-speak, as in the development of new theories or conceptualisations or the refinement of research methods, the 'internal' dynamics of scientific creativity. The configuration of researchers and other participants keeps on changing and gives rise to the often temporary nature of a 'Mode 2' working style. Teams are brought together and dissolve upon having finished their work, only to

be re-configured in a different constellation for another task. In other words ‘Mode 2’ knowledge, in this trans-disciplinary form, is embodied in the expertise of individual researchers and research teams as much as, or possibly more than, it is encoded in conventional research products such as journal articles or even patents.

The third characteristic is the much greater diversity of the sites at which knowledge is produced and an associated phenomenon, the growing heterogeneity in the types of knowledge production. The first phenomenon, it can be argued, is not especially new. Research communities have always been 'virtual' communities that cross national and cultural boundaries. But their dynamics have been transformed. Once interaction within these communities was limited by the constraints both physical (the ability to meet) and technical (letters and telephones); now as a result of advances in information and communication technologies interaction is unconstrained - and instantaneous. The orderly hierarchies imposed by these 'old' technologies of interaction may have been eroded by this communicative free-for-all. This shift has been intensified by the second phenomenon, the fact that these research communities now have open frontiers which has allowed many new kinds of ‘knowledge’ organisation - such as think-tanks, management consultants, activist groups - to join the research game. The spread and diffusion of information and communication technologies supports and further enables the process of societal distribution of the many, heterogeneous sites of knowledge production.

The fourth characteristic of 'Mode 2' knowledge is that it is highly reflexive. The single epistemological ideal of a neutral “view from nowhere” has been replaced by multiple views, with each situated somewhere. The research process can no longer be characterised as an 'objective' investigation of the natural (or social) world, or as a cool and reductionist interrogation of arbitrarily defined 'others'. Instead it has become a dialogic process, an intense (and perhaps endless) 'conversation' between research actors and research subjects - to such an extent that the basic vocabulary of research (who, whom, what, how) is in danger of losing its significance. As a result traditional notions of accountability as being a form of external review of mature research concepts and projects have had to be radically revised. On the organizational level of the research system, a distinct shift from a ‘culture of autonomy’ to a ‘culture of accountability’ has taken place. The consequences (predictable and unintended) of new knowledge can no longer be regarded as being ‘outside’ the research

process. Problem-solving environments influence topic-choice and research-design as well end-uses.

The fifth characteristic is that novel forms of quality control are emerging - for a number of reasons. Limits of the traditional, i.e. discipline-based peer review system have become more pronounced. First, in ‘Mode 2’ knowledge scientific ‘peers’ can no longer be reliably identified, because there is no longer a stable taxonomy of codified disciplines from which 'peers' can be drawn. Secondly, reductionist forms of quality control can not easily be applied to much more broadly framed research questions; the research 'game' is being joined by more and more players - not simply a wider and more eclectic range of 'producers' but also orchestrators, brokers, disseminators, and users. Thirdly, and most disturbingly, clear and unchallengable criteria to determine quality may no longer be available. While scientific excellence (however defined) remains an indispensible criteria, it is obvious that additional criteria – be they economic, political, social or cultural – must be intergated as well. This means that we must learn to live with multiple definitions of quality, which seriously complicates (even compromises) the processes of discrimination, prioritisation and selectivity on which policy-makers and funding agencies increasingly rely.

In *The New Production of Knowledge* the idea of 'Mode 2' knowledge, with these five characteristics, was developed in a number of concrete contexts. The first was the commercialisation of research. It provided a more nuanced account of this pervasive phenomenon than either of the two standard but opposite (and one-dimensional) accounts - commercialisation as a threat to scientific autonomy and so, ultimately, to scientific quality; and commercialisation as the means by which research is revitalised in terms both of its priorities and uses and of the resources it commands (because public funding of research is inherently both constraining and insufficient). The second context to which we attempted to apply the idea of 'Mode 2' knowledge was the development of mass higher education systems. The great increase in the number of students over the past half century and the equally spectacular expansion of research have often seemed uneasy bedfellows. Although the former initially enhanced the resource base for the latter, especially between 1945 and the mid-1970s, in recent years these two elements in the modern university's mission have become increasingly competitive as resources have become constrained in a post-welfare state environment. More seriously, mass access and high-quality research have appeared to be driven by, and to address, different value systems. But this

appearance may partly be explained by the persistence of a traditional - 'Mode 1' - account of research. Within the context of 'Mode 2' knowledge these tensions are reduced, and new synergies are apparent between the democratisation of higher education and the wider social distribution of knowledge production.

The third context was the particular role played by the humanities in the production of knowledge, although many humanists might reject such vocabulary. The conventional view is that the humanities are the most scholarly and detached disciplines, furthest removed from the turmoil of application and contextualisation. Their 'uses' are almost entirely internalised. Our account in *The New Production of Knowledge* challenged that view. Instead we saw the humanities as the most engaged of all disciplines, not simply because they flow through the culture industry (for example, through novels or popular history) but because they comfortably and inevitably embody notions of reflexivity which the natural, and even the social, sciences distrust normatively and methodologically. The fourth context was globalisation. Not only has 'knowledge' in the form of world brands and massive (and instantaneous) data flows, become the key resource in the global economy; 'scientific' knowledge more narrowly defined has also been both more highly integrated than ever before but also more widely distributed. The idea of 'Mode 2' knowledge, in our view, is a useful tool to unlock some of these apparently contradictory phenomena. For example, the tension between modernity (Enlightenment values and scientific culture) and modernisation (the application of science and technology) becomes much less of a problem if a 'Mode 2' perspective is adopted.

Finally, two key issues remain to be discussed. The fifth and sixth contexts to which we attempted to apply the idea of 'Mode 2' knowledge were the least well developed in *The New Production of Knowledge*. They were, first, the potential re-configuration of institutions that flowed from the wider distribution and greater reflexivity of knowledge production; and, secondly, how 'Mode 2' knowledge can be managed. The modern world is still populated by expert institutions, which not only are essential for the advancement of social and technical progress and structure professional careers but also shape personal and group identities and influence both the constitution and the uses of knowledge in powerful ways. Similarly the production of knowledge, however widely distributed, however trans-disciplinary, however heterogeneous, however reflexive, still has to be managed. More choices have to be made more urgently about scientific

priorities. Although this explosion of choices may make it more difficult to aggregate them into, or shape them within the framework, of planned programmes with clear and stable goals, this does not mean that the problem of management has disappeared. But clearly 'Mode 2' knowledge must be managed in new ways.

The changing research environment

Before entering into the argument presented in *Re-Thinking Science* let us briefly review some of the major trends in the changing research environment today. The nature of the research process is being transformed, and this transformation has many separate elements. Scholars disagree about their respective novelty and intensity. However, three trends are generally accepted to be significant – the 'steering' of research priorities, the commercialisation of research and the accountability of science. These, and other, trends, or changes in practice, have given rise to new discourses of science and research.

The steering of research priorities

The first is the increasing desire to 'steer' research priorities. This operates at several levels.

The supranational level: The best example of which perhaps are the successive European Community Framework programmes. These programmes have attempted to shape research priorities and build research capacity to meet identified social and economic needs. On the whole these efforts have been supported by the research community because the Framework programmes, inevitably, have been broad in their scope, and consequently few areas have been categorically excluded and because these programmes have provided genuinely additional resources;

The national level: Although highly prescriptive research and development programmes (for example, those funded ministries of health, defence or agriculture) have existed for some time, there has been a growing tendency for all ministries to develop dedicated research programmes. These programmes, rather confusingly, both focus on short-term political agendas and attempt to develop long-term research capacity. There has been a tendency for 'Foresight' exercises, which initially attempted to predict future research needs in a relatively open and speculative way, to be succeeded by

more directive approaches as industry and trade ministries have attempted to identify both areas of international excellence and of inadequate research capacity within the context of global economic competitiveness;

The system level: Research councils have increasingly adopted more proactive (or top-down) identification of research priorities in place of the essentially reactive (or bottom-up) policies whereby the best research proposals, as identified by peer review, are funded. Much greater emphasis is now placed on thematic programmes. Although typically broad in their scope, these programmes are often the product of an awkward - and unstable - compromise between 'political' goals, promising science and available research capacity. In a similar way universities have begun to manage their research priorities more aggressively rather than simply providing a (logistically and normatively) support environment in which the individual and team research can flourish.

The commercialisation of research

The second element is the commercialisation of research, although this label can be misleading; *engaged research* may be a more accurate description. This has taken two main forms. First, as the public funding of research has become less adequate, researchers have increasingly turned to alternative sources of funding. Secondly, universities and other research organisations have become more aware of the value of the 'intellectual property' generated by their research. More attention, and anxiety, has focused on the first than the second – perhaps wrongly. The available public funding for research is inevitably outrun by the sheer fecundity of research potential, although this is not an argument for abandoning efforts to increase public funding. The funding of research has always come from a plurality of sources; arguably this contributes to the diversity - and creativity - of the research system. Of greater concern perhaps is the tendency of Government to define its role in research funding in quasi-commercial rather than fiduciary terms. This attempt to align public-policy with market priorities in research policy creating what are, in effect, public-private partnerships is likely to reduce diversity and creativity.

The second aspect, the determination to exploit 'intellectual property', raises even more significant concerns. The motives of universities and similar organisations are obvious enough. First, public expenditure on higher education and research generally has failed to keep pace with costs and

universities have been encouraged to develop alternative sources of income. Secondly, with the emergence of a Knowledge Society knowledge 'products', many of which are derived from university research, are increasingly valuable not in terms of their long-term potential but of their immediate market value. But, however understandable the motives of universities for seeking to exploit their 'intellectual property', it has two important consequences:

By raising the question of who 'owns' this property (the individual researcher or research team, the research community in the relevant discipline, or the institution) and then negotiating their respective shares, the exploitation of intellectual property transforms the organisational character of the university. Because inevitably greater emphasis must be placed on the responsibilities of the researcher-producers as employees and on their use of and dependence on university-provided facilities it becomes more difficult to maintain a culture of collegiality.

The exploitation of 'intellectual property' also challenges the idea (or ideal) of science as a public good. This raises awkward issues. One, of course, is commercial confidentiality. If 'intellectual property' is valuable, it cannot be given away 'free' by open publication in peer-reviewed journals or at scientific conferences open to all. Another, even more crucial, is that the quality of science is largely determined by its exposure to refutation and counter-argument. This becomes much more difficult if the circulation of research findings is artificially restricted.

The accountability of science

The third element in the transformation of research is the growing emphasis placed on the management of research - and, in particular, efforts to evaluate its effectiveness and assess its quality. During the past decade there has been a remarkable intensification of the associated processes of audit, assessment and evaluation which has given rise to the suggestion that we now live in an Audit Society - with sinuous but suggestive links with the concept of a Knowledge Society (Power 1997). These processes are at work at every level within the research system - within the research team as its evaluates the contributions of its individual members, in departments as they seek to maximise their research performance and in institutions as they struggle to manage their overall research effort as well as in funding councils and Government departments. This is a key point. It is a mistake to imagine that

accountability is being forced on universities and other research institutions by hostile external forces, even if the mutual trust once rooted in the collusion of political, administrative and academic élites has been eroded; the processes of assessment and accountability have been deeply internalised - and, at the same time, have moved from the arena of professional or collegial responsibility to the domain of organisational (and managerial) competence.

Accountability is part of a phenomenon that extends well beyond the realm of academia and research institutes and even beyond the world inhabitated by science policy makers and managers of research funding. Power has theorised these processes in an interesting way as 'rituals of verification'. He questions conventional accounts of audit, as a self-sustaining system of practical knowledge. Instead, he argues that the audit explosion reflects a distinctive response to the need to process risk. Audit emerges as a 'paradoxical and complex combination of surveillance and trust' (Power, 1997: 134-5). It elicits a self-organizing description of the organization in terms of constant activation, as though every component of the organization were in state of perpetual self-awareness, animation and expliciteness. Far from being a mere manifestation of the continued intrusion of utilitarian thinking and economic rationality into research, this 'terror of transparency' (Strathern, 2000) is part of a larger picture of accountability. It provides additional evidence for the increasing difficulty to establish clear conceptual demarcations between science and society. Science has burst through the boundaries of professionalization and institutionalization, bringing its practioners closer to other professional and highly educated groups in society, while at the same time it has exported, successfully, some of the characteristics of the scientific ethos to these groups.

The shift towards an audit and accountability culture (which can be regarded as forms of institutional reflexivity) puts the self, or the organization, center-stage. They are expected to conspire in their own surveillance. Social control is internalized and so transformed into self-control. On the one hand the self is freer to define how specified objectives should be achieved; on the other hand the specification of performance is tightened. In a de-regulated and de-centralized world, the self and the organization, become more entrepreneurial, free to choose means of how to accomplish goals, but less free to define the goals themselves.

As a result of these and other trends, research which is variously described as ‘pure’, ‘blue-skies’, fundamental, disinterested (there is a range of labels, which emphasise particular characteristics of such research) is now a minority preoccupation - even in universities. Research councils and Research Assessment Exercise panels now include ‘user’ representatives alongside more traditional scientific peers. Detailed impact studies and lengthy evaluations have become routine. ‘Knowledge’ is now regarded not as a public good but instead as ‘intellectual property’ that is produced, accumulated, traded like other goods and services in the so-called Knowledge Society. But it is not simply a question of new practices; a new language has also had to be invented – a language of application, relevance, contextualisation, reach-out, technology transfer, knowledge management.

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Re-Thinking Science

The New Production of Knowledge provoked a lively debate. The argument presented in the book was criticised on a number of grounds. In the eyes of some of these critics it amounted to little more than a legitimisation of malignant trends, in particular the subordination of research to market and political agendas on the mistaken assumption that scientific breakthroughs could be predicted and therefore planned. According to other critics the argument was not underpinned by adequate evidence; they argued that the characteristics of knowledge production summed up by the 'Mode 2' label were neither as significant nor as novel as we had suggested. Other critics again pointed out that, although much was made of the wider social distribution of knowledge and, therefore, of the more intense engagement between science and society, no real attempt was made to discuss the dynamics of society which was treated as an unproblematic given. Finally some critics accepted the accuracy of this account of 'Mode 2' knowledge production but insisted that it described social and political epiphenomena; the core of science remained inviolate.

Re-Thinking Science, therefore, was an attempt both to respond to these criticisms and, more substantially, to develop the argument. Some of these criticisms were well-founded - in particular the last two, the former because it highlighted a key piece of the argument that was missing and the latter because, were it to be true, it would radically undermine the whole thesis advanced in *The New Production of Knowledge*. The other criticisms, in our

view, were less well-founded. The idea of 'Mode 2' was never intended to be a new-fangled label for applied science or programmatic research; by questioning the linearity and predictability of the research process it called into question notions of applied as well as pure research. As has already been pointed out neither *The New Production of Knowledge* nor *Re-Thinking Science* was intended to be a thoroughly researched empirical study. So the aim of this second book was not simply to answer critics of the first. Rather it was to take the two most substantial critiques of the idea of 'Mode 2' and, by addressing them, offer a more theoretical account of the argument advanced in *The New Production of Knowledge*. This was done in four main ways.

First, the relationships between ‘science’ and ‘ society’ were articulated more clearly, in order to give substance to the twin notions of 'science speaking to society' and 'society speaking back to science'. In particular the second book attempts to identify key changes taking place in society. In the 1970s were confidently described in terms of the evolution of industrial society into a higher state of state, post-industrialism in which knowledge accessible to (almost) all would replace physical, energy and financial resources rationed to the rich and in which the rough edges of ideological conflict would be smoothed away and knowledge prosperity. In the past quarter century this optimistic vision has been progressively superseded by other dark images of future society in which, for example, risks have remorselessly accumulated and new hegemonic 'networks' emerged.

Re-Thinking Science attempted to steer between optimists and pessimists, arguing instead that the great sub-systems of modernity (State, Market, Culture - and Science itself), once clearly partitioned, were becoming increasingly transgressive; this fuzziness helped to create the transaction spaces in which 'Mode 2' knowledge developed (and also, perhaps, the new social movements). This second book concentrated on four key characteristics which, it was argued, were evident both in society and science. These were (i) the generation of uncertainty/ies, which reduces the possibility of post-positivistic planning - in both arenas; (ii) the trend towards self-organisation, which is intimately related to the growth of reflexivity - again in both domains; (iii) the emergence of new forms of 'economic rationality' according to which, as in any 'futures' market, the potential of science was measured by its immanent rather than instrumental value; and (iv) the re-constitution of time / space of which the revolution in information and communication technology was only one aspect; more

important was the emergence of new spatio-temporal categories which compromised older ideas of sequencing and distancing, so upsetting traditional relational categories.

Secondly, the assertion in *The New Production of Knowledge* that 'Mode 2' knowledge was produced in a 'context of application' was refined into a more developed argument about different forms of contextualisation, so removing any possible doubt about the mistake of a facile identification between such knowledge and applied research. Three forms of contextualisation were examined. The first was weak contextualisation. Counter-intuitively perhaps national R&D programmes are a good example because, to succeed, they must simplify both social and scientists contexts diminishing the potentiality of both, The second was contextualisation in the middle range, in which the majority of 'Mode 2' knowledge production was clustered. Here so-called 'trading zones', transaction spaces and what we labelled 'Mode-2 objects' play a crucial role in determining this form of contextualisation in which local contingencies shape synergy and potential. The third was strong contextualisation where powerful reflexive articulations between science and society were at work. This might take highly specific forms, or relate to the interaction between the world of ideas and much wider social movements such as feminism or environmentalism.

The third way in which a more theoretical account of 'Mode 2' knowledge was developed was to argue that this new knowledge form was not merely a secondary phenomenon, contingent / parasitic on ‘Mode 1’ science, as some critics had suggested. Three pieces of evidence were offered in support of this claim, which was crucial to the argument in *Re-Thinking Science*. The first was that 'Mode 2', especially in its trans-disciplinary dimension, could make a fundamental contribution to the development not only of new methodologies but also of new concepts and theories; the failure to recognise this contribution probably arose the fact that it was not encoded in disciplinary frameworks or embodied in familiar research products such as journal articles. The second piece of evidence was the epistemological core of science, the values in which it was ultimately rooted, was often a mirage; often it was empty (as, for example, when scientific ideas were absorbed by non-host cultures predominantly as technical artefacts without regard to their original normative significance) or, more usually, crowded with competing epistemologies. The third was that reliable knowledge, the traditional goal of scientific inquiry, was no longer (self?) sufficient in the much open knowledge environments that were now emerging; knowledge also needed

to be ‘socially robust' because its validity was no longer determined solely, or predominantly, by narrowly circumscribed scientific communities but by much wider communities of engagement comprising knowledge producers, disseminators, traders and users. Nor was socially robust knowledge less advanced or sophisticated than reliable knowledge; arguably it was superior.

Finally, two new ideas were introduced. The first, related to the fuller explication of contextualisation, was the concept of the *agora*. This archaism was deliberately chosen to embrace the political arena and the market place - and to go beyond both. The *agora* is the problem-generating and problem-solving environments in which the contextualisation of knowledge production takes place. It is populated not only by arrays of competing 'experts' and the organisations and institutions through which knowledge is generated and traded but also variously jostling 'publics'. It is not simply a political or commercial arena in which research priorities are identified and funded, or an arena in which research findings are disseminated, traded and used. The *agora* is in its own right a domain of primary knowledge production - through which people enter the research process and where 'Mode 2' knowledge is embodied in people, processes and projects. The role of controversies in realising scientific potential is also played out in the *agora*.

The second new idea introduced in *Re-Thinking Science* was that the context of application. As has already been said this was taken to be one of the key characteristics of 'Mode 2' knowledge in *The New Production of Knowledge*. But it was no longer sufficient. Indeed, to the extent that the context of application seemed still silently to reinforce notions of hierarchy and linearity and to suggest that positivistic predictions of applicability were still possible, it could be regarded as a dangerously misleading concept. Instead, against a background of inherent uncertainty about the future state of knowledge (and of almost everything else) from which, of course, scientific potential is derived, it is necessary to reach beyond the knowable context of application to the unknowable context of implication. Here knowledge-producers have to reach out and anticipate reflexively the implications of research processes.

The four processes described in *Re-Thinking Science* – the co-evolution of science and society in a Mode 2 direction, contextualization, the production of socially robust knowledge and the construction of narratives of expertise – are brought together, often in conflictual and controversial forms, in the

agora. But they also can form a framework for re-thinking science. Co-evolution denotes an open, and certainly more integrated, system of science-society interaction which enhances the generation of variety, whether in the choice of scientific problems, colleagues or institutional designs, on the one hand, or the selective retention of certain choices, modes or solutions on the other hand. Increasing permeability provides the basis for greater contextualization, by opening up the number of routes along which society can 'speak back to science'. These processes, in turn, lead to the social distribution of knowledge, knowledge that is valid not only inside but outside the walls of the laboratory. As the walls of laboratories become open, more and more researchers take their places as actors in the *agora* and so broaden the range of experts in interaction with others. Reliable knowledge can become socially robust only if society perceives the process of knowledge production to be participative. This, in turn, depends upon a reciprocity in which the public understands how science works, but, equally, science understands how the public works. This enhanced mutual understanding needs to be guided by a vision, supported by appropriate images as well as transparency about how they have been generated and by whom.

The vision developed here is processual. It is an invitation to re-think science while emphasizing that even the best of 're-thinking' is not yet accompanied by the changes that depend on 'science re-thought'.

*) This article is based on a revised version of Nowotny Helga, Peter Scott and Michael Gibbons "Mode 2 Revisited: The New Production of Knowledge", forthcoming in *Minerva* (2003)

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Multiple Context Mode. Note You might want to assign unique MAC addresses to subinterfaces defined on the ASA, because they use the same burned-in MAC address of the parent interface. For example, your service provider might perform access control based on the MAC address.Â Multiple context mode does not currently support the following features for remote access VPN: â€¢ Clientless SSL VPN â€¢ AnyConnect 2.x and earlier â€¢ IKEv2 â€¢ IKEv1 â€¢ WebLaunch â€¢ VLAN Mapping â€¢ HostScan â€¢ VPN load balancing â€¢ Customization â€¢ L2TP/IPsec. Additional Guidelines â€¢ The context mode (single or multiple) is not stored in the configuration file, even though it does endure reboots. At long last, it is argued, â€œscience has been drawn out from its relative social isolation, its elite status, and moved closer to the mundane concerns of societyâ€.14 Both Notker Hammerstein and Rudolf Stichweh have influentially claimed that scientific disciplines are inventions of the late eighteenth and early nineteenth centuries, since when â€œscientists continue to believe in the cognitive rationality of an.Â 22 Helga Nowotny, Peter Scott and Michael Gibbons, â€œRethinking science: mode 2 in societal contextâ€, in Elias G. Caryannis and David F.J.Campbell (eds), Knowledge creation, diffusion and use in innovation networks and knowledge clusters (Westport: Praeger, 2006), 39-51, on p. 39.