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Item Type	Preprint
Authors	Uranga, Mikel Gómez
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Download date	2026-11-01 11:13:12
Link to Item	http://hdl.handle.net/20.500.12424/174065

Ethical Issues and Social Participation in Technological and Scientific Policies

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Science, Technology, Economy and Society

Any development in science and technology leads to greater benefits for all of society. Therefore, the more resources devoted to research, the higher the levels of well being society as a whole will reach. This method of reasoning is mechanist in nature and is set within a traditional modernist perspective. Modernist authors' optimistic view of the development of science and technology prevents them from worrying about the consequences of scientific growth or the moral problems they may cause. From this viewpoint, scientists and technicians would have full autonomy to choose the paths they wish to follow in their research. However, in the 60s in US, certain organisations appeared which demonstrated participative pressure from some stakeholders, such as, for instance, the Environmental Protection Agency, the Nuclear Regulatory Commission, the Office of Technology Assessment, etc.

In the 70s and 80s, concepts developed which related science, technology and society. From this perspective, science and technology are not understood as autonomous activities but as intrinsically social processes where the non epistemic features (moral values, professional and economic interests, religious principles, social traditions) are considered to be an integral part of the generation of science and technology (López Cerezo, 2003).

Changes in the scientific-technological field have far reaching consequences on all scopes of life. Therefore, participation from different interest groups, as well as social groups, is extremely important when undertaking science and technology policy and planning. The need to consider social interaction processes in scientific tasks deviates from the modernist traditional concept and takes us to an era of greater relativism. This heuristic empirical vision translates as the validation of more open "softer" technologies which are, a priori, distant from determinism. More open solutions are encouraged, influenced by the socio-institutional environment.

Regulation of research from democratic governments and control from other political institutions is not enough to account for the entire spectrum of stakeholders; in other words, those agents affected or involved in these activities. Democracy is made stronger by participation of social, economic, scientific, etc. groups. This democratic participation should mean equal opportunities for groups taking part outside the realm of their authority. In this sense, social risks should be defined as democratically as possible.

At present, a considerable part of research in different fields may be prompted by interests from the world of business. The foremost fields such as biotechnology, the search for new medicines, or biogenetics are driven by economic (or business) reasons. The "avalanche of patents" in these sectors can only be explained by reasons related to privatizing knowledge resulting from research. Trying to separate the activities and results of scientific research from business today would be like separating the body from the soul from a non-religious viewpoint. However, in this paper, our interest is focused above all on how governments (mainly the US government) justifies and legitimizes this through Science and Technology proposals or plans which are not aimed at improving the world of business. As an economist, it causes me concern to often observe that many decisions that have economic consequences or interest certain business areas are explained, justified and sold to the public with non economic reasons or at least explanations which have nothing to do with the world of business. This veil that deliberately conceals decision making should not only concern ethicists but also economists.

Our main concern in this article focuses on the contents of scientific and technological development. It is essential to know what motivations and justifications

determine that certain lines of research are undertaken and continued. Increased R&D budgets are sometimes the result of pressure from international society or groups; environmental problems are a case in point. The negative effects of industrial development must be alleviated; this is the case of climate change and the spread of some diseases. The benefits of research must also reach the most disadvantaged sectors and poorest nations to combat these situations. However, this latter point may clash with the interests of multinational groups whose main aim is to increase profits rather than improve the health and well being of the majority of the world's population. Work on patents and the spread of many diseases in the most impoverished nations proves our point. With a view to increasing military spending, references are made to the fight against international terrorism instead of addressing the true causes behind it.

For generations, our education as economists has included dilemmas like what society should choose to produce: either guns or butter. We could apply this dilemma to the focus of our study to ask if it is better to increase financial allotments demanded by the military or seek to improve sectors such as food, housing, health, education, human rights, peace, etc. There are authors who are in favour of a new social contract and "propose new relationships between science, technology and society; in other words, adjust those relationships to new ethical standards that already govern other social activities, making these relationships more democratic so that society can influence the priorities and objectives of scientific and technological research, which calls for a truly democratic public debate" (López Cerezo, 2003: 147).

Technological scientific research does not develop spontaneously. Although it is true that both scientists and technologists have a certain margin of freedom to choose the path their research will follow, in most cases these paths are previously designed by governments, agencies or the firm. All the agents and institutions that influence the design of scientific technology policy may be guided by different interests or motives:

1. Some may be mainly financial or market reasons; others may have extraeconomic priorities such as, for instance, national security, which are due to reasons of a military nature.
2. Other interests may mainly be focused on solving group needs which may be characteristic of a certain regional or national community while others may be

more global in scope. This would be case of the hole in the ozone layer or the greenhouse effect.

In this paper, we acknowledge specific points of the contents and policies on research in different countries and regions. However, the hypothesis we are working on is the existence of some global subject areas dominant in scientific-technological research, with the USA as the centre of authority where the first advances in these areas are taken. These areas take shape as R&D programmes in U.S. government agencies and organisations.

The scope of government guidelines in the field of science and technology is local, regional or national. However, the critical mass that the USA represents in the fields of science, the military and business is so superior to that of other nations and regions that it can impose its own criteria for technical scientific development on the others in actual practice. The Americans' priorities in science and technology are references to be followed by other countries (European Comission 2002).

The influence of stakeholder groups on government design of science and technology policies is limited more to the global than local level. Claims for greater environmental respect, to create a more sustainable world, are global. Big cultural changes among people concerning health, diet, the environment, welfare, etc. are spreading all over the earth although pressure groups are obviously more visible in some countries such as Northern Europe, Germany, the USA, Canada and Japan. Michael Callon (2003) analyses the varied participation of some groups interested, either directly or indirectly, in the direction researchers are taking and public controversy on the impact of science and technology.

Rationality and the aims of science-technology plans

1. Aims related to needs (human and social): Global risks and Science

Scientific work is influenced by scientific policy: the creation of scientific infrastructure, science-technology laws, programmes financing, evaluation methods.

Policy decision making is increasingly based on scientific reports. Decision making concerning the risks of society requires complex management with the intervention of different consulting firms and evaluation bodies, and highly complex handling by institutions. Governance of the scientific research system is a complex mesh, from national to local institutions.

As opposed to the presumed autonomy in the choice of scientific lines, broad outlines of development with big objectives are designed. These big objectives are the result of historical circumstances at a given moment. For instance, the V. Bush Doctrine, determining the historic context (the Cold War, three national security lines (military industrial complex), health. Some objectives have been replaced by others, and others change over time, becoming more complex, vague. For instance, health includes new scientific disciplines (biogenetics, computer science, application of new materials, telecommunications, etc.) or the military sector (biotechnology, telecommunications, etc.).

Scientific production requires a context of development and wealth that offers both the economic and human resources needed for research work. The paradox is that the nations that need to improve their levels of health and quality of life the most do not have the resources to maintain a research infrastructure. And they are the very ones that most need to have those results and scientific orientations in the fields where their deficiencies are the greatest.

A problem arises in allocation scientific resources, and it is that of financing only those which generate short term returns. We must bear in mind that the evolution of science is complex, and lines of research which once had little effect on the market later proved to be interesting and highly profitable. Others become more important due to progress in interdisciplinary developments. Therefore, abandoning certain lines or fields which do not offer economic returns at a certain moment may place a heavy mortgage on the future. Discontinuing certain basic research may act as a brake on the road to accumulation. It is not a matter of results but of knowledge procedures (House Committee on Science, 1998).

The USA sets the tendencies for scientific research all over the world. The following important tendencies can be observed: 1. Progress towards interdisciplinary conditions which are expressed in the programmes we will analyse later. 2. The search for long term growth in which science and technology will push the industrial sector; 3.

Sustaining an advanced health system; 4. Reinforcement of an ethical educational system, 5. Improved quality in the immediate area, 6. Advances in information and communication technologies; 7. Growth of all subjects linked to security and the defence industry (National Science and Technology Council, 2000).

Scientific advances are being made in planetary networks. The broad areas coincide with global challenges (mentioned previously). "Targeted basic research": Research which has no direct application but however, "downstream" there are groups that can benefit from it. U.S. federal agencies pay attention to financing research of this type (House Committee on Science, 1998).

Chart 1 Main Areas of Research in Applied Sciences

Different initiatives serve to distribute a funds system that foresees links between research and each of the U.S. federal agencies that focus on a certain field. The chart shows a great many of the NSIC (National Science and technology Council) programmes that would receive backing from the federal government for scientific work. Many of the programmes focus on prevention of disasters or problems of nature that can occur. Others are linked to more advanced scientific models at present. All the scientific material has an interdisciplinary nature. One part refers to pressure or social problems (generally indirect). In general, they have very transversal applications. Some are very internally diversified such as health and the environment. Most of these programmes can be used downstream. There is no indication of an endogenous condition of science in which knowledge remains in the science itself; it has an application and increased value on the market (business economy).

In the EU, most of the programmes have the features shown in the chart above. Very complex science management is required since many agencies and different areas have to be co-ordinated. There is a stronger inclination to form international partnerships. From the chart 1, we observe that most of the National Science Foundation (NSF)'s areas of research are focused on general problems caused from the type of development which has been encouraged by developed economies and societies. In actual fact, what motivates and justifies most of the activities envisaged by the NSF is improvement of scientific capacity and technology to be able to meet the many risks

that threaten man and nature. It is immaterial whether these risks are related to natural causes and disasters, the vulnerability of networks and computer systems or the appearance and spread of new diseases.

The agendas of all research policies and programmes are marked by management of global risks such as: climate change, the ozone layer, urban pollution, urban waste, nuclear and industrial waste, pesticides, hormones in food production (with systems made up of over 20 million samples) genetically modified food, etc.

Participative ethics are needed. The types of intervention and regulation in sciences and environmental technologies, as well as research and development in these areas, depend on the participative framework and existing values. The choice of scientific lines of research and the resources they are endowed with are very complex decisions yet also very much influenced by pressure from participative environments. Along these lines, it would be necessary to consider the following points in order to evaluate the influence of the environment on scientific activities:

A greater number of cultures with plural values as opposed to monistic conceptions of the environment.

The greater or lesser application of the “caution” principle.

The influence of a pragmatic environmental culture.

The decisions concerning environmental matters cannot be explained by economic reasons (mainly by use of cost/benefit models), whereas certain “value systems” should be taken into consideration. (Dale Jamieson, 2003).

Precautionary principle (J.Parker 1998) is a preventive principle which is spread and developed in multiple areas and contexts. The idea is that certain political and economic interest groups cannot veto the possibility of science responding to some social demands. Risk evaluation is subjected to discussions on social issues. “Since then (early 1980’s), the so-called ‘Precautionary Principle’ has been widely adopted in the regulation of marine pollution, climate change, biodiversity loss, dangerous chemicals and the release of genetically modified organisms. One archetypal and globally influential formulation is Principle 15 in the 1992 Rio Declaration on Environment and Development, which holds that: ‘Where there are threats of serious irreversible damage,

lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”” (A. Stirling, 1999: 5).

Tension is placed on the principle between the opinion of social groups and the endogamy of scientists. At present, this tension is expressed not in principles but in consulting and participation procedures in each of the important subjects of science that affect the population. There is observed to be a change in scientific policy making without explicitly considering the social needs towards a more complex and participative model where criteria are set to improve quality, greater regulation in relational features, the proliferation of social and ethical consultations.

Different examples with problems on the local/global scope such as the following are developed: environmental management, energy management, water management; with a wealth of stakeholders and networks with different interests and social contexts. In these areas of risk management, the development of research is necessary to compensate for the scarcity of natural resources. Some risk evaluation procedures are ranked by estimating the acceptable risk level which depends on the institutional/cultural environment where it is measured. Thus, for example, the acceptable risk in environmental affairs in a German lander will be very different from that of a Portuguese region.

There is consensus that society should be represented in decisions on designing research lines that encourage the social good. It will be necessary to study the different participative democratic cultures (including referendums), how to intervene in governance from society, and evaluate the consequences of scientific work. From a sensitivity of science closer to the world of business to a more shared sensitivity. There is a tendency towards a more civil economy in which an increasing number of firms themselves take part. It is seen how certain advanced focal points of science are found in societies with a greater critical civil body where, for instance, numerous groups claim for a high quality of life.

Citizens could accept the fact that their taxes are used for scientific research to lower risks. They might be interested in decreasing the risks involved in nuclear power plants (Douglas Maclean, 1998), or to minimize risks for health caused by the destruction of the ozone layer, the appearance of new diseases, the gradual disappearance of drinking water, the collapse of computer networks, air pollution,

hunger, etc. If evaluation of risks presents difficulty in terms of calculating probabilities, the very perception of what poses a risk or not is more complicated. "Analysis must begin by identifying which risks to study and what to count as a risk, an exercise that usually requires making value judgments"....."The question raised by this concern is not whether ethical judgments must be made in the process of risk analysis; rather it is whether ethical issues are involved in even thinking about some possibilities as appropriate subjects of risk analysis" (D. McLean, 1998, 1517).

Scientific policies are mediators between the interests and needs of the world of business and civil society on the one hand and scientific researchers on the other. Not very participative democratic systems tend to leave out the demands of the different social groups. It is important to evaluate the mediating efficiency of policy decision makers in order to know the level of influence that society exercises on the production of science. Science producers should be subjected to a world of rules and values that govern society, just as firms have to increasingly obey certain rules of ethics, scientists will have to better respond to those moral and social criteria.

2. Objectives linked to security

A new concept of 'national security' was created in the USA in 1994. ³ Its definition was based on five concepts: 1) health security, through the search for prevention and treatment of diseases, as well as food security; 2) environmental security, which includes all activities related to the environment; 3) economic security, which aims for industry and the economy to benefit from the positive effects of technological-scientific progress; 4) national security, based on the U.S.'s technological and scientific superiority over other nations, which calls for a high level of basic research; 5) personal security, which is achieved through improving the quality of life and greater democratic participation.

As we shall see later, this way of conceiving security is the result of a situation which was very different from what determines our concept of national security today. In any case, from the present perspective, that concept of security contains large gaps and is in some ways limited to the national reality of the United States. Concerning the first aspect, we must point out that the military component of technologies and diffusion of science and technology in a context of world globalisation have been overlooked.

In this paper, we have seen that the new keys to understanding development of the big lines of research in science and technology can be found in the capacity to face up to the great risks today's civilisation is confronted with. Not only is the participation of different social groups and all types of movements (consumers, users, firms, professionals, religious, ecologists, etc.) necessary but possible to be able to anticipate the great challenges posed by our disorderly development. However, science and technology are not exclusively developed in the civil or economic realm. The military has always had a great influence on its evolution.

Nowadays, technologies are increasingly based on science and the basic research which is mainly done at universities is more international so it is not possible to produce science without growing collaboration between universities. As Eugene B. Skolnikoff (2002) said, "I am concerned about four principal values: commitment to openness, resistance to classified research, maintaining open relationships between universities and industry (including foreign industry) and, of course, relations with foreign students" (Skolnikoff, 2002: 66). This definition of values is the one that may be challenged after the 11 September events as priority is given to a new conception of national security.

For the past decade, the USA's main concept of security has moved increasingly towards the idea of security against the threat of international terrorism. Therefore, the objective of greater security is becoming more closely linked to a military-police objective. The USA's new international doctrine relates military activity to threats to national security. In this area, stakeholders can exercise very little pressure to take part in decisions concerning funds earmarked for the different lines of research, and sometimes it is totally impossible. Those social groups that mobilise to speak out on human rights and/or oppose war could perhaps be an indirect influence that would serve to rethink some of the objectives of scientific-technology policies.

The first objective set down in the USA defence area's programmes on R&D is maintaining its dominant position over other nations. It is strange that, on the other hand, the European Union aims to reach a level comparable to that of the USA in the coming decades. In the USA: "In repeat of past budgets, the Federal Year 2005 proposes record funding for federal R&D due to large increases in defence and homeland security R&D; but with right constraints, would see flat funding or cuts" (AAAS, 2004: 1).

The terrorist attacks of 11 September marked a turning point after which big increases in R&D in the areas mentioned in the previous paragraph would be justifiable. The Department of Defense (DOD) now accounts for approximately 50% of the federal funds devoted to R&D in the USA. If we compare the part of funds directed to R&D for the DOD in comparison to other agencies, the difference is tremendous: "DOD RDT activities show that they are heavily skewed towards development rather than research. This is in contrast to research oriented models like the National Institutes of Health (NIH) or NSF" (A.D. James, 2004:11, Prest). The increase in spending focused on development is mainly evident in the weapons systems. The trials and tests that are run on these weapons in real situations enable us to set up interest relationships between weapons producer-researchers and the military personnel that use them in wars.

Increased spending for allocations in the military field requires justification for its approval. If the main point of the argument for justification is security from possible attacks, this calls for preventive measures including the most recent wars (Afghanistan, Iraq) which have not yet concluded. Is war a morally acceptable answer? Can this military intervention be justified as the best defence from an ethical point of view? The answer to these questions is complex and goes beyond the scope of this paper. In any case, I would like to present some possible replies in a schematic manner:

"Wars are certainly unjustified unless a number of conditions are satisfied. I think that war can be justified only as defense" (Terry Nardin, 1996:33).

However, without a world government it is difficult to judge who has the legitimacy to declare war. In any case, if international procedures have failed, especially the lack of consensus in the UN, we find that we can almost consider the unilateral declaration of war as immoral. Therefore, it should not be possible to justify increased spending on research and development related to the military with these reasons.

The funds allocated to all American agencies not involved in defence have stagnated or clearly dropped in recent years. Although funds for NIH research have risen in the last years, those that are not related to military fields in the agency have dropped. Take, for instance, the following areas: Physical sciences, engineering, mathematics, computer sciences, environmental sciences.

The Department of Homeland Security (DHS) was established in 2003 to prevent terrorist attacks within the United States. While federal investment (USA) remained stagnant, "the Department of Homeland Security (DHS) would continue its dramatic expansion of R&D budget of 1.2 billion, up \$163 million or 15.5% after an even larger increase last year" (AAAS, 2004: 3).

The strategy developed at all government levels in the United States looks to strengthen security against possible terrorist attacks. Energy and communications infrastructures and services supply to large metropolitan areas are considered vulnerable points. The fields of science and technology have been re-situated in this new scenario and certain types of research are priority areas in US government plans. The following section contains examples of some potential threats that are to be fought against and presents research priorities to achieve this objective.

Chart 2- Threats and Demands

Threats and needs	Demands for research on
Location of persons and objects	Sensors (chemistry, physics and engineering)
Nuclear and radiological problems	Nuclear science
Bioterrorism (smallpox, anthrax, plague, tularaemia, botulinum toxin, haemorrhagic fevers)	Biomedical sciences and medical services (public health networks, emergencies, specialists in infectious diseases, rapid diagnosis)
Protection of water, food and agriculture	Biological and chemical sciences and technologies
Cyberattacks	Information technologies
Infrastructure nodes	Systems analysis and engineering
Studies on terrorism	Social sciences

Source: Own study based on Branscomb (2002) and Henderson (2002).

In this far reaching strategy the United States has undertaken, all state agencies and key organisations must contribute to covering these needs and facing up to the challenges posed. US government agencies such as the NIH, NSF, DOE and NASA have big financing capacity for R&D. However, they do not have a specific mission for

the task of fighting against terrorist attacks. The organisations and agencies which would be best prepared to meet these challenges have little experience in R&D. The conceptual problem that arises in view of this challenge is understanding the need to go beyond the operational and subject borders which government agencies influence to face up to a problem which runs through practically every field. In effect, the idea is to change the philosophy of technological scientific strategy so that research resources can be organised according to the existing problems. In other words, an attempt is being made to find effective solutions to existing problems rather than contribute to the progress and development of a specific line of science.

Conclusions

That scientists and technologists have the autonomy to define the paths that certain scientific progress should follow, and that the consequences of this are always beneficial are two modern myths that should be partially abandoned. The development of science and technology is determined by the capacity that different social, economic, political and religious groups to influence it.

In recent years, two types of criteria have been consolidated that can be used to formulate new channels of research, and justify the allotment of financial resources: The "risks" derived from development of our industrialised civilisation, and the "security" of the people in the richest nations. The possibility of influence exercised by "social groups" has been more feasible in the case of risk criteria. The second type of criteria has received a reply with higher military content.

In the two types of justification (risks and national security), decision makers seem to impose a "more pragmatic" or "more realistic" ethical direction which hinders a simplistic answer when making an ethical valuation of the interpretation of this justification. Those two macro objectives—justification may become criteria used to make decisions on how much money is invested in lines of scientific research on the current world scene, with capitalist nations (mainly the USA) imposing the value system.

This empirical observation mainly centres on the USA because that is where the central tendencies of scientific progress are designed and also where the world's biggest critical mass of researchers is found. However, the result may be slanted towards the security logic criteria for obvious reasons stemming from the 11 September terrorist attacks and also the current military dominance the USA is exercising alone.

I think that the current position of the U.S. administration to justify military intervention is based on a “realistic” current (Jeff McMahan, 1996) when understanding the morality of international relations that conform to the following logical chain: war is only justifiable for reasons of self defence and this concept is closely linked to “national security”, which is understood as a more global strategy which goes beyond mere defence strategy. For instance, other fields ranging from diplomacy to the media would also be included (J. D. Becker, 1998). We could also include the “justification” of spending on research and development in the field of applied sciences in this strategy.

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Chart 1- Main areas of research in applied sciences

	Answering to	Contents and Sciences	Social pressure and participation	Secondary functions	To which areas of the economy is applied	Exploitation downstream (industry-market)
Global change climate research	Natural phenomenon and catastrophes	Interdisciplinary	Indirect	Coordination between agencies	Own area	Yes
Information technology	Development of technological paradigms	Interdisciplinary	Yes	Coordination between agencies	All the cross areas military included	Yes
Generation internet	Development of technological paradigms	Interdisciplinary	Direct	Development of education system	All the cross areas	Yes
Nanoscale science	Development of technological paradigms	Interdisciplinary	Indirect	Coordination between agencies	Cross areas (partial) military included	Yes
Ecological systems	Natural phenomenon and catastrophes	Interdisciplinary	Indirect	Coordination between agencies	Own area and applications	Yes
Toxic's and risk	Natural phenomenon and catastrophes	Interdisciplinary	Yes	Coordination between agencies	Some areas of Health and Food	Yes
Air quality research	Natural phenomenon and catastrophes	Interdisciplinary	Indirect	Coordination between agencies	Some areas of Health and Food	Yes
Natural disaster reduction	Natural phenomenon and catastrophes	Interdisciplinary	Indirect	Coordination between agencies	Own area	Yes
Biotechnology	Diseases and improving the food production	Interdisciplinary	Yes (indirect groups of ethics)	Coordination between agencies and property rights	Own area and Health Agricultural branches	Direct
International Science, Engineering and technology	Development of technological paradigms	Interdisciplinary	Indirect	Coordination of international organizations	All the cross areas	Yes
Intellectual Property Rights	Use of science	Interdisciplinary	Indirect	Coordination between agencies	All the cross areas	Direct
Emerging infectious diseases	Diseases	Interdisciplinary	Direct	General coordination	Health military included	Yes (partial)

International water	Diseases	Interdisciplinary	Direct	General coordination	Health	Yes (partial)
Agricultural Biotechnology and Capacity in developed countries	Diseases	Interdisciplinary	Direct	Coordination of international organizations	Food	Yes
Comittee on National Security	National Security	Interdisciplinary	No	Militar (holding)	Militar indutry	Yes
Reviewing the Government/Universit y partnership	Evolution	-	Direct	Coordination	Cross areas	Yes
Plant Genomes	Like biotechnology	Like biotechnology	Like biotechnology	Like biotechnology	Like biotechnology	Like biotechnology
Research Misconduct	Ethical problems	-	Professional codes of conduct	Coordination	All the research areas	-

Source: Myself and National Science Foundation (2003)