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International Scientific Cooperation: Considerations from Previous Efforts

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INTERNATIONAL SCIENTIFIC COOPERATION

CONSIDERATIONS FROM PREVIOUS EFFORTS

The Commission on Macroeconomics and Health (CMH) is almost certain to call for a new institution to create the international public goods of improved medical technologies and products for the developing world.[1] In order to help in detailing that recommendation and developing useful and effective methods for actually carrying out the necessary research, it is desirable to review previous efforts at international cooperation. This essay attempts such a review, looking at a number of previous cases of international scientific and technological cooperation in order to identify the factors most likely to lead to success, as well as the special difficulties that most need to be taken into account in designing such cooperation. It begins with a short background section that discusses the economics of cooperation and briefly describes the various cases that will be most taken into account. It then turns successively to four issue areas: maintaining political support for the necessary public expenditures, making decisions that are both scientifically and politically sound, finding effective international organizational arrangements, and allocating the benefits of the cooperation among the different nations involved. The final section summarizes and integrates the lessons of the examples.

1. BACKGROUND FOR AND EXAMPLES OF INTERNATIONAL SCIENTIFIC COOPERATION

[1] See I. Kaul et al, Global Public Goods; International Cooperation in the 21st Century, (New York: Oxford University Press for the United Nations Development Program, 1999).

It is now generally accepted that some forms of science and technology deserve governmental support. Many nations support basic science or precompetitive technology, on the grounds that such knowledge benefits society and is unlikely to be conducted by the private sector, even with the stimulus of intellectual property systems. This has been a major pattern in most developed nations since World War II. Moreover, nearly all nations support research in areas in which they are primary consumers or in which they believe that there is a broad social need deserving government intervention. The obvious examples are defense, medicine, and agriculture. Finally -- and this is a point where there is substantial controversy -- many nations believe that they should support research designed to make their national industries more competitive internationally. Examples include the European Airbus program and the efforts by many nations to support domestic industry in the computer and semiconductor areas.

1. Logic for and economics of support for international scientific cooperation.

Legislatures are highly likely to prefer support for domestic research, in order to ensure that benefits accrue to their own society.[2] They may even be fearful that support for foreign or international research will contribute to the competitiveness of foreign firms. As one RAND study concludes:

> . . . we found little to support the idea that ICRD [International Cooperation in Research and Development] is primarily another form of "foreign aid." Quite the contrary, we learned that ICRD is primarily aimed at fulfilling the mission of the sponsoring agency, not to fulfill an international agreement. U.S. government agencies tend to guard their R&D funds jealously:

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[2] Thus, the U.S. Bayh-Dole Act includes a provision requiring that, in the absence of a waiver, products developed under an exclusive license of technology funded by the United States shall "be manufactured substantially in the United States," 35 U.S.C. § 204.

Program managers do not spend dollars for the sake of political expediency.[3]

Moreover, there is good reason to be fearful that internationalizing a program will complicate and increase expenses of the project. There will be more decision-makers and therefore more obstacles.[4] And, perhaps because of the difficulties of coordination, experience with cooperative weapons programs has been "at best, rather mixed," with cooperative programs costing as much as three times as much as comparable national programs.[5]

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3 Id. At Conclusion, p. 1.

4 F. Jacq, Megascience and National Decision-Making Processes, Megascience: The OECD Forum; Megascience Policy Issues (OECD 1995), p. 49, 87.

5 J. Birkler, M. Lorell, M. Rich, Formulating Strategies for International Collaboration in Developing and Producing Defense Systems, RAND National Defense Research Institute Issue Paper (1997), available at http://www.rand.org/publications/IP/IP161/.

Yet, two kinds of factors may override this national preference and lead to support for programs that involve international cooperation. One is that the activities in different nations may benefit one another in the sense that the whole becomes greater than the sum of the parts. This is often, if not always, true of science itself; it is likely to be an especially strong effect if the different technological actors are complementary. Thus, Airbus builds on the different complementary capabilities of research and manufacturing capabilities in different nations each specializing in particular aspects of the aircraft. And international geological cooperation builds on the fact that the information collected in one geographic region may be useful in understanding that collected in another region. Such international cooperation in science is almost certainly growing in proportion to national science, reflecting a fundamental change in the way science proceeds.[6]

The other factor support cooperation is that of economy of scale. There need to be only a few large particle accelerators; increased energy is important and expensive. By pooling their resources, nations can build a more powerful accelerator than they could using their own resources.

2. The examples

Although there will be consideration of other examples, the following five examples will be

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[6] See the very impressive international coauthorship statistics presented by Y. Okubo, L'internationalisation de la science; Une analyse bibliométrique, Futuribles, Num. 210, p. 43 (June 1996). The conclusion is supported by the changes identified by the RAND corporation in its 1998 report, supra, and its 2000 update to that report, C. Wagner, A. Yezril, & S. Hassell, International Cooperation in Research and Development: An Update to an Inventory of U.S. Government Spending, (RAND Report MR-1248-OSTP), (2000), hereinafter cited as RAND 2000.

dominant in the analysis of this essay. Brief background is presented here on each for the sake of easier understanding later in the analysis.

1. Airbus

Airbus[7] is a European collaboration to produce aircraft competitive with those produced by the U.S.-based Boeing. It was originally created in the 1960s, based on a Memorandum of Understanding between the British, French, and German governments, revised in 1969 to one between the French and German governments. Paralleling this intergovernmental arrangement was a consortium of the participating firms, created in 1970 as a *Groupement d'Intérêt Économique* under French law. This is a structure similar to a partnership, and the key initial partners were Aerospatiale, a firm heavily owned by the French government, and Deutsche Airbus, a private German firm. Since then, a number of partners from other nations have been added, and in 2000 the French, German, and Spanish partners have integrated their operations into EADS (the European Aeronautic Defense and Space company), created under Dutch law.[8] The Airbus operations of EADS and of BAE Systems (the UK partner) were also centralized in 200 into one firm, under one management, owned 80 % by EADS and 20 % by BAE.[9]

At the time of its creation, Airbus was expected to, and it did obtain subsidies from the French and the German government, in the form of over $ 7 billion of loan advances, presumably repayable from profits. It has produced a series of aircraft such as the A300, A310, and A320. It is now organizing production of a new aircraft, initially identified as the A3XX, and now called the A380. It is to be competitive with the B-747. Commitments for repayable funding of research for development of this aircraft were obtained from France, Germany, and Great Britain during the year 2000. As a commercial effort, Airbus has been very successful, and now holds roughly half of the global airliner market.

2. CERN

CERN[10] is the European Organization for Nuclear Research, an international organization

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[7] See D. W. Thornton, Airbus Industrie — The Politics of an International Industrial Collaboration (1995); K. Hayward, International Collaboration in Civil Aerospace, (London: Frances Pinter, 1986).

[8] EADS - A Company Profile, at http://www.finance.eads.net/ctefaq.html.

[9] See http://www.airbus.com/about/.

[10] Originally Conseil Européen pour la Recherche Nucléaire, now the European

created by a treaty among 12 European governments in 1953.[11] It has been constructing and operating particle accelerators since 1954, including the Large Electron Positron collider. It is now building a Large Hadron Collider (LHC), near Geneva, Switzerland to go on line in 2005. The organization was founded with 12 members, and now includes 20, most from the European Union. Israel, Japan, the Russian Federation, Turkey, and the United States hold observer status. In a 1997 agreement between CERN on the one hand and the Department of Energy and the National Science Foundation on the other, the United States agreed to cooperate in the LHC after giving up on its own Superconducting

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Laboratory for Particle Physics. See http://press.web.cern.ch. For background, also see U.S. Department of Energy, Office of Energy Research, Division of High Energy Physics, Drell Report, HEPAP's Subpanel on Vision for the Future of High-Energy Physics, May 1994, [hereinafter Drell Report], available at http://www.hep.nt/documents/drell/summary.html.

[11] F. Schmid and J.-M. Dufour, Le C.E.R.N., exemple de coopération scientifique européene, 103 Jour. de Droit Internationale 46 (1976).

Super Collider in Texas.[12]

3. CGIAR

[12] "U.S. to contribute $531 million to CERN's Large Hadron Collider Project, CERN Press Release PR07.97 - 08.12.97, available at http://press.web.cern.ch/Press/Releases97/PR07.97ELHC-US.html.

The Consultative Group on International Agricultural Research (CGIAR),[13] is a loose consortium of national donors, private foundations such as the Rockefeller Foundation, and international organizations such as the Food and Agricultural Organization and the World Bank, to support agricultural research for the benefit of developing nations. The "consortium" is not a legal entity but a combination of regular meetings and a small secretariat to coordinate grants to a network of 16 research centers around the world. These centers have independent boards of directors and legal personalities. Among them are the International Corn and Wheat Research Center in Mexico, created initially by the Rockefeller Foundation, and the International Rice Research Institute in the Philippines, created initially by the Ford and Rockefeller Foundations; it is these research centers that are most responsible for the Green Revolution. These institutions and others were included in the CGIAR consortium, founded in 1971.[14] The CGIAR has total funding on the order of $ 350 million per year.

4. GEF

The Global Environment Facility (GEF)[15] is a collaborative project of the World Bank, the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP). It was created in pilot form in 1991 and deeply reorganized in 1994. It administers a fund designed to assist developing nations in complying with international environmental agreements. The fund is replenished every several years in increments; on the order of $250 million is spent per year. Use of the funds is restricted to a group of situations in which environmental expenditures by the developing nation would not be cost-effective for the nation itself, but would benefit the world or the global commons. Arguably, this is not a research collaboration, but it is so similar to some possible visions of a CMH recommendation that its inclusion in the analysis is appropriate. Moreover, some of its grants involve research, and essentially all involve scientific judgment.

5. International Space Station

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[13] See www.cgiar.org.

[14] W. Baum, CGIAR – How it all began; A 1985 Annual Report Reprint (1988), available at http://www.worldbank.org/html/cgiar/publications/cgbaum.pdf.

[15] http://www.gefweb.org/.

The International Space Station is the largest peacetime scientific program in human history, building and operating an orbital research facility some two hundred miles above earth.[16] Sixteen countries are participating though their space agencies. It began as Space Station Freedom of the U.S. National Aeronautics and Space Administration (NASA) in 1984. In the face of U.S. budget limitations, NASA reorganized and redesigned it a number of times, internationalizing it to broaden financial support. Japan, Canada, and the EC were incorporated in 1988; Russia in 1994. The arrangements were further revised and formalized with an intergovernmental International Space Station Partners Agreement, and a series of bilateral Memoranda of Understanding in January 1998.[17] At the time Russia joined, NASA expected the total cost to be about $ 17 billion; this amount has been escalating. The U.S. contribution to this project is the largest such contribution to any international scientific collaboration in which the United States participates.[18]

2. BUILDING POLITICAL SUPPORT

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[16] General Accounting Office, Space Station, Update on the Impact of the Expanded Russian Role (July 29, 1994), http://www.fas.org/spp/civil/gao/nsi94248.htm.

[17] See International Space Station Partners Agreement, Remarks made at signing session, January 29, 1998, available at http://www.state.gov/global/oes/space/980129_space_agreement.html. Although I've not found this agreement on the web, I have found the parallel memoranda of understanding. For the Russian one, see ftp://ftp.hq.nasa.gov/pub/pao/reports/1998/nasa_russian.html.

[18] Numbers for collaborations of different agencies with different nations are presented in RAND 1998 and RAND 2000.

This brief review of the various cooperative programs itself suggest some of the motivations that governments bring to international scientific cooperation -- and confirms the difficulty of building political support for such cooperation. The process is necessarily an iterative and complex one in which the various scientific constituencies must interact repetitively with the various political groups that may support the collaboration.[19] The motivations will be analyzed here in three categories: commercial, broader national, and global.

1. Commercial objectives

[19] Jacq, supra at 84-96.

Commercial objectives are likely to be the most effective in encouraging cooperation. Airbus, in which the (reimbursable) public commitments are at least $ 7 billion is a clear example. The development team negotiated simultaneously with potential airline customers and with the governments who would be providing the reimbursable commitments to fund the development. And in the process, they made heavy use of the media. Presumably, the governments believe that the expenditures will be cost-effective in producing a substantial total employment and trade benefit. In light of the special economics of the Airbus-Boeing duopoly, this may be accurate.[20] By creating a competitor to Boeing, Europe may have lowered the price it (and all) must pay for aircraft, and at the same left its European firm able to obtain a substantial oligopoly rent.

In its move to initiate the A380, Airbus certainly reflected a careful commercial approach. Thus, it set a requirement of a minimum number of aircraft orders, as a milestone that would have to be achieved before incurring the costs of full development. The particular case, however, is mixed with factors beyond the commercial one. Certainly, Europe took into account the link between the commercial aircraft sector and the defense sectors in which it may well have desired to maintain an independence from the United States. Moreover, the merchantilist goal of maintaining a national high-technology industry is also touched with a twinge of national pride:

> For the Europeans, who have breached the domain of the Americans with the development of the Ariane rocket and Airbus aircraft, the planned super Airbus is probably financially and technically the greatest challenge. . . . The reputation of European industry will grow. Such technological projects are well suited for distinguishing oneself in international competition and offering oneself as a first-rank partner on a global scale. This time, Europe is not presenting itself as a dissonant chorus, but as a resolute competitor on the markets of the future.[21]

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[20] See P. Krugman, Import protection as export promotion: international competition in the presence of oligopoly and economies of scale, in P. Krugman (ed.), Rethinking International Trade (Cambridge, MA: MIT Press, 1990). CHECK

[21] Neue Rhein/Neue Ruhr Zeitung of Essen, Europe's Airbus: A Resolute Competitor (June 23, 2000), available at http://www.nrz.de/free/nrz.archiv.set-000.html: translation available at http://usinfo.state.gov/admin/005/wwwh0j20.html.

2. Broader national objectives

Two of the cases show national scientific support agencies turning to international cooperation as a way to reduce the costs of megaprojects. (And, again, national pride is involved.) CERN and the ISS are both clear examples.

For the European partners, CERN was certainly a way to achieve high-energy physics on a scale that no one partner could have achieved financially. It is interesting that the issue of scale also became one for the United States, which had ended up "going it alone" in building its new SSC in Texas. Apparently the United States had hoped to obtain foreign partners, but had not worked hard enough to obtain them before making all the key decisions – by that time, in the words of an insider, "the perception of foreign nations was that we only wanted their money, not their scientific involvement!"[22] This program, like NASA's space station program, further suffered from severe cost overruns, and, because of its very magnitude, drew opposition from some in the scientific community who felt that it diverted funds from other scientific projects that might be more valuable. It was, surprisingly, eliminated in 1993 by a vote in the House of Representatives after over $ 2 billion had been spent, partly because there was no international support for it. House Science Committee Chairman Sensenbrenner reflected five years later:

> The United States . . . failed to secure international partners before beginning construction of the SuperConducting Super-Collider (SSC). With initial cost estimates of 4 billion dollars, the US decided to fund the project on its own. As the costs of the SSC escalated past 18 billion dollars, the US was forced to solicit international partners to finance completion of the project. . . . [A]cceptable funding agreements could not be secured with enough international partners to keep the project from being canceled. Had international partnerships been properly arranged at the beginning of the project, we would be completing work on the SSC rather than just beginning construction of the LHC.[23]

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22 J. Watkins, Science and Technology in Foreign Affairs, Science, Vol 277, p. 650 (Aug 1, 1997).

23 In R. M. Jones, House Science Committee Chairman Sensenbrenner on the SSC, LHC, and ITER, The American Institute of Physics Bulletin of Science Policy News, Vol. 4 (Jan 14, 1998), available at http://www.aip.org/enews/fyi/1998/fyi98.004.htm. The same point was made by then Secretary of Energy Hazel O'Leary and Representative George E. Brown, The Future of the Superconducting Super Collider, Dec. 10, 1993, available at http://www.lbl.gov/Science-Articles/Archive/ssc-and-future.html.

The United States decided instead to become a partner in the new CERN LHC, and made an initial contribution of $ 531 million toward the European facility.[24]

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[24] CERN, PR07.97 - 08.12.97, US to contribute $ 531 million to CERN's Large Hadron Collider Project (December 12, 1997), at http://press.web.cern.ch/Press/Releases97/PR07.97ELHC-US.html.

The story of the ISS is quite similar (except that the US program was folded into the international program rather than being abolished). But the special feature here is that Russia was welcomed into the program as a participant (almost certainly on terms that overvalued Russia's real contribution).[25] Foreign policy motivations vis-a-vis Russia certainly contributed to the U.S. willingness to continue the program with Russia as a partner. It is also clear that the program was not intended to provide deep cooperation –"each participating agency is incentivized to spend its tax dollars at home. The ideal outcome is to have no transfer of funds among the nations. With the international partnership, every country is responsible for a *pro rata* share of the operations cost necessary to sustain the basic infrastructure and capabilities."[26]

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[25] At the end of 1993, NASA estimated a $ 2 billion saving through Russian participation. SOURCE??? But the General Accounting Office estimated a negative saving, i.e. cost, of $ 0.4 billion. General Accounting Office, Space Station: Update on the Impact of the Expanded Russian Role (July 29, 1994), available at http://www.fas.org/spp/civil/gao/nsi94248.htm. Marcia Smith, CRS Issue in Brief, 93017: Space Stations, at http://www.fas.org/spp/civil/crs/93-017.htm.

[26] Report of the Cost Assessment and Validation Task Force on the International Space Station , NASA Advisory Council, April 21, 1998, ¶ 2.4, available at http://www.reston.com/nasa/cavtf/cavtf.html.

3. Global objectives

The CGIAR demonstrates a pure global objective. There have been benefits to developed-world plant breeders and farmers as a result of CGIAR activity,[27] but these have certainly been at most minor factors in motivating the donor nations to contribute to the program, and it is, in general, development ministries (and foundations) that channel funds to the CGIAR institutions. What is extremely significant here is the political weakness of such a pure development objective. There is broad economic consensus that agricultural research is a highly cost-effective components of foreign assistance,[28] yet this is the smallest of the collaborations examined here. Moreover, in real terms, funding has been somewhat declining for over a decade and has faced sharp cuts at times, e.g. from early Clinton administration decisions to deemphasize agriculture in favor of environmental and democracy-building funding. It is only the fact that the World Bank has undertaken a role as funder of last resort that has enabled the system to maintain a reasonable year-to-year funding pattern.[29]

The GEF is somewhat a hybrid. Arguably, it is a development institution like the CGIAR. Yet, it also oriented to environmental goals that appeal directly to very powerful constituencies in developed nations. Moreover, it arguably would not exist unless a number of developing nations had refused to commit themselves to international environment agreements without such funding. A parallel fund was created in 1990 in the context of the regular meeting of the parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. The GEF was established the same year as a pilot program by the World Bank, in collaboration with the United Nations Development Program (UNDP) and United Nations Environment Program (UNEP). A bargain was then made in connection with the 1992 UN Conference on Environment and Development (the Rio conference) in which the GEF would become the "interim financial mechanism" for the funding components of the Climate Change and Biodiversity conventions achieved at the Rio meeting, provided it was made more "democratic" and "transparent."[30] As will be seen below, the negotiations to achieve this democracy and transparency

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[27] P. Pardey et al., Hidden Harvest, U.S. Benefits from International Research Aid, International Food Policy Research Institute, Food Policy Statement Number 23 (September 1996), available at http://www.cgiar.org/ifpri/pubs/fps23.htm.

[28] A Meta-Analysis of Rates of Return to Agricultural R&D: Ex Pede Herculem?, Julian M. Alston, Connie Chan-Kang, Michele C. Marra, Philip G. Pardey, and TJ Wyatt, IFPRI Research Report 113 (September 2000), available at htttp://www.ifpri.org.

[29] See the tables of contributions in the annual CGIAR, Financial Report, available at http://www.cgiar.org/finlist.htm.

[30] See D. Fairman, The Global Environment Facility: Haunted by the Shadow of the

were quite difficult. And many in the environmental community, doubting the environmental credentials of the World Bank, regarded the creation of the GEF in 1990 as a kind of preemptive strike designed to protect the developed nations from a larger financial commitment under greater developing nation control, such as was discussed under the title "Agenda 21" at Rio.[31] This is thus a quite uneasy compromise that has left many environmentalists quite dubious.

4. Implications

Future," in R. Keohane & M. Levy (eds), Institutions for Environmental Aid: Pitfalls and Promise (Cambridge, MA: The MIT Press, 1996), p. 55.

[31] See, e.g. K. Horta (Environmental Defense Fund), Global Environment Facility, Foreign Policy in Focus, vol. 3:1-4 no 39 D (1998).

In today's international politics, altruism is a weak motivation for international cooperation.[32] The largest and most financially successful collaborations have built on much more. This includes the existence of strong domestic constituencies, as in the case of Airbus, and the national scientific and environmental constituencies supporting CERN and the ISS. It further includes foreign policy goals, as in the cases of Airbus, ISS and the GEF. It almost certainly includes high-level visibility -- only the smallest of cooperative research programs can long survive within the confines of development ministries. And the successful projects have clearly taken their public and media relations quite strongly into account. Although the choice of allies and political motivations is, in the present exercise, fundamentally an issue for the Commission itself, it is clear that they should consider ways in which developing world health care contributes to developed world foreign policy goals, and explore what forms of alliance may be appropriate with donor nation constituencies such as the developed world's public health care sectors and pharmaceutical industries — taking into account at the same time the broader risks of such alliances.

3. MAKING GOOD DECISIONS

In any international scientific collaboration, there is strong risk that decision-making will, intentionally or unintentionally, favor national interests over the common interest. A decision-maker or committee may give a particular national scientist extra time on a machine, or grant a supply contract to a national colleague. And there are much deeper, and more difficult, problems in achieving a realistic long-term vision that provides as much benefit as possible.

1. Scientific/technical decisions

The more clearly scientific or technical decisions, especially those in which there is a market test, are generally the easiest to organize and to manage. Airbus provides a good example of sound technological decisions; otherwise its aircraft would not have turned in the safety and performance records that they have, nor could they have been as innovative in such features as the "fly-by-wire" system in which the computer plays a much greater role in the control of the aircraft's flight. Almost certainly, this was the result of engineering traditions and of commercial demands; there were clearly efforts to organize the collaboration in a way that would avoid the problems faced by the earlier Anglo-French collaboration to produce Concorde. In Airbus, there were several levels of government and corporate boards, but there was an expectation of significant French leadership in the design process,

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[32] Remember that even the Marshall Plan was a relatively short program in political terms – the idea was proposed in 1947, it was funded in 1948, and the last payments were made in 1951.

and there was a single executive appointed to supervise each model.[33] Presumably, the engineering collaborators among the various partners must have worked with minimum interference from the more political levels that shaped the national subsidies for the enterprise, at least once a specific project was approved. Even so, there were risks that cost control may have been difficult with a development and production system that was still quite decentralized. This may have been one of the reasons for the recent integration into EADS, in which there really is a single management.

The CGIAR also faces issues of scientific quality control, a task that, in at least some cases, some of its donors might find difficult on their own. It has responded through a combination of rather independent Director Generals (DGs) and a Technical Advisory Committee (TAC). Part of the basic CGIAR approach is that the Director Generals (DGs) of specific research centers are generally appointed for a fixed term, typically on the order of 5 years. And the performance of the institutions is reviewed by a committee organized by TAC, again typically every 5 years. The reviews are significant, and can lead to decisions not to renew a DG's contract. The approach is intended to give the DG the a significant period of freedom to develop and implement a creative program, and, at the same time, to provide a mechanism for replacing the DG who is not developing such a program. Moreover, although each of the institutions has its own Board of Directors, TAC serves to reassure donors that the monies being provided to the specific institution are being used well.

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[33] Hayward, supra.

Although it is rare that TAC makes specific scientific judgments regarding the feasibility of a project, it does make judgments regarding the overall direction of the research program; here the key question is whether the donors, who remain independent, will be willing to follow its judgment in allocating their contributions to different programs at different research centers. TAC has played a role beyond formally scientific judgment in integrating environmental and gender-equity concerns into agricultural research. These are particularly important issues for agriculture. Agriculture is one of the most important modifiers of the global environment, and in many societies agricultural technologies interact very closely with family structures and therefore with sexual roles. What is not clear, at least to a casual observer somewhat familiar with the system, is whether there have followed actual relevant changes in the research programs at the working level. And it is certainly significant that recent proposals for CGIAR reform emphasize converting TAC into a more purely scientific body (a Science Council), and creating an Executive Council to provide stronger coordination than is feasible with a group as large as the assembled donors. [34]

2. More political decisions

The broader, more political decisions are harder. Consider, for example, the Airbus decision whether or not to proceed with the new A380. Undoubtedly, the judgment here must include not only technical feasibility and commercial feasibility, but estimates of the market risks, as well as a political analysis of the kinds of support likely to be available from national governments. One's assumption is that there was a champion largely responsible for this new project; this would presumably be within the corporate/engineering group which would, in essence, be interested in developing a proposal for a new aircraft. Once the corporate concept was developed and its economics analyzed, it must have been put forward as a proposal to the national governments, in essence, as a request for an

[34] Charting the CGIAR's Future – Change Design and Management, MTM/01/05: Designing and Managing Change in the CGIAR. Report to the Mid-Term Meeting 2001, May 21-25, Durban, South Africa, available at http://www.worldbank.org/html/cgiar/publications/mtm01/mtm01.html.

investment/subsidy.

CERN recently faced a similar kind of decision. In order to build the LHC, it is necessary to shut down the LEP — and during the year 2000 it looked as if it might be possible to operate the LEP at high power for a continued period with a possibility of very significant discoveries with respect to the Higgs Boson, a current research target in high energy physics. The question then was whether to extend the lifetime of the old machine at the expense of delaying the more powerful new machine. CERN's decision-making procedure attempts to balance political and scientific concerns. CERN is supervised by a Council representing the member states. This council is supported by a Financial Committee and by a Scientific Policy Committee, staffed by experts independent of their national governments.[35] In turn, these are supported by lower level committees. Apparently LEP's Experiments Committee and the CERN Research Board both recommended some delay in the shutdown, which was granted by CERN's Director General Professor Luciano Maiani in the fall of 2000, extending the planned shutdown time from the end of September until November 2.[36] The LEP's science committee sought a longer extension, but CERN's management team opposed such an extension. In this situation, the DG contacted representatives of member states who sit on CERN's council and have ultimate authority over CERN's programs, and decided not to grant a longer extension.[37]

[35] See http://public.web.cern.ch/Public/CERNOP/council.html.

[36] CERN, LEP shutdown postponed by one month (September 14,2000) at http://press.web.cern.ch/Press/Releases00/PR08.00ELEPRundelay.html.

[37] Oliver Morton, No Stay of Execution for LEP, Science Now (Nov. 8, 2000) at http://www.bric.postech.ac.kr/science/97now/00_11/001108b.html.

The GEF has faced real problems. One group comes from its initial phase, when it was operating as a pilot program and apparently sought to fund a substantial number of projects on a consensus basis. With the Rio meeting in sight, it apparently even made a substantial number of commitments before ever convening its scientific and technical advisory panel. Then, after Rio, it turned to the restructuring implied by the Rio compromise. There was of course the necessity for a balance between the donor interests, reflected in large part by the World Bank, and the developing-nation interests reflected in large part by the UNEP and UNDP. The ultimate compromise, achieved in 1994, established a council with 16 developing nation members, 14 developed members, and 2 members from the former socialist bloc. Each of these groups was to choose its own members. Where there was no consensus, decisions were to be based on a double-majority of 60 % of countries represented and of donation-weighted votes. Equally difficult was the effective coordination of the three participating agencies, which, in the political context, led to disputes about project criteria and priorities, as well as about the role of NGOs.[38] And the program has had a number of major reviews, including one now in progress.[39]

3. Implications

The more complex the task, the more essential it is to have management by an individual, or at least by a small committee – large groups are unable to manage complex programs. It is, of course, also essential to keep the scientific input strong and to ensure that scientifically irrational decisions are not made for the sake of political convenience. This certainly requires some form of scientific panel to collaborate with the international program's executives. Yet it is also clear that any international scientific cooperation will bring issues which demand far more than a scientific judgment. And it is essential that all involved participants have some role in the process. Thus, there are important roles for broader councils and consultation procedures, and, as suggested by the difficulties of the GEF, it is important that the precise role and goal of these balances be well understood and agreed as the organization is created. An example of such an important problem for the CMH is the choice between using funds for supply of medicines for immediate global needs and using them for research for longer-term benefit – decision-making on such issues will be extremely difficult.[40] It may be essential to make

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[38] Fairman, supra.

[39] G. Porter et all, Study of GEF's Overall Performance (1998???).

[40] The variety of interests that must be taken into account in defining a management structure is well spelled out in the recent UK Cabinet Office Proposal, Performance and Innovation Unit, Cabinet Office, London, Tackling the Diseases of Poverty: Meeting the Okinawa/Millennium Targets for HIV/AIDS, Tuberculosis, and Malaria, 8 May 2001, available at http://www.cabinet-office.gov.uk/innovation/.

the balance between these two goals quite explicit in the basic agreements, and it may be wise to set up separate decision-making processes for achieving each of the two goals.

4. INTEGRATING THE STAFF AND MANAGEMENT

An international research consortium can range from, at one extreme, a fully integrated operation to, at the other extreme, a very loose coordination of essentially independent entities. Both the overall integration of management and integration in the recruitment and management of the staff — do the members of the staff view themselves more as employees of the consortium or as employees of the individual participants in the consortium. The examples explored range from the fully integrated to the loosely integrated.

1. Full integration with international civil service

Until the recent changes in the organization of Airbus, the most integrated of the collaborations considered was CERN. CERN, befitting the fact that it is managing specific, internationally-owned facilities, has its own international staff, comparable to the international civil service staffing the United Nations and a number of its affiliated organizations.[41] In the case of CERN, integration reaches the level of a uniform pay scale, although employees are subject to national tax legislation based on their own nationality.[42]

The CGIAR uses what is effectively a similar system. Formally, the various research centers are independent institutions run by their own boards of directors, organized under national or international law. They typically enter into a host-nation agreement with the nation in which they are headquartered; this agreement provides many of the types of immunities and privileges associated with international organization immunity. Moreover, many of the staff are recruited locally and paid local pay scales. However, the management and scientific staff is recruited internationally and paid at developed-world salary levels. The internationally recruited employees of each center are frequently considered in searches to fill a new position at another center, and many of the employees have careers that include service at each of a number of centers. This exchange of people contributes to a substantial integration of the entire group of research institutions.

2. Long-term cooperation with national employees

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[41] See http://www.un.org/depts/icsc/index.html.

[42] CERN, Staff Rules and Regulations, at http://weboffice.web.cern.ch/WebOffice/Doc/OtherTools/MakingPdf/dumped.pdf..

A next lower level of integration is long-term collaboration among genuinely independent entities. The obvious example is the ISS. NASA and its Russian and other foreign collaborators have not created an integrated organization. Rather they have created a structure to coordinate essentially independent national programs, for example, allocating responsibilities for specific modules to specific national programs. There is a consultation process organized through a Multilateral Coordination Board, but the leadership is in individual nations (or European regional operations) for the decisions involving the modules or experiments each contributes. And there are clearly no international employees; rather each of the employees is an employee of the specific national government.

Airbus attempted such an approach, but has recently shifted to a much more integrated approach. As noted above, it was initially created as a *Groupement d"Intérêt Économique* , but the components were integrated into a single corporation in July, 2000. There may well remain difference in detailed personnel policies in the different operational centers, but the entire program is now clearly under one management control. Probably, the leaders of the less-integrated operation decided that they needed more than contractual incentives and management integration. Presumably, the greater depth of integration also facilitates cost control.

3. Network/research grant approach

The still weaker level of integration is that in which the international entity consists only of a secretariat to coordinate a variety of genuinely independent national or local operations. The GEF is the obvious example. To the extent that science is advanced (or other environmental activity encouraged), it is by local entities; the central entity is only a facilitator.

The central question here is whether the overall research program can be given coherence in such circumstances -- will the whole be more than the sum of the parts or will the funds just be used in an effectively uncoordinated way for activities of interest to the local entities (which they might well be doing anyway)? This is an issue in a variety of contexts such as NIH funding of university research or the various existing medical research initiatives such as the International Aids Vaccine Initiative (IAVI). There are benefits in the decentralization, at least with respect to highly scientific work, for it encourages the evolution of independent and novel ideas from a variety of sources. At the same time, the benefits of integration are essential; they are most likely to be achieved through very wise management by the grantors and through substantial efforts to maintain scientific communication among the different participants.

4. Implications

The most important criterion for choosing a depth of integration is the character of the task to be done. The closer the task is to engineering and production, the deeper the integration that is needed; the closer it is to scientific research in poorly understood areas, the better it is to have decentralization. For international medical research, this suggests (currently) emphasizing decentralization. But there are important balancing factors that must be considered. An effective decentralized operation requires strong central management; this may be difficult to achieve. And, the more there is are significant national constituencies, the more there will be political support for the operation. CGIAR, with its employment creation focused in the developing world, is in a politically weak position in its donor nations.

5. ALLOCATING THE BENEFITS

An international scientific collaboration will normally have no difficulty allocating the designed benefits. Airbus will divide any profits as planned. The GEF will provide the global or transnational environmental benefits it can. And the space station agreements spell out precisely what laboratory accommodations each party will have on the station.[43] However, the allocation of less central benefits may be much more important politically and much more difficult. The two classic areas of conflict are employment and intellectual property rights.

1. Employment and *juste retour*

As a working political principle, every international collaboration must provide each donor nation with a share (a *juste retour*) of employment comparable to the nation's share of the financial cost. Obviously, the principle has its limits. Yet it was clearly essential to the negotiation of the Airbus subsidies — why would France or Germany contribute unless they expected to obtain a proportionate share of employment? And comparable issues are present in CERN, where there is a need to allocate both employment and research time on the machine itself. Indeed, in a situation such as CERN, the employment created by the facility is part of the *juste retour*. And CERN is required to take *juste retour* into account in awarding contracts to suppliers.[44]

2. Intellectual property

[43] See Memorandum of Understanding Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency Concerning Cooperation on the Civil International Space Station, supra, at ¶ 8.3.

[44] J. Rembser, Intergovernmental and International Consultations/Agreements and Legal Cooperation Mechanisms in Megascience; Experiences, Aspects and Ideas, in Megascience Policy Issues, supra.

Intellectual property poses harder issues, in part because it is a less intuitively understood benefit than is employment. International scientific collaborations have taken two strategies: placing results in the public domain (and thus avoiding the issue) or negotiating a well-defined allocation of rights.

1. Placing data in the public domain

Placing data in the public domains avoids many of the problems of negotiating rights to data. But it reflects much more – a sense that certain kinds of scientific information[45] should not be subject to patent protection, because it is better for the progress of science to keep them in the public domain. The most clear example of this strategy is the Bermuda principles adopted by the international human genome program.[46] This was a program designed to coordinate various national efforts by public sector entities to sequence the human genome. Many of the scientists involved strongly opposed the patenting of genomic information. They therefore agreed at one of their regular meetings that all sequencing data would be made public at a rate and in a way that would seriously complicate patenting efforts.[47] CERN defined a similar policy in 1956.

2. Allocation approaches

In most commercial collaborations, intellectual property rights in the intended collaborative products will be carefully allocated. For example, in a collaboration to create a new product, the intellectual property rights protecting the product will either be held by the new joint venture marketing the product or by the parent collaborators; this allocation will, of course, be part of the allocation of the intended profits, which will, in turn, reflect the investments by each party. More difficult issues arise with respect to the other inventions made along the way. For example, one of the parties may develop its own technological capabilities during the course of the collaboration. It is likely to retain the relevant intellectual property rights in these new technologies, so that it can apply the technologies in other markets, but grant a license to the other partners for use of the technologies in the specific area of agreed collaboration. And, in planning for completely unexpected inventions, it is common for the

[45] Schmid & Dufour, supra.

[46] The Human Genome Organization (HUGO) at http://www.gene.ucl.ac.uk/hugo/.

[47] The Wellcome Trust, Summary of principles agreed at the International Strategy Meeting on Human Genome Sequencing, 25-28 Feb. 1996, available at http://www.gene.ucl.ac.uk/hugo/bermuda.htm. This approach is more effective in Europe, where publication bars patenting than in the United States, where there is a one year grace period, during which one can apply for a patent for published work.

intellectual property rights to be retained by the inventing firm (save as a license to the collaborators may be needed to make the collaboration effective), and for the rights to be jointly owned where the invention is jointly made.

The pattern generally followed in contemporary U.S. government international agreements is that rights are to be held by the inventing entity or jointly owned in the case of joint inventions, with the exception that each nation will have the right to use any inventions in its own territory.[48] This replaces an earlier approach (1990) in which the emphasis was placed on the right of each party to use inventions in its own territory. It is the more contemporary pattern that is used in NASA agreements, and therefore presumably applies to the U.S.-Russian ISS arrangements.[49]

Government supported research programs are increasingly allocating intellectual property rights to the grant recipient. For example, under the Bayh-Dole Act of 1980,[50] the U.S. government normally permits its grantees to retain patent rights on all inventions they make. The government does retain certain rights to use the technologies for public purposes or to ensure that the technology is applied if the grantee is not moving to exploit the patent rights. But it has hesitated to use these rights, so the grantees normally have very substantial control over their inventions.[51] Although the exact scope of such exceptions undoubtedly differs from nation to nation, many national grantors are following the Bayh-Dole pattern in the hope that it will encourage commercialization of government-supported innovation and that it will bring royalties. The trend will make it increasingly difficult for international collaborations to maintain information in the public domain. Moreover, governments may insist on

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[48] For a review of the law and a selection of sample agreements, see U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Supplementary Handbook on the C-175 Process: Routine Science and Technology Agreements, January 2001, especially Appendices H, I, and J. U.S. federal law creates a policy to require provisions to protect intellectual property in all U.S. international science and technology agreements, Pub. L. 100-418, August 23, 1988, 22 U.S.C. § 2656b.

[49] But see the very complex memorandum of the NASA Office of the General Counsel, Intellectual Property and the International Space Station: Creation, Use, Transfer, and Ownership and Protection, September 1999, available at http://www.hq.nasa.gov/ogc/iss/index.html.

[50] Pub. L. 96-517.

[51] See the Report of the National Institutes of Health (NIH) Working Group on Research Tools, June 4, 1998, especially Appendix D, available at http://www.nih.gov/news/researchtools/index.htm.

protection of intellectual property rights as a condition of support of international collaboration.[52]

[52] Thus, 22 U.S.C. § 2356 (c) requires that U.S. foreign assistance funds not be used to acquire pharmaceuticals manufactured outside the United States if those pharmaceuticals would be subject to a U.S. patent if manufactured in the United States.

Those development institutions able to do so have generally attempted to discriminate between developed and developing nations in allocating intellectual property rights, with the goal being to obtain and possibly utilize rights in the developed world while making research products as freely available in the developing world as possible. This discrimination is suggested by emerging CGIAR practice. Until the biotechnological revolution, agriculture had had a scientific open access policy that made only limited use of intellectual property.[53] When the CGIAR institutions finally concluded they had to move to use of intellectual property rights, they generally sought a pattern in which their inventions, or inventions derived from their collaborations with others, would be patented with the possibility of a royalty (or a bargaining chip in negotiations to obtain rights to use other technologies) in developed world markets but made available freely for developing nation application. This form of differentiation has become a norm to the extent legally possible; similar approaches are taken by the International Aids Vaccine Initiative (IAVI) in its research grants.[54]

3. Implications

These dimensions of collaboration, like others before them, suggest the need to think carefully about the *juste retour* — in both employment and intellectual property -- in the design of new international medical collaborations. To what extent will developed-world scientists, in universities or the pharmaceutical industry, be an important constituency? To what extent will donor governments view a new collaboration as a way of helping their own pharmaceutical industries (which are radically globalizing, at least as between the United States and Europe)? Can the arrangements be designed to take advantage of such motivations without undercutting the intended goals? And what about the use of a portion of the research support in developing nations in ways that contribute to the creation of a globally competitive pharmaceutical industry in those nations? These issues can become quite difficult.

[53] There was, and still is, a legal system for protecting plants, the Plant Breeder's Rights or Plant Variety Protection System; one of the important features of this system is that protected varieties can be freely used to create new varieties. The system is now being effectively replaced by stronger rights under regular patents.

[54] See IAVI's Intellectual Property Agreements: Using "Social Venture Capital" to Help Ensure Global Access to AIDS Vaccines, available at http://www.iavi.org/.

For example, suppose an international medical fund seeks to allocate its expenditures among the following four options: buy a product from a developed world supplier? Buy a comparable but not quite equivalent product from a developing world supplier? Support research in the developed world to create a better substitute product? Or support research in the developing world to create a better substitute product?

6. CONCLUSIONS

A review of this type is more valuable in the questions it poses than in the answers it provides. But it strongly suggests that achieving solid resolutions to three important interrelated issues will be crucial to the effectiveness of any new research support system proposed by the CMH:

1. How will the institution obtain the necessary political support in the developed (donor) world? This may require appeal to national public health interests — which requires careful consideration of the extent to which developed-world health really is linked to developing world health and of the extent to which the developed world public health constituency actually has political power. It may also require appeal to the developed world pharmaceutical industry, which may pose political issues in the developing world.

2. More broadly, what should be the working relationship with the international pharmaceutical industry? This industry's development and production capabilities will certainly be needed, and its political support may be needed. What are the appropriate mechanisms to manage and organize collaborations?, The structure of this relationship has important implications for research strategy and for the extent to which there should or will be research conducted within the developing world (beyond clinical trials under developed world auspices). It therefore also affects donor nation concerns that the international collaboration may affect the competitiveness of their national pharmaceutical firms.

3. How should the developing world be represented in the management of the collaboration? A major developing-nation role is essential and must be combined with responsiveness to solid scientific judgment. The GEF experience suggests that this is likely to be both crucial and difficult.