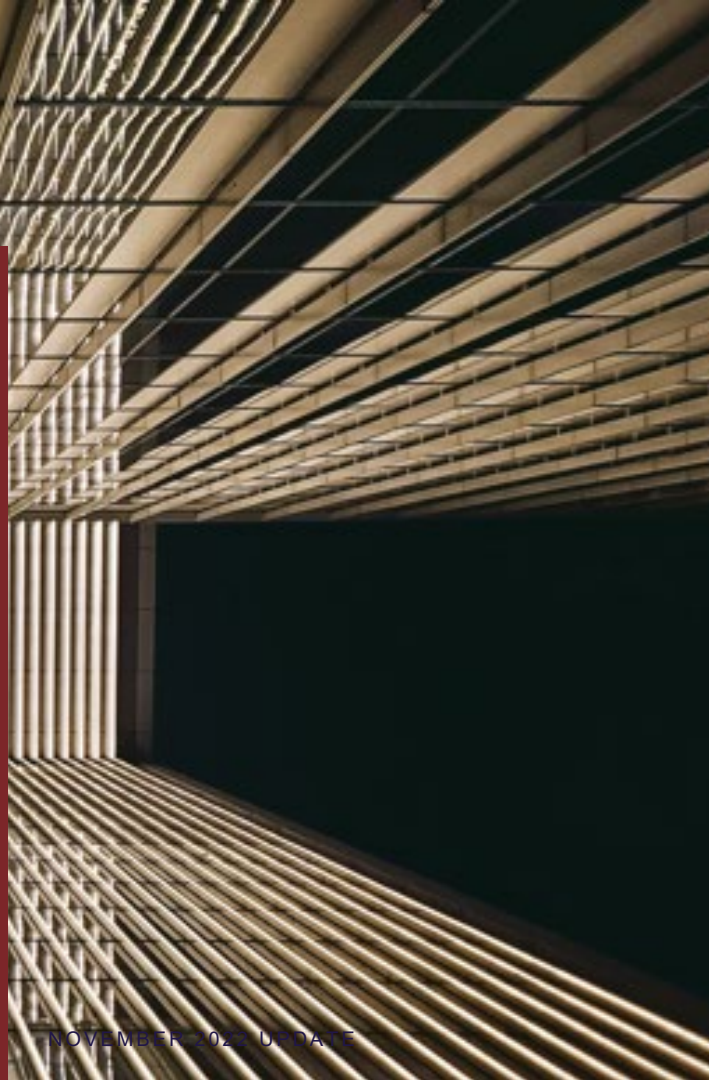
NATIONAL ACADEMIES *Sciences Engineering Medicine*

Improving the Intelligence Community's Leveraging of the Full Science and Technology Ecosystem

Dr. Frederick R. Chang, Committee Chair



NOVEMBER 2022 UPDATE

Committee Roster

Chair: Frederick R. Chang, Southern Methodist University*
Vice Chair: **Michael A. Marletta,** University of California, Berkeley*

Committee Members

- Lillian Alessa, University of Idaho
- Tomas Diaz de la Rubia, University of Oklahoma
- Visha M. Dixit, Genentech
- Donald Duncan, Johns Hopkins Applied Physics Laboratory
- Gerald L. Epstein, National Defense University
- Kathleen Fisher, Tufts University (Resigned from the committee October 2021)
- James R. Gosler, Johns Hopkins Applied Physics Laboratory
- Laura M. Haas, University of Massachusetts, Amherst
- Robert F. Hale, Center for Strategic and International Studies
- Daniel E. Hastings, Massachusetts Institute of Technology
- Frances S. Ligler, North Carolina State University
- Bernard S. Meyerson, International Business Machines Corporation
- Lisa J. Porter, LogiQ (Resigned from the committee in May 2022)
- Peter Schiffer, Yale University*
- Anthony J. Vinci, Center for a New American Security*
- Michael S. Witherell, Lawrence Berkeley National Laboratory

* Today's presenters

Report Outline

- Chapter 1: Introduction
- Chapter 2: A Vision for Strengthening the IC's Ability to Leverage Science & Technology
- Chapter 3: Leveraging the S&T Activities of Other Federal Agencies
- Chapter 4: Leveraging Expertise From the Full U.S. S&T Ecosystem
- Chapter 5: Leveraging the Global S&T Community
- Appendix A: Leveraging the Future Research and Development Ecosystem for the Intelligence Community by the U.S. Research Community Proceedings of a Workshop—in Brief (April 19, 2021)
- Appendix B: Leveraging the Future Research and Development Ecosystem for the Intelligence Community—Understanding the International Aspect of the Landscape Proceedings of a Workshop—in Brief (June 9, 2021)

Charge for This Study

The National Academies of Sciences, Engineering, and Medicine will appoint an ad hoc committee to plan, organize, and write a consensus report that will be based largely on two unclassified workshops.

- The first workshop will review projections of the evolution of the R&D ecosystem and implications for the Intelligence Community (IC).
- The second workshop will focus on how elements of the IC might strengthen and enhance their ability to contribute to the maintenance of the R&D ecosystem to help ensure that the R&D needs of the IC are included in the R&D agenda, leverage that system, and benefit from the investments of other government agencies and the private sector.

Study Scope

The IC Needs to Address Four Major Questions:

1. How can the IC agencies determine how best to spend their S&T funds, and how can those individual investments be coordinated across the IC? Better coordination—but not centralized management—would be valuable.

2. How can the IC derive best value from—and influence as appropriate—the investments of other U.S. government agencies?

3. How can the IC gain best benefit from the efforts of U.S. industry and academia (including both in R&D and in education) and national laboratories?

4. How can the IC best interact with the global S&T enterprise? Failing to engage with the increasingly globalized S&T environment risks forgoing what may be the best available technology and raises the likelihood of technological surprise. On the other hand, there are also risks associated with adversarial access to critical S&T and on reliance on technology that adversaries originate, dominate, own, or control.

How the Study Was Conducted

- Discussions with over 20 subject-matter experts
- Two full-day workshops (summarized in report)
- Interviews of S&T professionals within the IC
- Existing literature of previous studies and reports from various sources
- Leveraging the expertise of committee members

Because this study is unclassified, the committee did not have access to information regarding specific IC S&T projects, budgets, or near-term or future gaps and challenges.

1. Introduction and Summary

Changing S&T Landscape

- The U.S. IC depends on cutting edge science and technology (S&T) and associated enterprise to inform intelligence missions and compete with its adversaries.
- Changes in the global S&T landscape over recent decades have heightened the importance of S&T to the IC.
- The global development of increasingly sophisticated technologies creates a challenge to the United States; in many cases such technologies are commercially available at a global scale.
- Strategic competition with our adversaries is in many ways enabled by science and engineering; indeed some U.S. adversaries lead in some technological areas.
- A component of the IC's core mission is to prevent surprise; an important category of surprise is S&T surprise.
- It is critical that the IC is aware and can innovate and leverage advances from all fields of S&T to inform and advance core intelligence missions.

1. Introduction and Summary (cont.)

Broad Observations of Committee

- In today's world, maintaining awareness of advances in S&T is more essential than ever, to avoid S&T surprise, to inflict surprise on adversaries, and to leverage those advances for the benefit of the nation and the IC.
- The IC, although cognizant of this need and strong in some aspects of S&T, does not give S&T the priority it merits.
- The best way to maintain awareness of S&T advances is through personal interactions between skilled IC experts and external scientists and engineers; S&T understanding is transmitted through expert networks, and not nearly as well through more passive means.
- The IC's existing efforts to track and leverage S&T need to be expanded, better coordinated, and given a higher priority.

2. Strengthening the IC's Ability to Leverage S&T

The IC S&T Enterprise Faces Numerous Structural Issues:

- Within ODNI, S&T responsibilities are divided between Director for S&T (D/S&T), the National Intelligence Officer (NIO) for S&T and the National Intelligence Manager (NIM) for S&T.

- Each IC agency has an S&T organization that has evolved according to the needs identified by that agency's director and senior management. This is a consequence of each agency having its own history and its own R&D culture, which predates the establishment of ODNI.

- The agencies differ in matters such as: (1) balancing short- and long-term research; (2) collaborating with other agencies; (3) maintaining in-house R&D capabilities; (4) assimilating relevant S&T advances; (5) making use of commercial capabilities and sources; (6) leveraging the technologies of major defense and aerospace systems integrators; (7) interacting with small innovative companies and other such innovators; and (8) interacting with the academic community.

- The National Intelligence S&T Committee (NISTC) plays a coordinating function, along with the D/S&T, that coordination has been limited by several factors, including the brevity of the meetings of the NISTC.

2. Strengthening the IC's Ability to Leverage S&T (cont.)

The IC S&T Enterprise Faces Several Operational and Cultural Issues:

- While most R&D in other contexts is conducted in an environment of open collaboration, the IC culture is generally closed.
- The research and technology environment routinely operates within a digital architecture, and procurement and contracting and security requirements slow adoption.
- The government's restrictive personnel practices impede the IC's abilities to employ experts in rapidly emerging technical disciplines.
- Achieving striking advances in research often requires the acceptance of risk and failure, and the IC tends to be risk-averse.
- IC S&T is not adequately resourced and prepared for non-traditional areas such as climate change, global health threats, and disinformation campaigns.
- IC agency S&T programs tend to be tightly "stove-piped" to meet agency mission needs, and to protect compartmentalization of highly classified information.

2. Strengthening the IC's Ability to Leverage S&T (cont.)

To Overcome Its Issues, the IC Must:

- Strengthen the IC's capabilities for monitoring all the relevant S&T landscape;
- Improve methods for collecting and using open-source information, with emphasis on S&T;
- Overcome bureaucratic obstacles that impede IC efforts to fulfill the IC's S&T missions;
- Establish IC standards and processes to ensure high-quality research, development, test, and evaluation;
- Strengthen the S&T leadership structure.

2. Strengthening the IC's Ability to Leverage S&T (cont.)

KEY RECOMMENDATION

Recommendation 2.1 ODNI should clearly designate an individual to strengthen the IC capabilities for leveraging S&T. This individual—a Chief Technology and Innovation Officer (CTIO)—would report to the Director of National Intelligence, serve as Chief S&T Advisor to the Director, and be charged with the responsibilities including:

- Developing and maintaining healthy sharing/participatory relationships across the IC and between it and many relevant domestic and global S&T entities;
- Identifying S&T trends with special IC relevance and plan balanced programs of open-source and classified collection and analysis to enable their expedited development and utilization;
- Leading efforts to integrate and coordinate S&T awareness and S&TI;
- Converting this heightened strength in S&T to operational advantage more rapidly and agilely;
- And maintaining a diverse, skilled team, selected from within the IC, to be deployed to support the above activities deemed critical to the S&TI mission.

2. Strengthening the IC's Ability to Leverage S&T (cont.)

Recommendation 2.2: The IC should increase its ability to mine open-source S&T information while remaining consistent with prevailing policies and laws regarding privacy protections. It must enable integrating open-source S&T information with classified intelligence.

3. Leveraging the S&T Activities of Other Federal Agencies

In addition to funding research at universities and in industry, the federal government is a major performer of R&D, maintaining hundreds of its own laboratories where federal, academic, and private-sector research staff work. Roughly half of this capacity is in the national security sector, of which the IC is an integral part. The government maintains formal mechanisms for R&D planning and coordination across government agencies, including multiagency R&D initiatives. Some examples are below.

Multiagency R&D Initiatives

- NITRD (Networking and Information Technology R&D)
- NNI (National Nanotechnology Initiative)
- USGCRP (US Global Change Program)

Federal R&D Agencies

- DOE Laboratories
- DOD laboratories
- Federally Funded Research and Development Centers
- University Affiliated Research Centers

3. Leveraging the S&T Activities of Other Federal Agencies (cont.)

Recommendation 3.1: The IC should position itself to take better advantage of opportunities afforded by interagency S&T committees and other contacts with non-IC agencies that have substantial S&T activities. More interagency staff exchanges would be helpful, as would more active IC participation in cross-agency R&D. Successful activities on the part of some IC agencies should be studied and mined for best practices.

Recommendation 3.2: The IC should engage in more active partnering with the DOE and DoD laboratories (government, FFRDC, and UARC), to take advantage of their extensive infrastructure and capabilities as well as to employ them as a vehicle for expanding the IC's access to academic and industrial R&D activities through overt relationships. The IC should increase its engagement with various laboratory program review activities.

4. Leveraging Expertise From the Full U.S. S&T Ecosystem

- The preponderance of S&T research in the U.S. occurs in university and commercial settings
- Many commercial enterprises now are rooted in cutting-edge S&T, such as Internet communication and commerce, AI-based software, and the growing bio-based economy. There are now many areas in which the private sector leads the government, and in many cases the government's access is no better than that of private consumers and even international adversaries. Many of the best technologists now work in commercial industry, particularly in the most game-changing areas for the IC such as AI and autonomy.
- One of the tremendous strengths of the U.S. university system is that it draws talent from around the world. Undergraduate students, graduate students, postdoctoral associates, and senior scholars all come to U.S. universities to study and to develop their research careers, and the vast majority of them stay to build their careers, many becoming U.S. citizens.
- The IC traditionally, and for good reason, keeps a low public profile. As a result, a large fraction of relevant academics may not be aware of how their expertise intersects with interests of the IC. In addition, many relevant researchers might be reluctant to engage with the IC because of perceived barriers associated with security.

4. Leveraging Expertise From the Full U.S. S&T Ecosystem (cont.)

Recommendation 4.1: The IC should encourage its technical experts to engage more extensively on a professional level with their peers outside the relatively small IC environment. This would involve attending conferences in their respective fields of expertise, making presentations, and giving talks at other institutions, all with home agency support regarding travel, leave, and expenses. In addition, IC agency experts should be rewarded for inviting outside scientists and engineers to give talks at their home IC agencies. If the proposal to establish a CTIO within ODNI is accepted, that office would be an ideal place to encourage and oversee these practices.

Recommendation 4.2: To institutionalize increased professional interactions between IC S&T experts and the rest of the technical world, IC agencies should consider establishing more rotational positions for leading researchers from academia and the private sector, including start-up and venture capital communities. Because SCI level clearances often require a long approval time and impose lifelong prepublication restrictions, some of the rotational positions should be established at both the unclassified and SECRET levels. The lower security level is often subject to a quicker security clearance process than is now practical for the higher-level clearances more typical of IC staff. That said, because TS//SCI clearances are usually standard for IC staff, they should be expedited, when possible, for rotational positions.

4. Leveraging Expertise from the Full U.S. S&T Ecosystem (cont.)

Recommendation 4.3: The IC should consider emulating some of the DoD's outreach efforts to scientists and engineers in R&D in order to establish trusted collaborations with academia and the private sector. Some of this is being accomplished in the IC, for example, in programs such as IC Scholarships and IC Centers of Academic Excellence. Such efforts should be expanded significantly to develop a trusted community of external researchers. This would be especially useful for engaging researchers without a long history of working with the IC.

Recommendation 4.4: The IC should adopt more forward leaning policies for working with commercial industry to support joint IC-commercial technology development, such as data sharing, as well as acquisition approaches targeted at more effective scaling and implementation of commercial technologies, such as bridge funding. Note that data sharing should go both ways: from the industry partner to the IC agency as well. In both cases, the IC should, by working directly with industry, become part of the technology development process. Additionally, a benefit to the IC of collaboration with the private sector would be increased S&T awareness.

5. Leveraging the Global S&T Community

Research and development (R&D) investment increasingly is distributed worldwide, with approximately 25 percent of global R&D funded by the United States, 20 percent by Europe, and 42 percent by Asia, including China, Japan, South Korea, and Singapore. Scientists are increasingly attending institutions of higher education, conducting scientific research, and pursuing careers in science, technology, engineering, and mathematics (STEM) in foreign countries. In addition, S&T is increasingly collaborative today; scientists frequently conduct research as part of international teams, and many scientists view themselves as part of a global scientific community. The percentage of scientific publications with authors from more than one country is increasing, and such publications have greater impact in field-weighted citation impact (FWCI) analyses.

5. Leveraging the Global S&T Community (cont.)

Barriers to leveraging global S&T

- The IC must always be mindful of security, which is especially critical in the case of international engagements.
- The IC has a constrained ability to interact openly with entities, particularly foreign entities, who may be either unwilling to work with it or who may be too willing to work with it.
- The IC may have difficulty obtaining access to certain international business and technology meetings and conferences.
- The IC does not currently allocate funding for international S&T cooperation, including funding for international travel.
- The Arms Export Control Act (AECA) and the International Traffic in Arms Regulations (ITAR) implementing the AECA have hindered Five Eyes cooperation in R&D in the past.

5. Leveraging the Global S&T Community (cont.)

Recommendation 5.1: Within its mining of open-source information in general, the IC should increase the collection of open-source information on S&T advances and early stage companies in foreign nations. The CTIO could coordinate these activities and potentially assign and/or post specialists to cover key regions and countries.

Recommendation 5.2: The IC should increase its interactions with FVEY (Five Eyes, the intelligence partnership among the United States, Canada, the United Kingdom, Australia, and New Zealand) and other allies through four steps:

1. Create a more systemic approach to cooperation, which could include having the CTIO develop a multi-year, allied S&T cooperation plan.
2. Set aside funding for international cooperative activities (e.g., personnel exchanges, joint R&D).
3. Support travel abroad to deepen foreign partnerships and build trusted relationships.
4. Develop common talent pools and facilitate commercial cooperation opportunities.

5. Leveraging the Global S&T Community (cont.)

Recommendation 5.3: The IC should work to establish a center (e.g., a non-profit or at a Federally funded R&D Center or University Affiliated Research Center) operated external to the IC, focused on open-source S&T information collection. This center should take full advantage of collection opportunities, through a presence at international symposia, where potential competitors display their state-of-the-art efforts in mission-critical areas, such as semiconductors, information technology, artificial intelligence and machine learning, quantum computing/sensing, biotechnology, and other emergent fields of S&T.

KEY RECOMMENDATION and KEY TAKEAWAY

Recommendation 2.1 ODNI should clearly designate an individual to strengthen the IC capabilities for leveraging S&T. This individual—a Chief Technology and Innovation Officer (CTIO)—would report to the Director of National Intelligence, serve as Chief S&T Advisor to the Director, and be charged with the responsibilities including:

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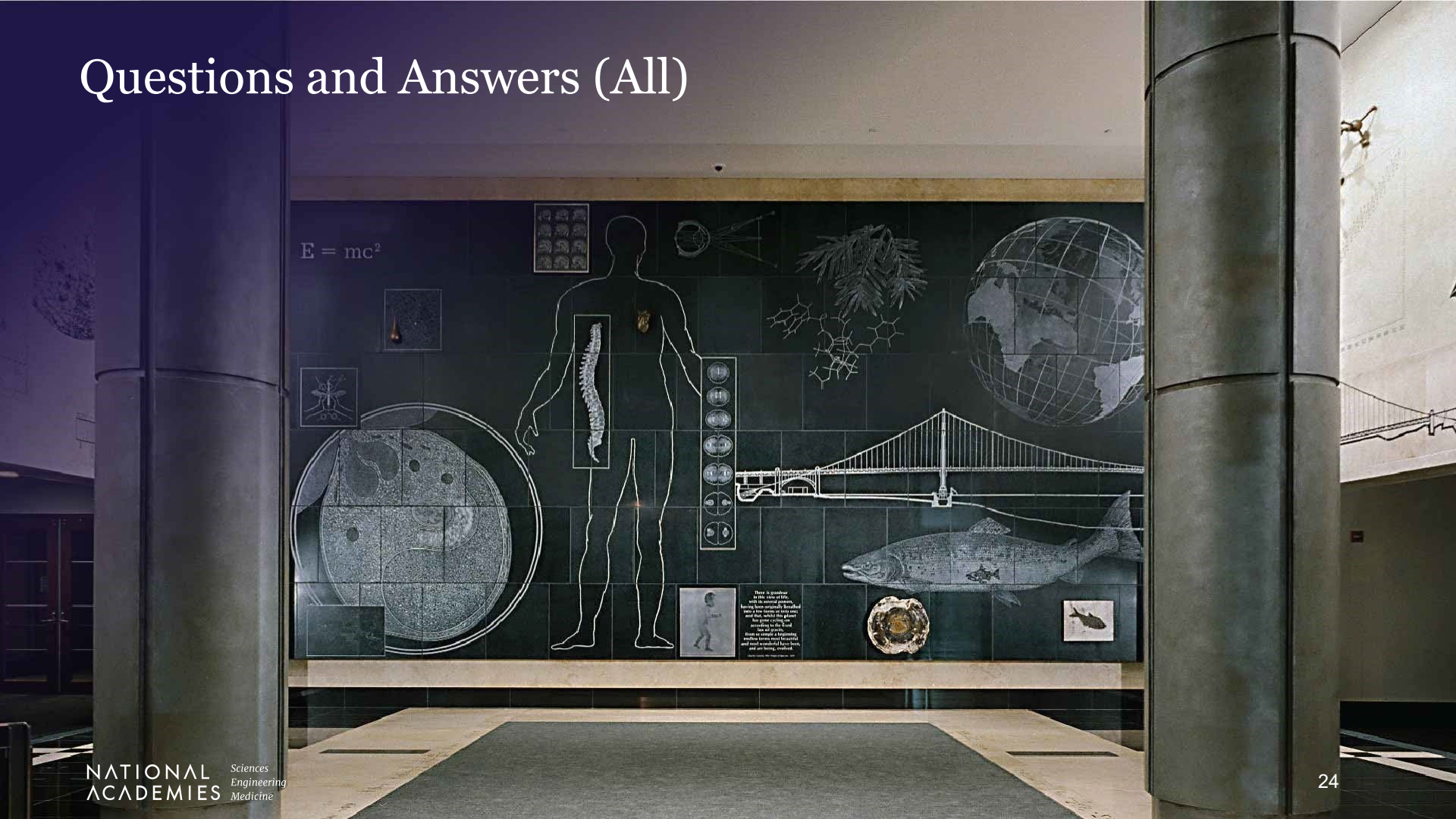
Questions and Answers (All)



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