US vs China in AI Research: Baselining Understanding

BLUF: Analysis of the global AI research landscape from a variety of international open source studies points to two generally shared conclusions:

1) (b) (5)

2) (b) (5)

Comparing analysis from primary reports of AI research landscape:

- ***Artificial Intelligence: How knowledge is created, transferred, and Used, Trends in China, Europe, and the United States***, report published by Elsevier on December 12, 2018: https://www.elsevier.com/connect/resource-center/artificial-intelligence
- ***China AI Development Report 2018****,* report published by China Institute for Science and Technology Policy at Tsinghua University in July 2018: http://www.sppm.tsinghua.edu.cn/eWebEditor/UploadFile/China_AI_development_report_2018.pdf
- ***Artificial Intelligence Index: 2018 Annual Report***, report published by Stanford University in December 2018: http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf
- ***China AI Index 2018,*** report published by Wuhan University in March 2019: http://www.ckgsb.edu.cn/uploads/%E3%80%8A%E4%B8%AD%E5%9B%BD%E4%BA%BA%E5%B7%A5%E6%99%BA%E8%83%BD%E6%8C%87%E6%95%B02018%E3%80%8B.pdf
- ***"China to Overtake US in AI Research,"*** article by Allen Institute for Artificial Intelligence on March 13, 2019: https://medium.com/ai2-blog/china-to-overtake-us-in-ai-research-8b6b1fe30595
- ***2019 Global AI Talent Report*** published by Element AI on April 4, 2019: https://jfgagne.ai/talent-2019/
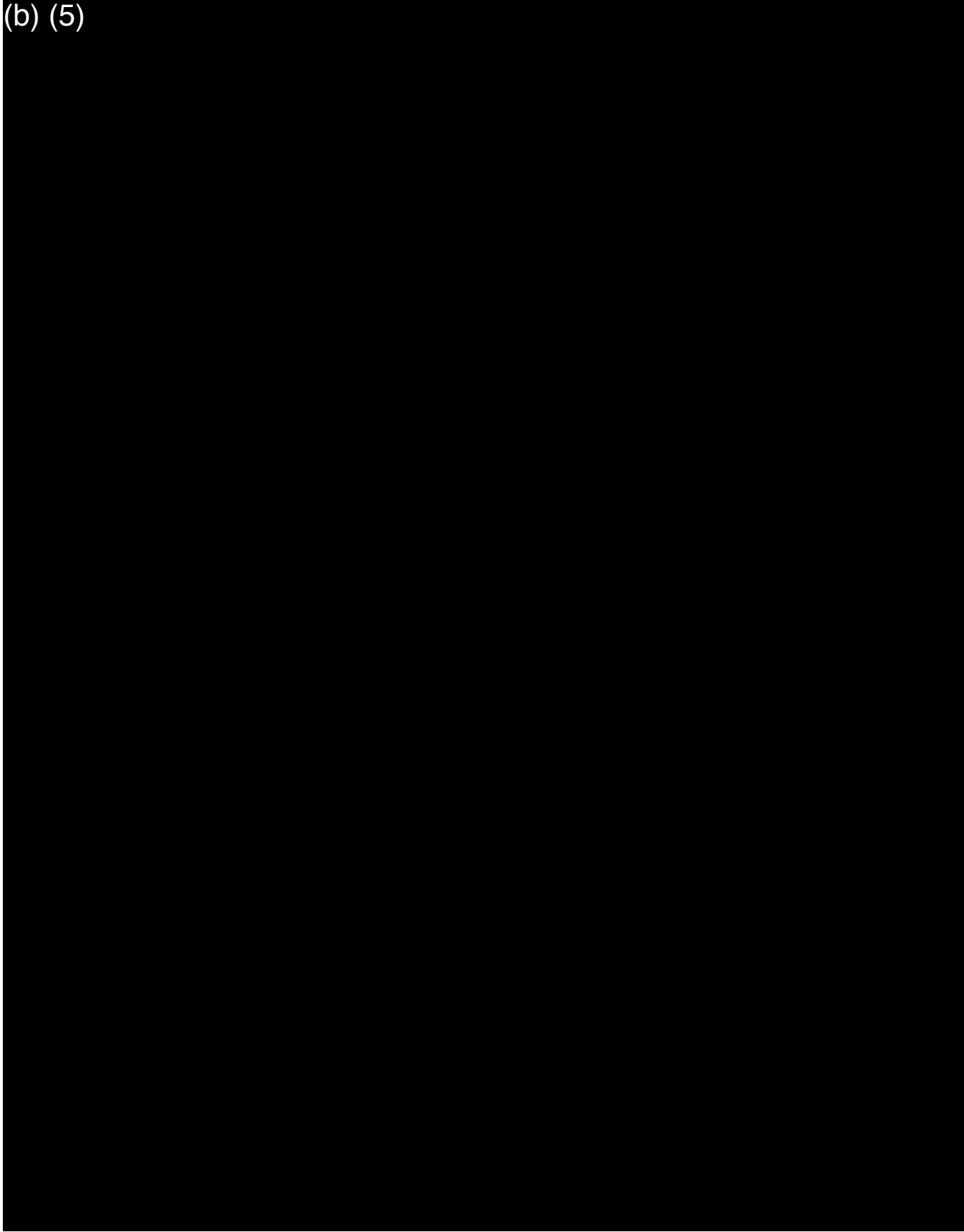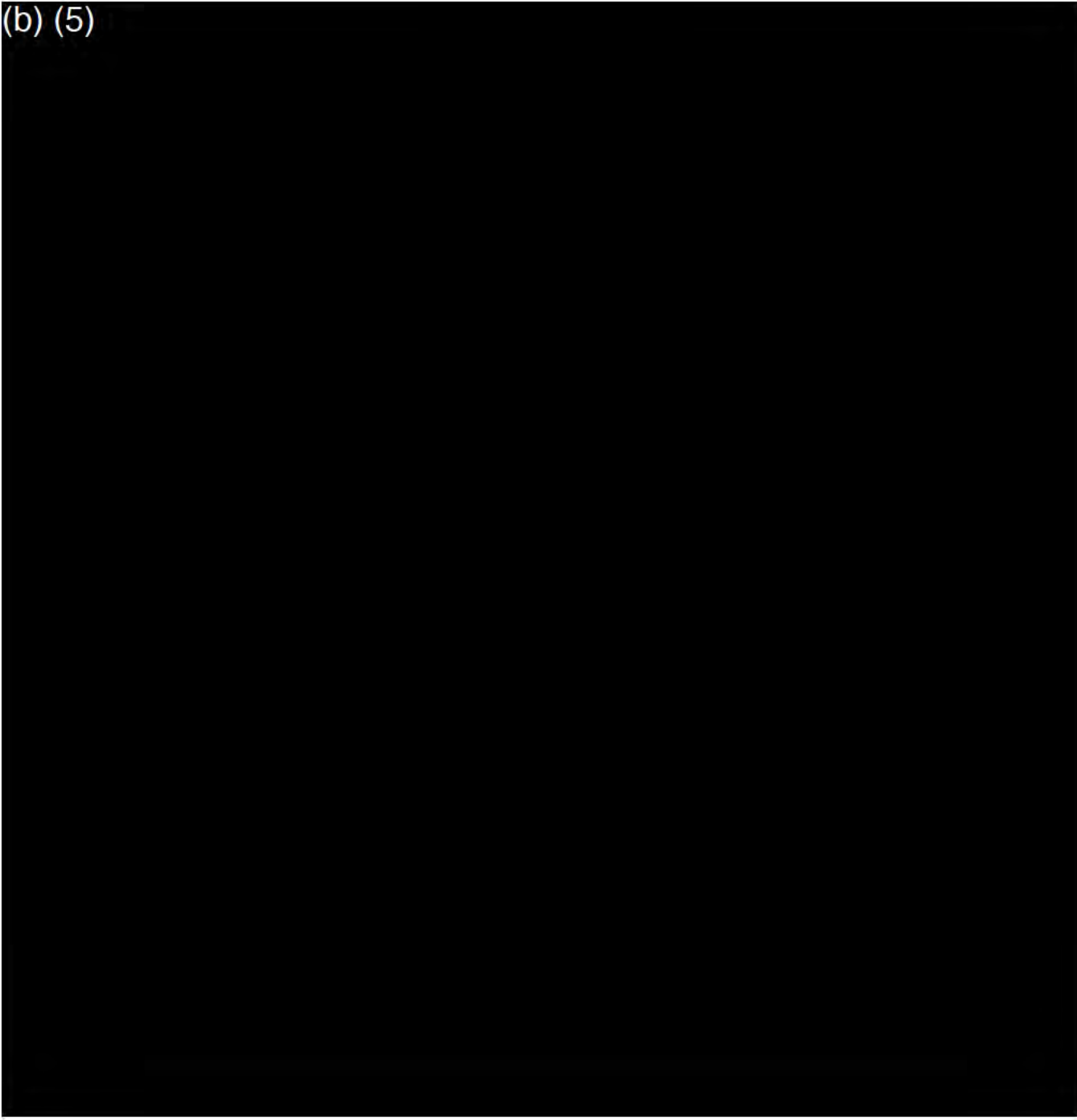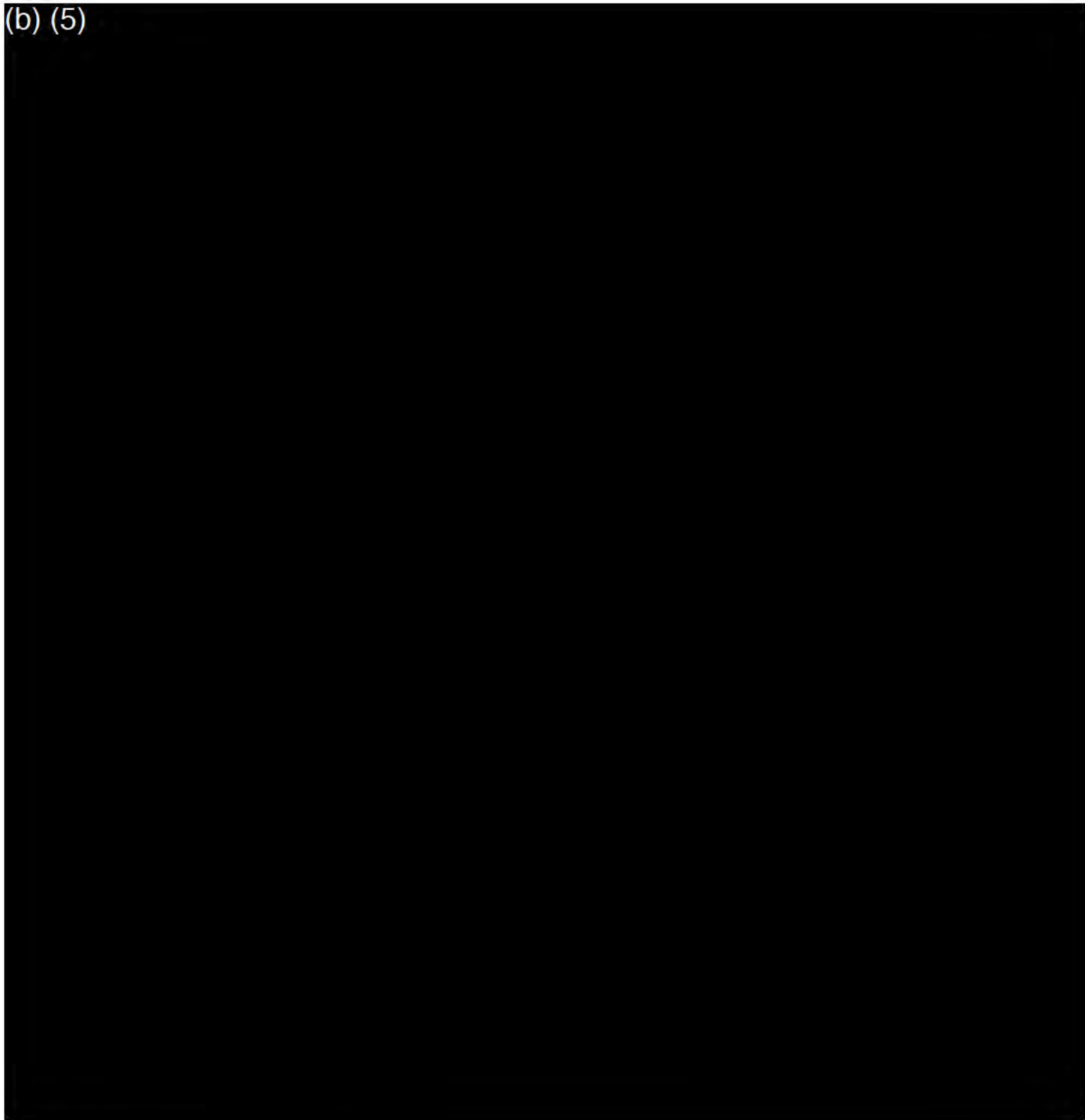
Research Publications (Quantity)

(b) (5)

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[1](b) (5)
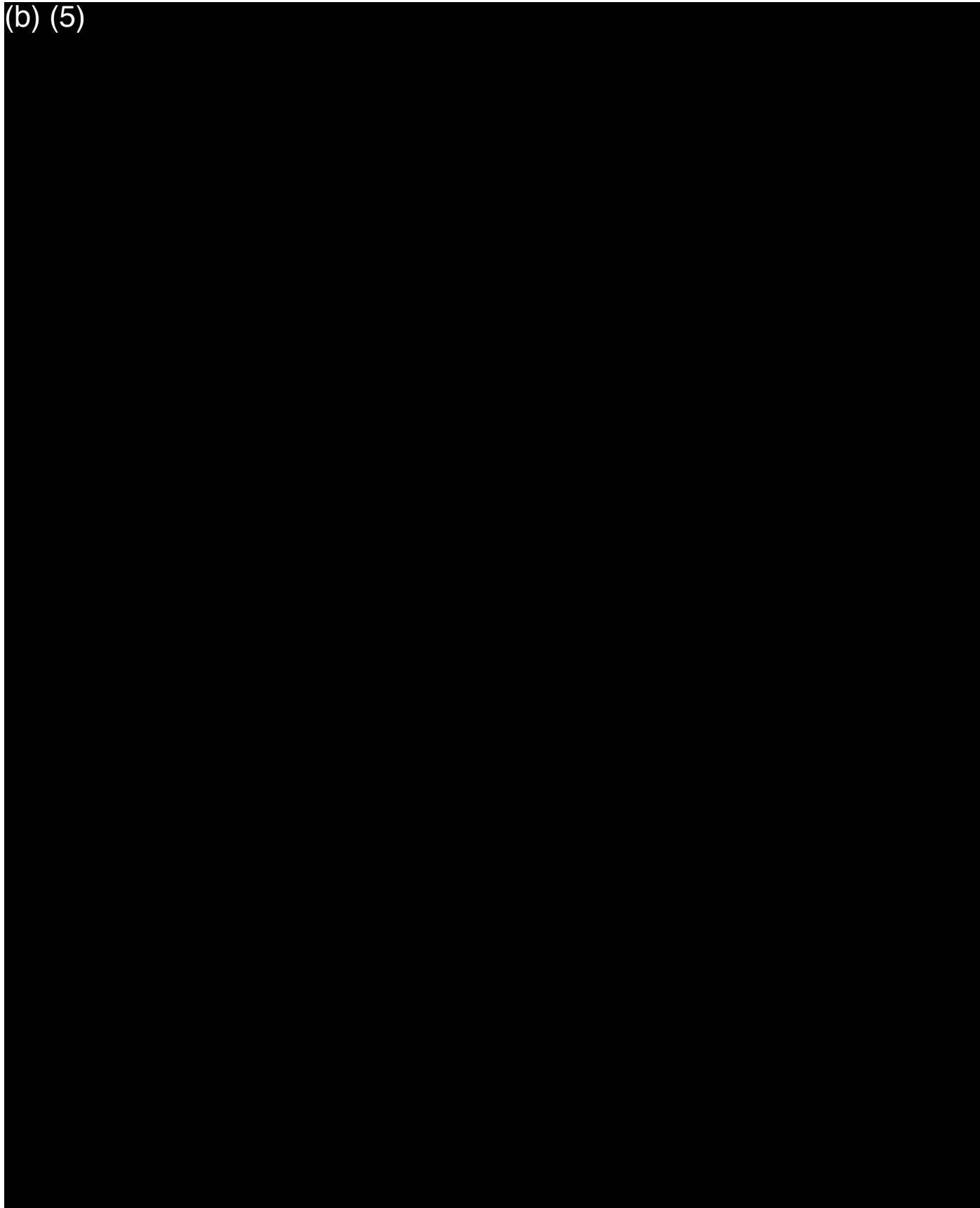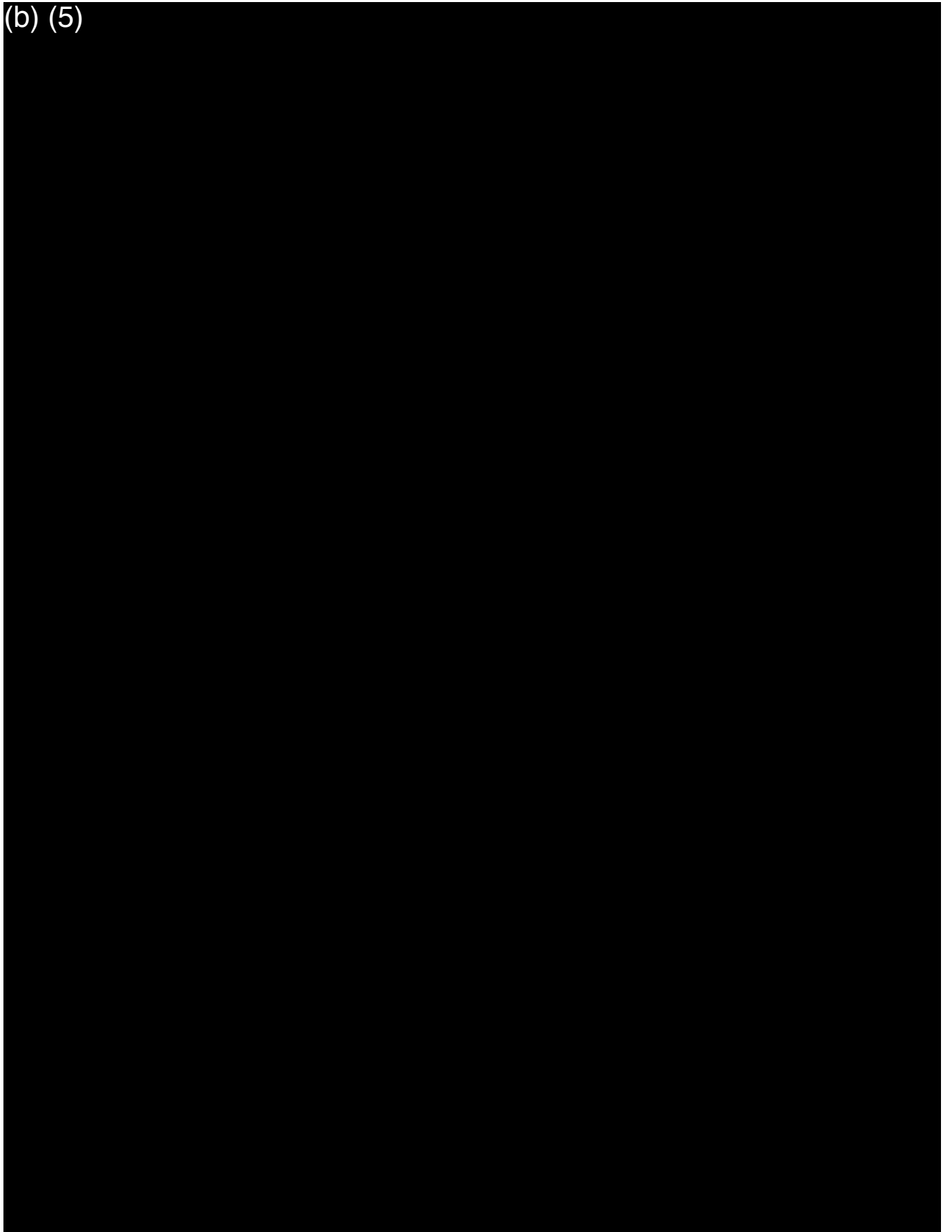
[2](b) (5)

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[4](b) (5)

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(b) (5)

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(b) (5)

Federal Funding of AI Research: Building Blocks

NATIONAL SECURITY COMMISSION ON ARTIFICIAL INTELLIGENCE

NSCAI Objective: Recommend additional federal resources to create a more robust environment for AI research including fundamental research, prototyping, and applications to foster the innovation and advancement necessary to maintain US leadership in the field and strengthen national security and defense.

PRIMARY EXISTING ORGANIZATIONS*

UNDER DISCUSSION

NIH
Est. 1887, NIH is an agency of HHS w/mission to seek fundamental knowledge & apply it to enhance health, lengthen life, & reduce illness & disability

$37.3 B (FY18) / Funds 300,000 researchers at 3,000 institutions

NSF
Est. 1950, sole USG agency supporting research & education across all fields of science & engineering

$8 B ($120M to fundamental AI, $500M to fundamental & applied) / 2,100 FTE and 359,000 grant recipients

DARPA
Est. 1958 to make investments in breakthrough tech for national security. Oversees ~250 R&D programs

$3.5 B FY 2019/ 220 FTE

DOE/DOD National Labs (FFRDCs)
FFRDCs that conduct scientific research, development & prototyping to meet national sec needs

Examples:
DoD Lincoln Labs: $1 B/ ~3,440 FTE

DOE Oak Ridge: $1.6 B/ ~7,400 FTE

(b) (5)

NIST
Est. 1901 as Bureau of Standards, NIST advances measurement science, standards, and technology in ways that enhance economic security

$1.2 B (FY18) / 2900 FTE + 1,800 guest researchers & engineers

University Affiliated Research Centers
Strategic DoD research centers associated with a university, education as part of mission

Examples:
JHU APL: $1.5 B/ 6,700 FTE
USU SDL: $115 M/ 680 FTE

Government Owned & Operated Labs
Each service branch manages research labs that focus on specific technology solutions for their forces

Example:
AFRL: $520 M in FY 2017/ ~10,000 FTE

IARPA
Est 2006. Invests in high-risk, high-payoff research programs to address challenges of the intel community

Classified budget / ~150 FTE

KEY
- New (New)
- Non-DoD/IC
- DoD
- IC

(b) (5)

epic.org

*Does not include DHS, DoS, NASA, or DOJ
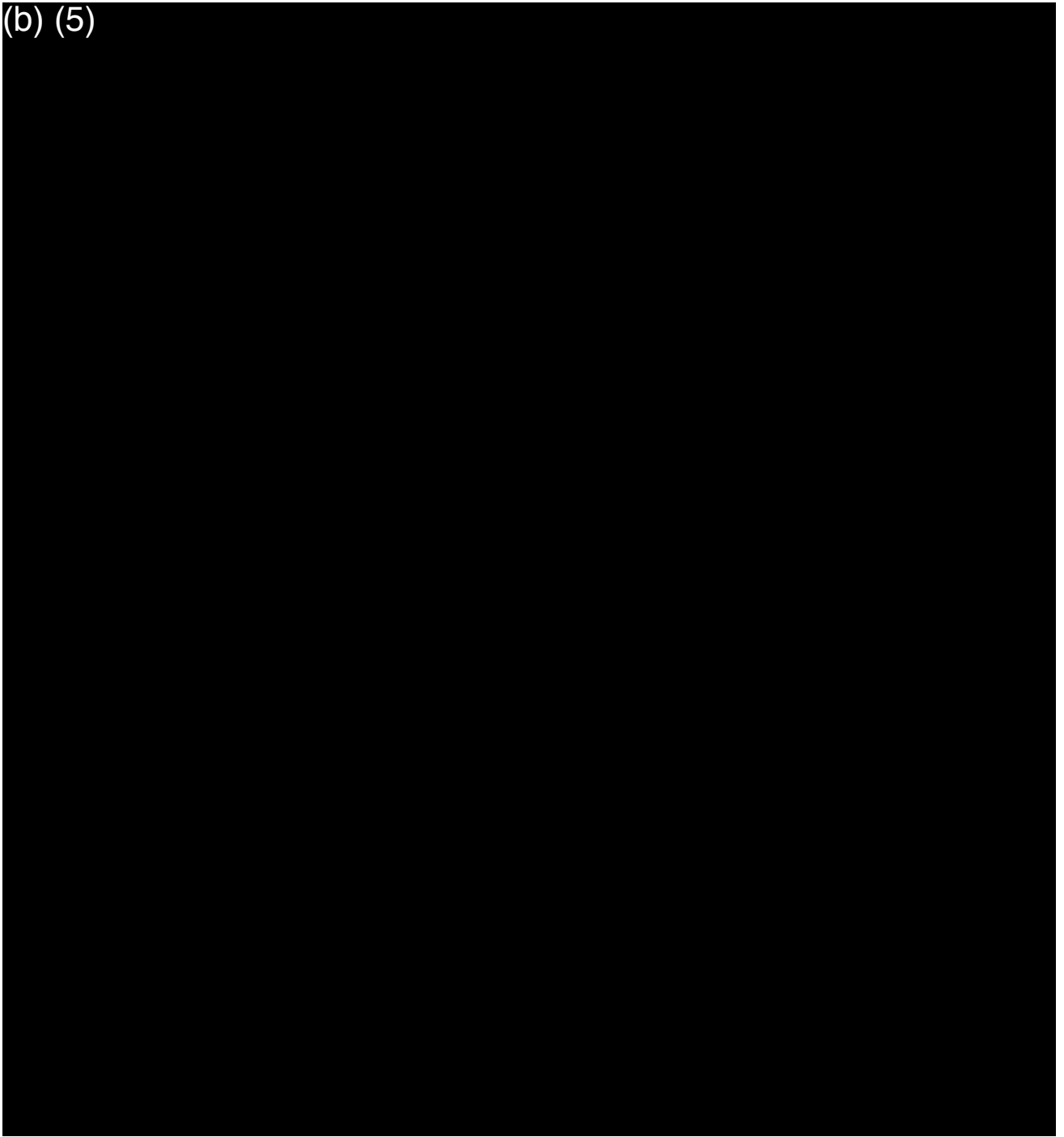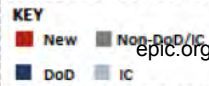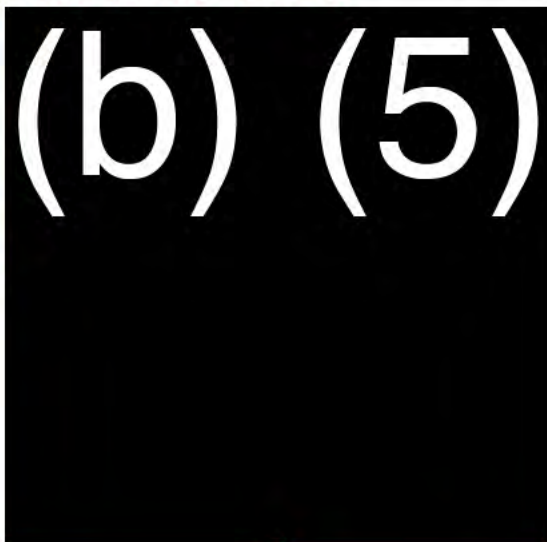
Federal Funding of AI Research: Building Blocks

NSCAI Objective: Recommend additional federal resources to create a more robust environment for AI research including fundamental research, prototyping, and applications to foster the innovation and advancement necessary to maintain US leadership in the field and strengthen national security

PRIMARY EXISTING ORGANIZATIONS*

UNDER DISCUSSION

NIH	NSF	DARPA	DOE/DOD National Labs (FFRDCs)
(b) (5)	(b) (5)	(b) (5)	(b) (5)

NIST	University Affiliated Research Centers	Government Owned & Operated Labs	IARPA
(b) (5)	(b) (5)	(b) (5)	(b) (5)

UNDER DISCUSSION: (b) (5)

(b) (5)

KEY
- 🟥 New
- ⬛ Non-DoD/IC
- 🟦 DoD
- ⬜ IC
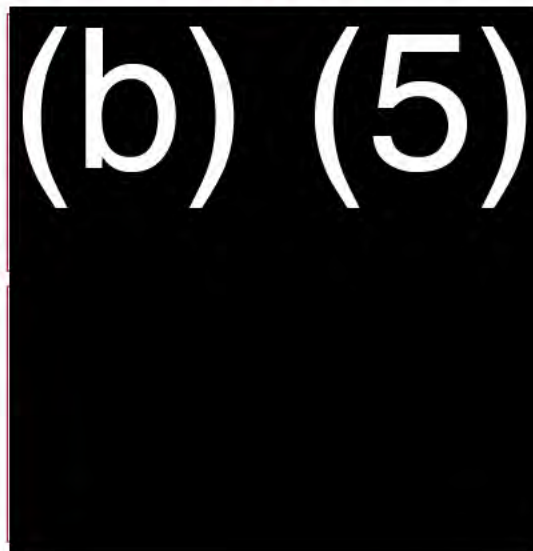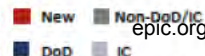
EPIC-2019-001-001762

*Does not include DHS, DoS, NASA, or DOJ

Subject: Status Update from the National Security Commission on Artificial Intelligence

Date: Monday, June 17, 2019 at 10:32:00 AM Eastern Daylight Time

From: Yll Bajraktari

To: Eric Schmidt, Robert Work, Safra Catz, Steve Chien, Mignon Clyburn, Chris Darby, Kenneth Ford, José Marie Griffiths, Eric Horvitz, <mark>Andy Jassy, (b)(6)</mark>, Gilman Louie, William Mark, Jason Matheny, Katharina Mcfarland, Andrew Moore

CC: <mark>NSCAI Staff, (b)(6)</mark>, <mark>NSCAI Commissioners, (b)(6)</mark>

Dear Commissioners,

Below is an update across all of our efforts prepared by <mark>NSCAI Staff Member, (b)(6)</mark>, including:

IMPORTANT: Special thanks to those of you that agreed to serve as mentor for some of our staff members. We will contact the rest of you in the coming days and really appreciate you taking time from your busy schedules to help educate next generation leaders.

1. Working Group / Special Project Updates
2. Plenary Information
3. Outreach and Engagement
4. Other Items

1—Working Group / Special Project Updates

WG1 – Maintaining Global Leadership in AI Research (Moore, Schmidt, Horvitz)

Status: The group will meet on the afternoon of June 28, in Washington, DC, and will **(b) (5)** ██

WG2 – Maintaining Global Leadership in AI National Security Applications (Catz, Ford, McFarland, Jassy, Chien)

Status: The group held its second meeting on June 11 **(b) (5)** ██████████████████████████ ████████████████ (June 11 SOC here).

WG3 – Preparing Our Citizens for an AI Future (Griffiths, Work, Mark, Clyburn)

Status: The group held its second meeting on June 7 **(b) (5)** ████████████████████ ████████████████ (June 7 SOC here)

WG4 – International Competitiveness and Cooperation in AI (Matheny, Darby, Louie)

Status: The group will meet on June 20, and focus on cooperation with allies and partners on AI. The meeting will include briefings from representatives of several key countries (UK, Australia, EU, Japan, **(b) (5)** ████████) on their national AI strategies, **(b) (5)** ████████████████████████████████████.

SP / Partnerships – Before the next plenary, the Special Project on Public-Private Partnerships will hold a session to assess emerging National Security Innovation Base ecosystems outside of Silicon Valley. We will send out the details as soon as we finalize them.

SP / Responsible Use – The Responsible Use of AI Special Project is now supported by Dr. Griffiths and Dr. Matheny. Other commissioners interested in attending project meetings should contact <mark>NSCAI Staff Member, (b)(6)</mark>). So far, staff have held engagements on the following: AI principles and code of conduct initiatives (Defense Innovation Board, OECD, RAND), AI and bias initiatives (American Psychological Association, Brookings, Wilson Center), autonomous weapon system reviews (OSD), and ethical challenges surfacing with AI deployment (Maven).

SP / Data – We are developing a growing list of programs, projects, and experts for further research and follow up. The Special Project on AI Data

invites commissioners' input and suggestions on projects, organizations, and experts who might offer relevant insights and experiences. Please contact <mark>NSCAI Staff Member, (b)(6)</mark>

2—Plenary Information

The next plenary meeting is scheduled for **July 11 in Cupertino, CA** (same location as the May meeting). We are coordinating with your staffs on details and will follow up with additional information as we get closer to the date.

The program will focus on: getting a domestic threat picture, the White House's National Security Presidential Memorandum on AI, working group outbriebfs, next steps regarding the November report, etc. Detailed agenda to follow in the next status update.

3—Outreach and Engagement

In the past few weeks, NSCAI staff members have engaged with the IC, NIH, CNAS, RAND, Wilson Center, OSD, Project Maven, Joint Staff, Reagan Institute, Elsevier, Shield AI, In-Q-Tel, OMB, DIB, American Psychological Assoc., Brookings, Booz Allen, IARPA . . . and many others.

4—Other Items

War on the Rocks: NSCAI staff is working with the online magazine War on the Rocks to issue a call for papers on topics relevant to the Commission's areas of interest. Once this is published we will circulate a link.

HASC Markup: On June 12, at the House Armed Services Committee markup of the FY20 NDAA, Rep. Elise Stefanik noted that the bill includes a provision to extend the NSCAI's mandate. She added: "The Commission is off to a running start, and frankly I have never seen a federal commission move so fast with such urgency and with tremendous backing from government and industry alike."

HPSCI Hearing: The House intelligence committee convened a June 13 hearing on "The National Security Challenge of AI, Manipulated Media, and Deepfakes." A summary is attached here.

Office of Technology Assessment: At the June 7 WG3 meeting, a question was raised about re-establishing OTA. Attached here is a brief backgrounder on the issue and the current debate.

We look forward to seeing you again in Cupertino on July 11th.

Best,

Ylli

Subject: Re: NSCAI - Status Update

Date: Saturday, August 24, 2019 at 2:39:43 PM Eastern Daylight Time

From: Steve Chien, (b)(6)

To: Yll Bajraktari (b) (6)

CC: Eric Schmidt (b) (6)   Andrew Moore (b) (6)   , Eric Horvitz
(b) (6)   Safra Catz (b) (6)   , Katharina Mcfarland
(b) (6)   >, Steve Chien (b) (6)   , Kenneth Ford
(b) (6)   José Marie Griffiths (b) (6)   >, Mignon Clyburn
(b) (6)   Robert Work (b) (6)   Darby, Chris
(b) (6)   , Jason Matheny (b) (6)   >, Gilman Louie (b) (6)
Andy Jassy, (b)(6)   William Mark (b) (6)   ,
NSCAI Commissioners, (b)(6)   , NSCAI Staff, (b)(6)

re: Framework beliefs

Sorry for the Spam, but I was not sure how to add these more general comments.

1. (b) (5)

2. (b) (5)

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On Mon, Aug 19, 2019 at 11:17 AM Yll Bajraktari (b) (6)   > wrote:

Dear Commissioners,

Hope you all are enjoying August and getting ready for September. We will have four working groups and three special projects meetings next month, while drafting the interim report - busy month!

Below is a status update prepared by (b) (6)   across all of our efforts:

1. Requests on Framework Beliefs and WG Research Memos
2. Data Special Project workshop invitation
3. Working Group / Special Project updates
4. Outreach and engagement
5. Additional items

1—Framework Beliefs Doc & WG Research Memos

Framework Beliefs: A reminder to *please review and comment* (either in the shared doc itself, linked here, or by email) *before Sept 1*. If you have any difficulty accessing the document, please contact Mike Gable (b) (6)   ).

WG Research Memos: Each Working Group is preparing a memo that aims to capture what the group has learned so far. These will be distributed ahead of the September WG meetings. *Please engage with your WG staff lead to provide input.*

2—Data Special Project Update/Request

Workshop: The Special Project on Data is planning a one-day "AI Data and Infrastructure Workshop" to further develop strategic priorities related to data for AI. *You are invited to attend on Sept 18 at the NSCAI offices* (unclassified).

The goal of the event is to illuminate ways to improve the USG's AI-relevant data holdings. (A draft agenda is linked here.) The staff is working to identify and invite experts. Thank you for the suggestions we've received so far, and we welcome more. If you are available to attend on Sept 18, please contact (b) (6) ████████████ .

3—Working Group / Special Project Updates

WG1 – Maintaining Global Leadership in AI Research (Moore, Schmidt, Horvitz)

The group continues to (b) (5) ████████████████████████████████ .
The group's Sept 26 meeting in DC will (b) (5) █████████████████████████████
███████████████████████████████ . (Draft agenda here)

WG2 – Maintaining Global Leadership in AI National Security Applications (Catz, Ford, McFarland, Jassy, Chien)

WG2 is continuing to (b) (5) ██████████████████████████████ in preparation for the group's Sept 9 meeting in DC. That meeting will (b) (5) ████████████████████████████ .
The staff is also visiting Service and academic labs and research centers. (Draft agenda here)

WG3 – Preparing Our Citizens for an AI Future (Griffiths, Work, Mark, Clyburn)

The group's next meeting on Sept 9 (b) (5) ███████████████████████████ . The group is continuing to work with the DIB and the JAIC to develop a shared workforce framework for review at the next meeting. Staff has engaged recently with Navy, CNAS, OSD/P&R, and other DoD officials. (Draft agenda here)

WG4 – International Cooperation and Competitiveness in AI (Matheny, Darby, Louie)

WG4 will hold its next meeting on Sept 16, which will (b) (5) ███████████████████████
███████████████████████████████████ (Draft agenda here)

SP / Partnerships – The special project will host a joint meeting with WG4 in September, focused on (b) (5) ██████████
████████████████████ . (Draft agenda here.) The project is also (b) (5) █████████████
████████████████ .

SP / Ethics – The first special project meeting is tentatively scheduled for late September. It will (b) (5) █████████
███████████████████ . (Draft agenda here.)
Recently, staff members have engaged with a wide range of USG components, and with Harvard, MIT, Cal Poly, and others.

4—Outreach and Engagement

Hill engagement: Before the August recess, staff met with House AI Caucus Co-Chair Rep. Jerry McNerney (D-CA) to update him on the Commission's work. (b) (5) ████████████████████████████████████ (Full readout here)

Note: If you speak with Members of Congress, please mention the Commission's upcoming conference on Nov 5. We would welcome their attendance. And if you have reason to be on Capitol Hill, please let us know if you have free time to meet with Members on Commission business. We are happy to coordinate meetings.

Recent staff engagements have included DHS, DOE, Army Research Lab, Wilson Center, OSD/P&R, Canadian Embassy, Data & Society, Naval War College, State Department, Google, General Dynamics, Raytheon . . . and many others.

We are tracking staff engagements in a spreadsheet linked here.

5—Additional Items

War on the Rocks: The first article in response to our call for ideas was posted on Aug 16. Eric Lofgren, "A Guide to Not Killing or Mutilating AI Research," linked here.

NSF Memo: On July 11, the National Science Foundation issued a policy on "Foreign Government Talent Recruitment Programs," linked here.

Wash Post article: The Post published an article on Aug 19 describing how "Chinese scientists are at the forefront of the quantum revolution," linked here.

Please let us know if you need anything from us.

Ylli

Subject: NSCAI - Status Update

Date: Tuesday, September 3, 2019 at 5:23:30 PM Eastern Daylight Time

From: Yll Bajraktari

To: Eric Schmidt, Andrew Moore, Eric Horvitz, Safra Catz, Katharina Mcfarland, Steve Chien, Kenneth Ford, José Marie Griffiths, Mignon Clyburn, Robert Work, Darby, Chris, Jason Matheny, Gilman Louie, Andy Jassy, (b)(6)____, William Mark

CC: NSCAI Commissioners, (b)(6), NSCAI Staff, (b)(6)

Dear Commissioners,

I hope you all had a great Labor Day weekend!

We wanted to send you an update prepared by (b) (6) on all our efforts.

1. Working Group / Special Project updates
2. Media, Outreach and Engagement

We have a big month ahead of us, with four working group meetings and three special project meetings -- while we also develop a draft of the Interim Report.

Here is the schedule of upcoming meetings:

WG1 - Sept 26
WG2 - Sept 9
WG3 - Sept 9
WG4 - Sept 16
SP Partnerships - Sept 17 (TBC)
SP Ethics - Oct 10
SP Data - Sept 18

1—Working Group/Special Project Updates

WG1 – Maintaining Global Leadership in AI Research (Moore, Schmidt, Horvitz)

The group continues to define national security priorities for AI research (see draft matrix here), and looks forward to Commissioner feedback during the conference call on 4 Sept at 10am (see dial-in info below) or by email. The group's Sept 26 meeting in DC will (b) (5) _____ (Draft agenda here)

Conference Call Information - 4 Sept, 10am
Google Hangouts: (b) (6)
Phone: (b) (6) ____, **PIN:** (b) (6)

WG2 – Maintaining Leadership in AI National Security Applications (Catz, Ford, McFarland, Jassy, Chien)

WG2 is continuing to examine (b) (5) _____ in preparation for the group's Sept 9 meeting in DC. That meeting will (b) (5) _____ (Draft agenda here)

WG3 – Preparing Our Citizens for an AI Future (Griffiths, Work, Mark, Clyburn)

WG3 has focused engagements over the last two weeks on service labs and service personnel offices. Coordination with the DIB and JAIC to create a shared workforce model has continued. The group's research memo has been circulated in preparation for the Sept 9 WG meeting. (Draft agenda here)

WG4 – International Cooperation and Competitiveness in AI (Matheny, Darby, Louie)

The group will meet on Sept 16 to (b) (5) _____ On Sept 17, WG4 and SP Partnerships will hold a joint meeting focused on (b) (5) _____ (Sept 16 draft agenda here)

SP Partnerships – The SP is focused on the Sept 17 joint meeting with WG4, and is also organizing staff-level meetings with major U.S. defense firms

to discuss their AI initiatives, in coordination with the Aerospace Industry Association. (Sept 17 draft agenda here)

SP Ethics – The first SP meeting on Oct 10 will ██████████ (b) (5) ██████████
████████████████████████████████ (Draft agenda here)

SP Data – The SP's Sept 18 workshop on "AI Data and Infrastructure" will aim to develop strategic priorities related to data for AI. **If you are available to attend, please contact** NSCAI Staff Member (b)(6) (Draft agenda here)

2—Media, Outreach and Engagement

Noteworthy Media:

- On Sept 2, War on the Rocks published an article in response to the NSCAI call for ideas. "AI Will Change War, But Not in the Way You Think," by Jonathan Clifford. (Link)
- The New York Times published an op-ed by Lucas Kunce, a Marine, on Aug 28, which encourages readers to respond to our call for ideas in War on the Rocks. Kunce argues that by working with the military on AI capabilities, tech companies can help save innocent lives and reduce suffering. Lucas shared the document with us beforehand and we are in the process of bring him on board as part of his Marine Corps reserve duty. (Link)
- After Vice Chair Bob Work participated in a conference at the Johns Hopkins Applied Physics Lab, two articles appeared. Breaking Defense focused on Mr. Work's rebuttal of the arguments advanced by the Campaign to Stop Killer Robots. Sputnik News focused on Mr. Work's comments about the prospect of an AI-enabled NC3 system.

Staff Visit to Boston Area: On Aug 20-21, a group of staff members met with several MIT components (including Lincoln Lab, Media Lab, and the Computer Science & AI Lab), Tufts Human-Robot Interaction Lab, Draper Lab, The Engine, and Harvard. A detailed trip report is attached here. MIT Lincoln Lab provided an especially clear and helpful set of slides, attached here.

We are tracking all staff engagements in a spreadsheet linked here.

Lastly, we have now 29 people in the office (17 direct hires, 11 detailees from Departments and Agencies and 1 intern). We also have 15 special government employees - experts that we can count to help us on anything related to AI. We continue to grow and expand our team.

Please let us know if you need anything from us. We look forward to seeing you soon.

Ylli

Vector Institute Model

Structure & Background:
- Pan-Canadian AI Strategy of 2017 provided $125 million for AI innovation and investment, establishing a partnership between the Canadian Institute for Advanced Research (CIFAR) and three new AI centers: AMII in Edmonton, Vector in Toronto and MILA in Montreal.[1]
- The Vector Institute formally launched in March 2017 and opened doors to a purpose-built space in January 2018.

Mission & Priorities:
- The institute's mission is to lead in Canada's knowledge, creation, and use of AI to foster economic growth and improve the lives of Canadians. They aim to recruit global talent and partner with Canadian industry and public institutions to ensure that they have the people and resources to be best in class in AI.

Funding:
- $135 million for the first 5 years, sourced from:[2]
  - Federal funding from Innovation, Science and Economic Development Canada through the Pan-Canadian AI Strategy, administered by CIFAR.
  - Provincial funding from Ontario's Ministry of Economic Development, Job Creation and Trade.
  - Industry sponsorships signed with 41 enterprise, startup and scale-up companies from a range of sectors.

> **Corporate Partners**
>
> **Platinum:** Accenture, BMO, Google, Loblaw Companies Limited, NVIDIA, RBC, Scotiabank, Shopify Inc., TD Bank Group, Thomson Reuters & Uber
>
> **Gold:** Air Canada, CIBC, CN, Deloitte, EY, Georgian Partners, Intact Financial Corporation, KPMG, Magna International, Manulife, PwC Canada, Sun Life Financial, TELUS & Thales
>
> **Silver & Bronze:** 13 Sponsors

Staff & Infrastructure:
- Over 220 active researchers: 21 faculty members, 63 faculty affiliates, 32 Postgraduate affiliates, 106 students (PhDs, Master's); and 24 professional staff.
- Board of Directors (10) drawn from public, private, and academic backgrounds.
- Computing Resources - Amazon Web Services, Google Cloud Platform, and Microsoft Azure have donated a combined total of nearly $500,000 USD in cloud computing resources.

Research & Impact:
- Published more than 100 papers in conferences and journals in 2018. Collaborating with 12 universities and their sister AI institutes. Faculty members and students won two of four Best Paper Awards and a Best Student Paper Award at NeurIPS 2018.[3]
- Engagement with Industry:
  - Endless Summer Schools - Flagship program for industry sponsors, designed to share knowledge of specific, leading research to assist industry leaders in building and refining AI solutions.
  - AI for Execs - Business-focused and less technical education seminars for senior management to learn about the opportunities of AI from use-cases across industries.
  - Banks Project - Bringing together Canada's largest financial institutions to develop new methodologies and algorithms to prevent financial crime.
- Health Initiatives:
  - Applying machine learning across Ontario's health sector in efforts to make healthcare data research-ready and accessible and improve efficiency across the system.
  - Partnering to develop cutting-edge cardiac care and decipher human disease heterogeneity.
- Education Initiatives:
  - Guidance for AI-related master's programs through a program review panel and program development fund to help offset the cost of developing new curriculum components.
  - Job fair as well as a Deep Learning and Reinforcement Learning Summer School.
  - Future efforts to include internships, merit-based scholarships and networking opportunities.

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[1] Pan-Canadian Artificial Intelligence Strategy. https://www.investcanada.ca/why-invest/pan-canadian-artificial-intelligence-strategy
[2] Vector Institute Annual Report 2018. P. 15: https://vectorinstitute.ai/wp-content/uploads/2018/11/vector_annual_2018.pdf
[3] Vector Researchers Win Top Honors at NEURIPS 2018. https://vectorinstitute.ai/2018/12/04/vector-researchers-win-top-honours-at-neurips-2018/