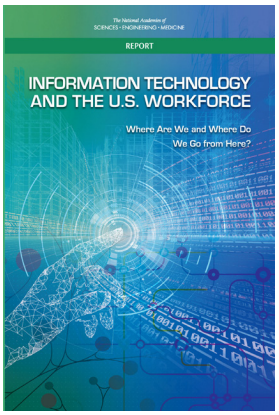
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
TO ACCELERATE TRANSLATIONAL RESEARCH

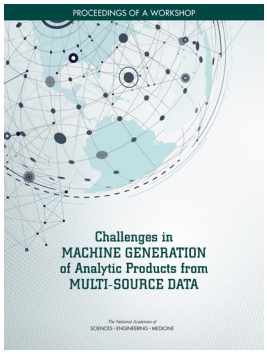
GOVERNMENT-UNIVERSITY-INDUSTRY RESEARCH ROUNDTABLE
February 13-14, 2018
National Academy of Sciences Building
Washington, DC 20418

List of selected reports from the National Academies related to the meeting topic



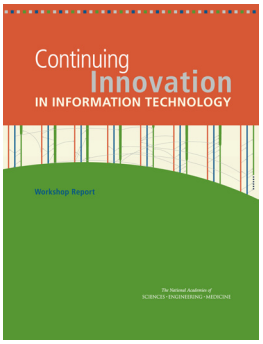
INFORMATION TECHNOLOGY AND THE U.S. WORKFORCE: WHERE ARE WE AND WHERE DO WE GO FROM HERE? (2017)
Recent years have yielded significant advances in computing and communication technologies, with profound impacts on society. Technology is transforming the way we work, play, and interact with others. From these technological capabilities, new industries, organizational forms, and business models are emerging. Technological advances can create enormous economic and other benefits, but can also lead to significant changes for workers. IT and automation can change the way work is conducted, by augmenting or replacing workers in specific tasks. This can shift the demand for some types of human labor, eliminating some jobs and creating new ones. Information Technology and the U.S. Workforce explores the interactions between technological, economic, and societal trends and identifies possible near-term developments for work. This report emphasizes the need to understand and track these trends and develop strategies to inform, prepare for, and respond to changes in the labor market. It offers evaluations of what is known, notes open questions to be addressed, and identifies promising research pathways moving forward.

CHALLENGES IN MACHINE GENERATION OF ANALYTIC PRODUCTS FROM MULTI-SOURCE DATA: PROCEEDINGS OF A WORKSHOP (2017)
The Intelligence Community Studies Board of the National Academies of Sciences, Engineering, and Medicine convened a workshop on August 9-10, 2017 to examine challenges in machine generation of analytic products from multi-source data. Workshop speakers and participants discussed research challenges related to machine-based methods for generating analytic products and for automating the evaluation of these products, with special attention to learning from small data, using multi-source data, adversarial learning, and understanding the human-machine relationship. This publication summarizes the presentations and discussions from the workshop.



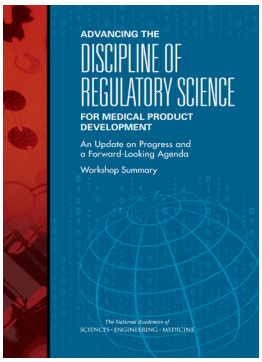
THE FOURTH INDUSTRIAL REVOLUTION: PROCEEDINGS OF A WORKSHOP-IN BRIEF (2017)
In October 2016, the National Academies of Sciences, Engineering, and Medicine held a meeting to consider the Fourth Industrial Revolution and its implications for manufacturing, as well as its likely social and economic effects. The meeting also explored the cross-sector collaboration between government, universities, and industry needed to accommodate emerging developments in the key technologies of the Fourth Industrial Revolution, namely artificial intelligence, virtual and augmented reality, and the Internet of Things. This publication briefly summarizes the presentations and discus sions from the meeting.

The National Academies of | SCIENCES ENGINEERING MEDICINE

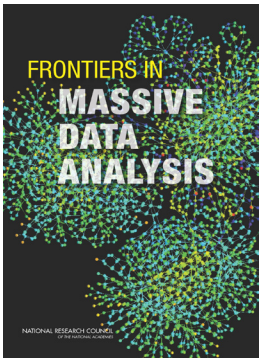


CONTINUING INNOVATION IN INFORMATION TECHNOLOGY: WORKSHOP REPORT (2016)
The 2012 National Research Council report Continuing Innovation in Information Technology illustrates how fundamental research in information technology (IT), conducted at industry and universities, has led to the introduction of entirely new product categories that ultimately became billion-dollar industries. The central graphic from that report portrays and connects areas of major investment in basic research, university-based research, and industry research and development; the introduction of important commercial products resulting from this research; billion-dollar-plus industries stemming from it; and present-day IT market segments and representative U.S. firms whose creation was stimulated by the decades-long research. At a workshop hosted by the Computer Science and Telecommunications Board on March 5, 2015, leading academic and industry researchers and industrial technologists described key research and development results and their contributions and connections to new IT products and industries, and illustrated these developments as overlays to the 2012 "tire tracks" graphic. The principal goal of the workshop was to collect and make available to policy makers and members of the IT community first-person narratives that illustrate the link between government investments in academic and industry research to the ultimate creation of new IT industries. This report provides summaries of the workshop presentations organized into five broad themes - (1) fueling the innovation pipeline, (2) building a connected world, (3) advancing the hardware foundation, (4) developing smart machines, and (5) people and computers - and ends with a summary of remarks from the concluding panel discussion.

BIG DATA AND ANALYTICS FOR INFECTIOUS DISEASE RESEARCH, OPERATIONS, AND POLICY: PROCEEDINGS OF A WORKSHOP (2016)
With the amount of data in the world exploding, big data could generate significant value in the field of infectious disease. The increased use of social media provides an opportunity to improve public health surveillance systems and to develop predictive models. Advances in machine learning and crowdsourcing may also offer the possibility to gather information about disease dynamics, such as contact patterns and the impact of the social environment. New, rapid, point-of-care diagnostics may make it possible to capture not only diagnostic information but also other potentially epidemiologically relevant information in real time. With a wide range of data available for analysis, decision-making and policy-making processes could be improved. While there are many opportunities for big data to be used for infectious disease research, operations, and policy, many challenges remain before it is possible to capture the full potential of big data. In order to explore some of the opportunities and issues associated with the scientific, policy, and operational aspects of big data in relation to microbial threats and public health, the National Academies of Sciences, Engineering, and Medicine convened a workshop in May 2016. Participants discussed a range of topics including preventing, detecting, and responding to infectious disease threats using big data and related analytics; varieties of data (including demographic, geospatial, behavioral, syndromic, and laboratory) and their broader applications; means to improve their collection, processing, utility, and validation; and approaches that can be learned from other sectors to inform big data strategies for infectious disease research, operations, and policy. This publication summarizes the presentations and discussions from the workshop.

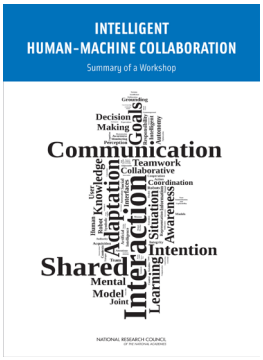


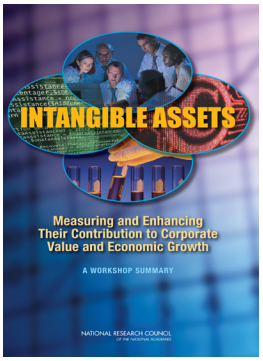
ADVANCING THE DISCIPLINE OF REGULATORY SCIENCE FOR MEDICAL PRODUCT DEVELOPMENT: AN UPDATE ON PROGRESS AND A FORWARD-LOOKING AGENDA: WORKSHOP SUMMARY (2016)
The field of endeavors known as "regulatory science" has grown out of the need to link and integrate knowledge within and among basic science research, clinical research, clinical medicine, and other specific scientific disciplines whose focus, aggregation, and ultimate implementation could inform biomedical product development and regulatory decision making. Substantial efforts have been devoted to defining regulatory science and communicating its value and role across the scientific and regulatory ecosystems. Investments are also being made in technology infrastructure, regulatory systems, and workforce development to support and advance this burgeoning discipline.
In October 2015, the National Academies of Sciences, Engineering, and Medicine held a public workshop to facilitate dialogue among stakeholders about the current state and scope of regulatory science, opportunities to address barriers to the discipline's success, and avenues for fostering collaboration across sectors. Participants explored key needs for strengthening the discipline of regulatory science, including considering what are the core components of regulatory science infrastructure to foster innovation in medical product development. This report summarizes the presentations and discussions from the workshop.



FRONTIERS IN MASSIVE DATA ANALYSIS (2013)
Data mining of massive data sets is transforming the way we think about crisis response, marketing, entertainment, cybersecurity and national intelligence. Collections of documents, images, videos, and networks are being thought of not merely as bit strings to be stored, indexed, and retrieved, but as potential sources of discovery and knowledge, requiring sophisticated analysis techniques that go far beyond classical indexing and keyword counting, aiming to find relational and semantic interpretations of the phenomena underlying the data. *Frontiers in Massive Data Analysis* examines the frontier of analyzing massive amounts of data, whether in a static database or streaming through a system. Data at that scale--terabytes and petabytes--is increasingly common in science (e.g., particle physics, remote sensing, genomics), Internet commerce, business analytics, national security, communications, and elsewhere. The tools that work to infer knowledge from data at smaller scales do not necessarily work, or work well, at such massive scale. New tools, skills, and approaches are necessary, and this report identifies many of them, plus promising research directions to explore. *Frontiers in Massive Data Analysis* discusses pitfalls in trying to infer knowledge from massive data, and it characterizes seven major classes of computation that are common in the analysis of massive data. Overall, this report illustrates the cross-disciplinary knowledge--from computer science, statistics, machine learning, and application disciplines--that must be brought to bear to make useful inferences from massive data.

INTELLIGENT HUMAN-MACHINE COLLABORATION: SUMMARY OF A WORKSHOP (2012)
On June 12-14, 2012, the Board on Global Science and Technology held an international, multi-disciplinary workshop in Washington, D.C., to explore the challenges and advances in intelligent human-machine collaboration (IH-MC), particularly as it applies to unstructured environments. This workshop convened researchers from a range of science and engineering disciplines, including robotics, human-robot and human-machine interaction, software agents and multi-agentsystems, cognitive sciences, and human-machine teamwork. Participants were drawn from research organizations in Australia, China, Germany, Israel, Italy, Japan, the Netherlands, the United Arab Emirates, the United Kingdom, and the United States. The first day of the workshop participants worked to determine how advances in IH-MC over the next two to three years could be applied solving a variety of different real-world scenarios in dynamic unstructured environments, ranging from managing a natural disaster to improving small-lot agile manufacturing. On the second day of the workshop, participants organized into small groups for a deeper exploration of research topics that had arisen, discussion of common challenges, hoped-for breakthroughs, and the national, transnational, and global context in which this research occurs. Day three of the workshop consisted of small groups focusing on longer term research deliverables, as well as identifying challenges and opportunities from different disciplinary and cultural perspectives. In addition, ten participants gave presentations on their research, ranging from human-robot communication, to disaster response robots, to human-in-the-loop control of robot systems. Intelligent Human-Machine Collaboration: Summary of a Workshop describes in detail the discussions and happenings of the three day workshop.





COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE (1997)
The focus of this report is on artificial intelligence (AI) and human-computer interface (HCI) technology. Observations, conclusions, and recommendations regarding AI and HCI are presented in terms of six grand challenge areas which serve to identify key scientific and engineering issues and opportunities. Chapter 1 presents the panel's definitions of these and related terms. Chapter 2 presents the panel's general observations and recommendations regarding AI and HCI. Finally, Chapter 3 discusses computer science, AI, and HCI in terms of the six selected "grand challenge" areas and three time horizons, that is, short term (within the next 2 years), midterm (2 to 6 years), and long term (more than 6 years from now) and presents additional recommendations in these areas.

About the Government-University-Industry Research Roundtable (GUIRR)
GUIRR's mission is to convene senior-most representatives from government, universities, and industry to define and explore critical issues related to the national and global science and technology agenda that are of shared interest; to frame the next critical question stemming from current debate and analysis; and to incubate activities of on-going value to the stakeholders. The forum is designed to facilitate candid dialogue among participants, to foster self-implementing activities, and, where appropriate, to carry awareness of consequences to the wider public.

For more information about GUIRR, visit our web site at www.nas.edu/guirr
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