



Science of Science & Innovation Policy and Understanding Science

Julia Lane



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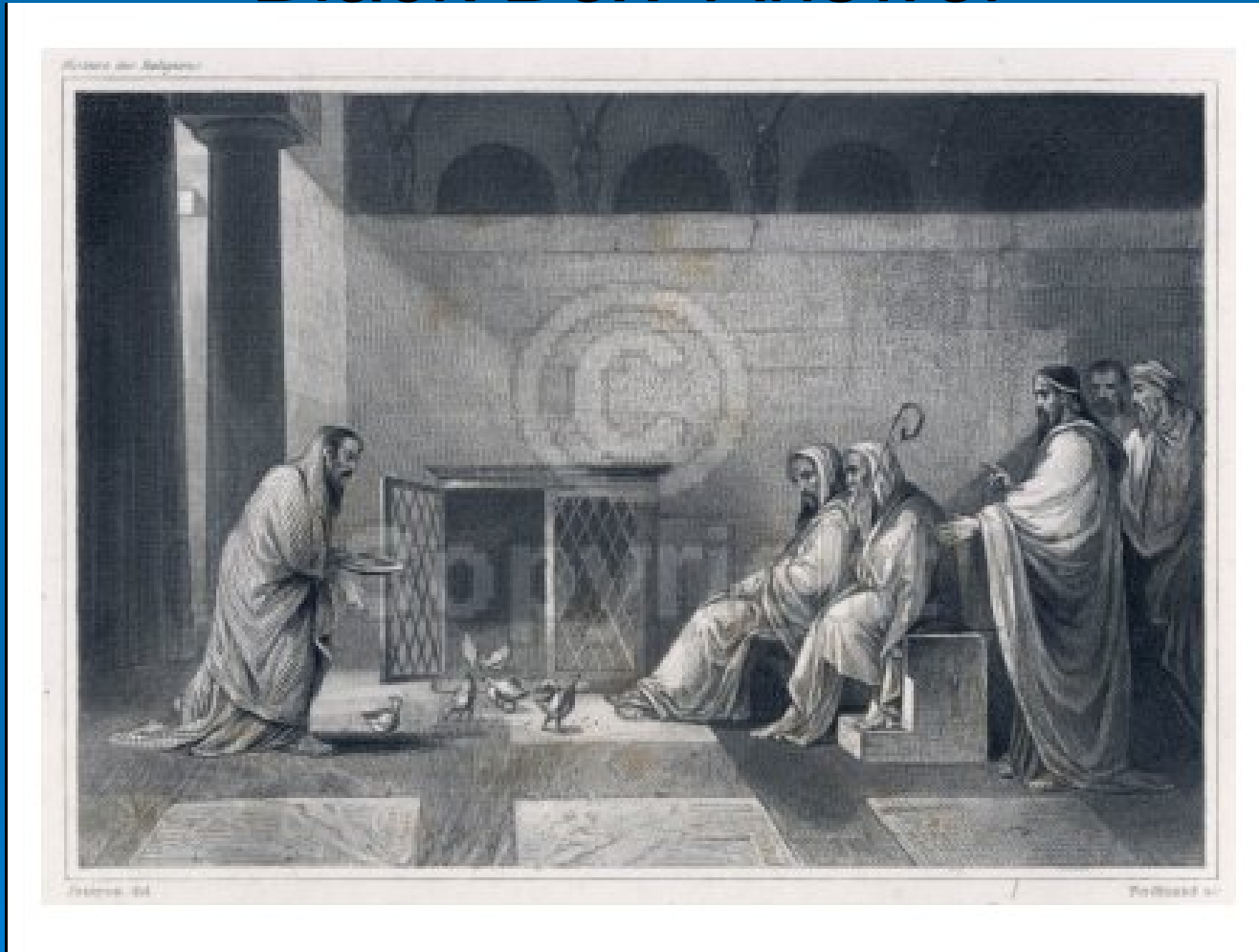


Graphic Source: 2005 Presentation by Neal Lane on the Future of U.S. Science and Technology

Tag Cloud Source: Generated from 2007 Presentation by John Marburger on Science Policy and Budget Issues



Scientists Can Provide a 'Black Box' Answer



ROMAN AUGURS: Roman augurs foretell the future by observing the behavior of hens © Copyright (c) Mary Evans Picture Library 2007



SciSIP Goals

Understanding

develop usable
knowledge and theories

Measurement

improve and expand
science metrics, datasets
and analytical models
and tools

Community of Practice

cultivate a community of
practice focusing on
SciSIP across the
academy, the public
sector and industry



The Challenge: Understanding innovation and the scientific enterprise

- Data Issues
 - Units of analysis?
 - Massive data from heterogeneous sources
- Conceptual issues
 - Creation and transmission of knowledge
 - Complex interactions of actors
- Analytical issues
 - Outcome measures?
 - Counterfactuals?
- Empirical issues
 - Role of standard statistics?



Awards from Solicitation I

- **Human capital development and the collaborative enterprise:**
- **Returns to international knowledge flows**
- **Creativity and innovation:**
- **Knowledge production system:**
- **Science policy implications:**



Awards from Solicitation II

- **Describing the Role of Firms in Innovation**
- **Measuring and Tracking Innovation**
- **Measuring and Evaluating Scientific Progress**
- **Advancing Understanding of Collaboration and Creativity**
- **Knowledge sharing and creativity**
- **Implementing Science Policy**



Awards of interest to this group

- Linking Government R&D Investment, Science, Technology, Firms and Employment: Science & Technology Agents of Revolution (Star) Database (Lynne Zucker and Michael Darby, University of California, Los Angeles)
 - Data creation with links from government investment in R&D through the path of knowledge creation, its transmission and codification; then commercialization
 - NSF, NIH, DoD and DoE grants,
 - All journal articles and citations, high-impact articles, highly-cited authors, UMI ProQuest Digital Dissertations
 - US utility patents (complete/parsed/cleaned),
 - Venture capital, IPOs, web-based firm data, and links to major public firm databases via ticker symbols and/or CUSIP numbers.
 - Concordance linking STAR IDs to the IDs in the Census Bureau's Integrated Longitudinal Business Database (ILBD) and Longitudinal Employer-Household Dynamics (LEHD) program, Census data, for use within the Census Research Data Centers.
 - Dissemination
 - a public graphics-based site primarily oriented toward policymakers and the media,
 - a public site providing access to researchers for downloads and database queries limited to the public constituent databases or aggregates derived from the licensed commercial databases, and
 - on-site access at the National Bureau of Economic Research providing researchers access to the complete STAR Database



Figure 1 – Major Features of the U.S. National Innovation System in the STAR Database: Policy, Innovation, Institutional Processes, and Economic Growth

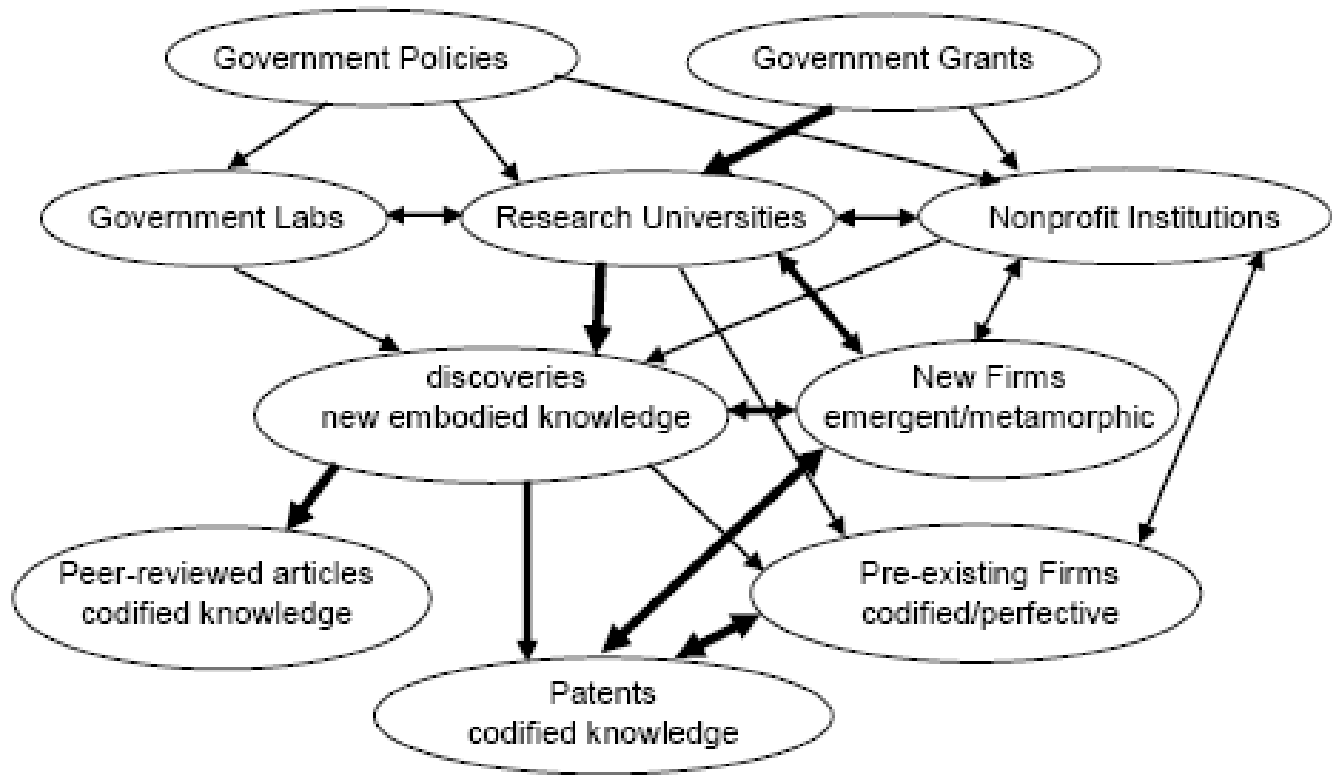
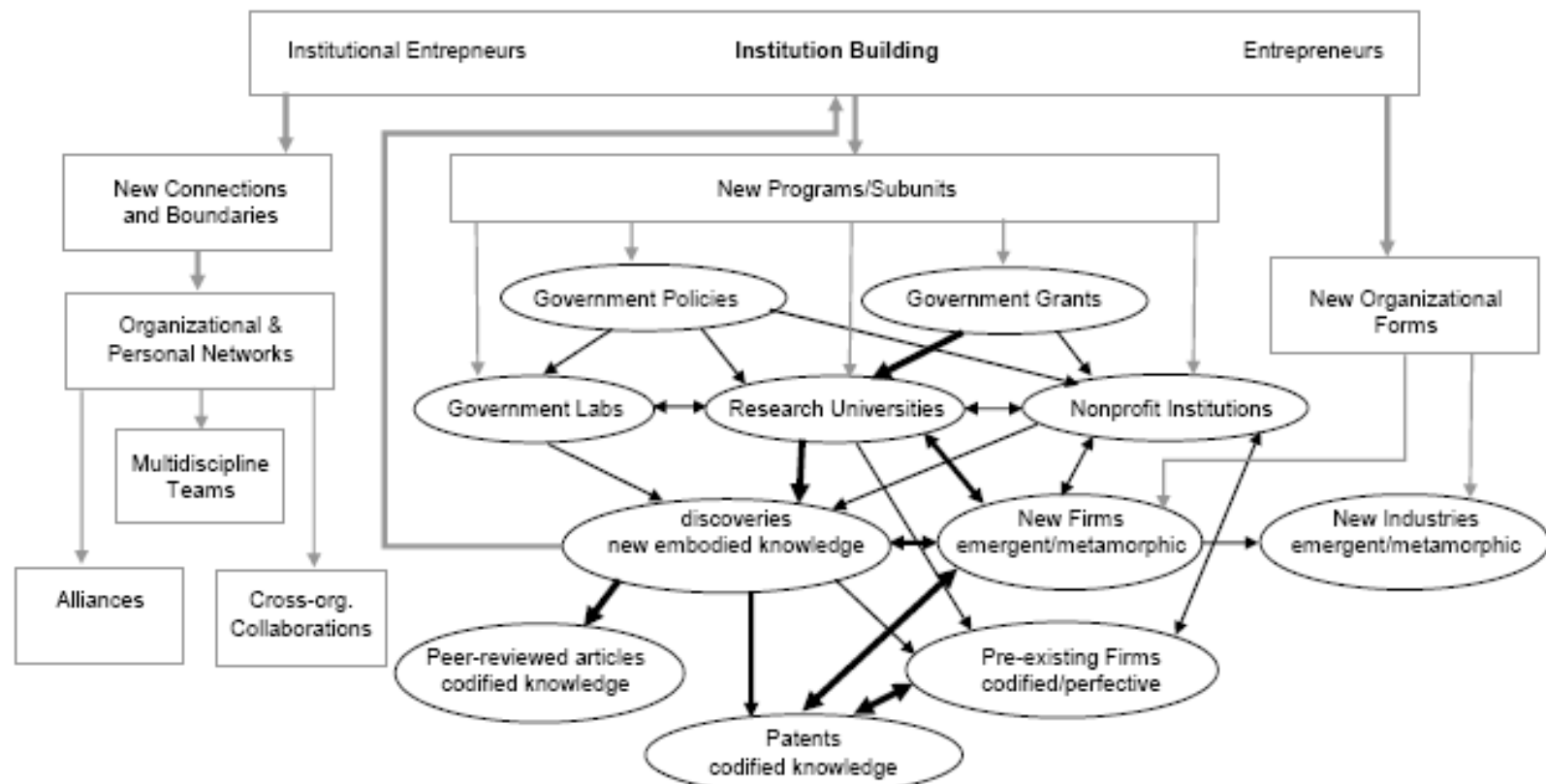




Figure 2 – Institutional Processes in Tandem with Knowledge Creation, Transmission and Use



Note: grey boxes and arrows denote institutional processes



Awards of interest to this group

- A Social Network Database of Patent Co-authorship to Investigate Collaborative Innovation and its Economic Impact (Lee Fleming, Harvard University)
 - Develops a freely available social network database built from all U.S. patent co-authorships since 1963; Complements NBER patent database
 - Unit of analysis at the individual inventor and aggregate levels including organizational, regional, and technological
 - 1) refines inventor identification by encouraging inventors to check the identification algorithm,
 - 2) develops currently unavailable social network variables,
 - 3) makes the relational data easily available via the Harvard-MIT Dataverse infrastructure
 - 4) develops real time capability to visualize patent co-authorship networks.



Figure 1: Bosch carburetor patents, circa 1980 (unpublished, developed with Dan Snow and Venkat Kuppuswamy). Note the difference with Figure 3, in that Bosch is much more collaborative. Nodes represent inventors and node size corresponds to the number of patents. Black nodes represent inventors who work in physical technologies, dark grey nodes represent electronic technologies, and light grey nodes represent inventors in both technologies. Tie width corresponds to the number of co-authored patents. Light grey ties represent later ties, black ties earlier ties, and dark gray ties intermediate



Figure 2: Ford carburetor patents, circa 1980 (unpublished, developed with Dan Snow and Venkat Kuppuswamy). Ford inventors are much more isolated and less collaborative than Bosch inventors illustrated in Figure 1.



Awards of interest to this group

- Modeling Productive Climates for Virtual Research Collaborations (Sara Kiesler, Carnegie Mellon University and Jonathon Cummings, Duke University)
 - Unit of analysis is project-based research collaboration involving researchers from different institutions
 - Studies the institutional environments of a sample of projects that were supported by the National Science Foundation.
 - Examines importance of a productive climate for distributed research collaboration,
 - Traces the linkages among productive climate and the institutional environments of these collaborations.
 - => better metrics for measuring and predicting performance and innovation in collaborations.



Index	Items
Knowledge outcomes ('ideas')	Started new field or area of research; developed new model or approach in field; came up with new grant or spin-off project; submitted patent application; presented at conference or workshop; published article(s), book(s), or proceeding(s); recognized with award(s) for contribution to field(s). Alpha = .63 (7 items)
Tools outcomes ('tools')	Developed new methodology; created new software; created new hardware; generated new dataset; generated new materials; created data repository; created website to share data; created collaboratory; created national survey; developed new kind of instrument; created online experiment site. Alpha = .65 (11 items)
Training outcomes ('people')	Grad student finished thesis or dissertation; grad student/post-doc got academic job; grad student/post-doc got industry job; undergrad/grad student(s) received training; undergrad(s) went to grad school. Alpha = .70 (5 items)
Outreach outcomes ('people')	Formed partnership with industry; formed community relationship through research; formed collaboration with researchers; established collaboration with high school or elementary school students; established collaboration with museum or community institution; established collaboration with healthcare institution. Alpha = .45 (6 items)

Table 1. Project outcomes studied in Cummings & Kiesler, 2007.



Awards of interest to this group

- Dynamics of Creativity and Innovation in Cyber-enabled Scientific Commons (Levent Yilmaz, Auburn University)
 - Agent simulation models
 - (1) considers the discourse of scientific activity, including the contribution of new knowledge in virtual scientific commons, growth of the domain knowledge, and the clustering of research into specialties,
 - (2) views science as an autonomous and self-regulating socio-cognitive system through the introduction of motivation and competitive nature of knowledge production, and
 - (3) explores the impact of alternative community cultures (e.g., exploration-oriented, service-oriented, and utility-oriented), peer evaluation styles (e.g., centralized, decentralized) on the sustainability and innovation potential of SCs.
 - Creates an integrated and customizable agent simulation framework, called SciSIM, for science policy mechanism design and decision analysis for virtual scientific communities to improve sustainable innovation.

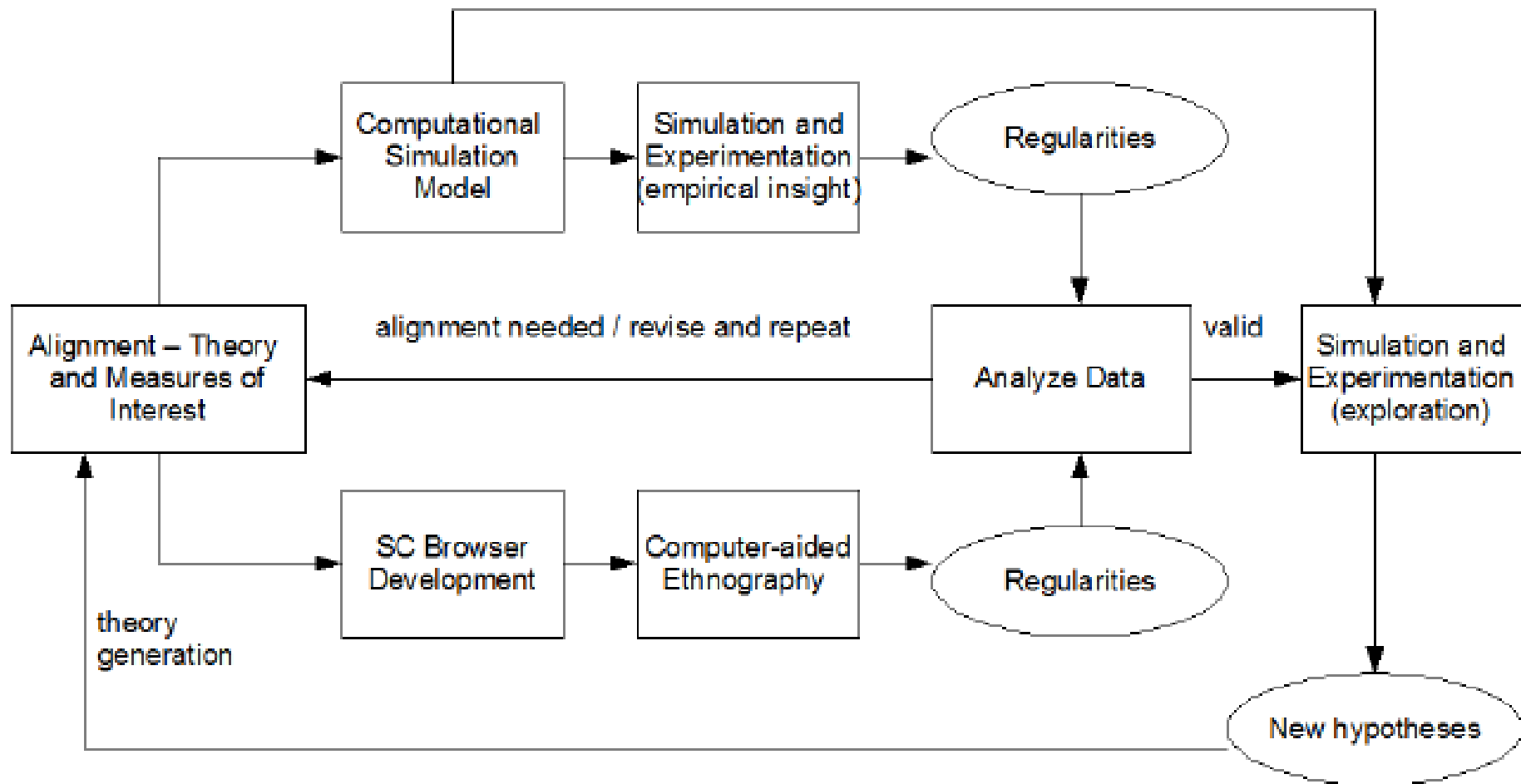


Figure 2: Research Strategy



Awards of interest to this group

- INTEGRATING SOCIAL AND COGNITIVE ELEMENTS OF DISCOVERY AND INNOVATION (CHRIS SCHUNN, UNIVERSITY OF PITTSBURGH)
 - Examines a video data collected from a recent highly successful case of science and engineering, the Mars Exploration Rover
 - Traces the path from the structure of different subgroups (such as having formal roles and diversity of knowledge in the subgroups) to the occurrence of different social processes (such as task conflict, breadth of participation, communication norms, and shared mental models) to the occurrence of different cognitive processes (such as analogy, information search, and evaluation) and finally to outcomes (such as new methods for rover control and new hypotheses regarding the nature of Mars).

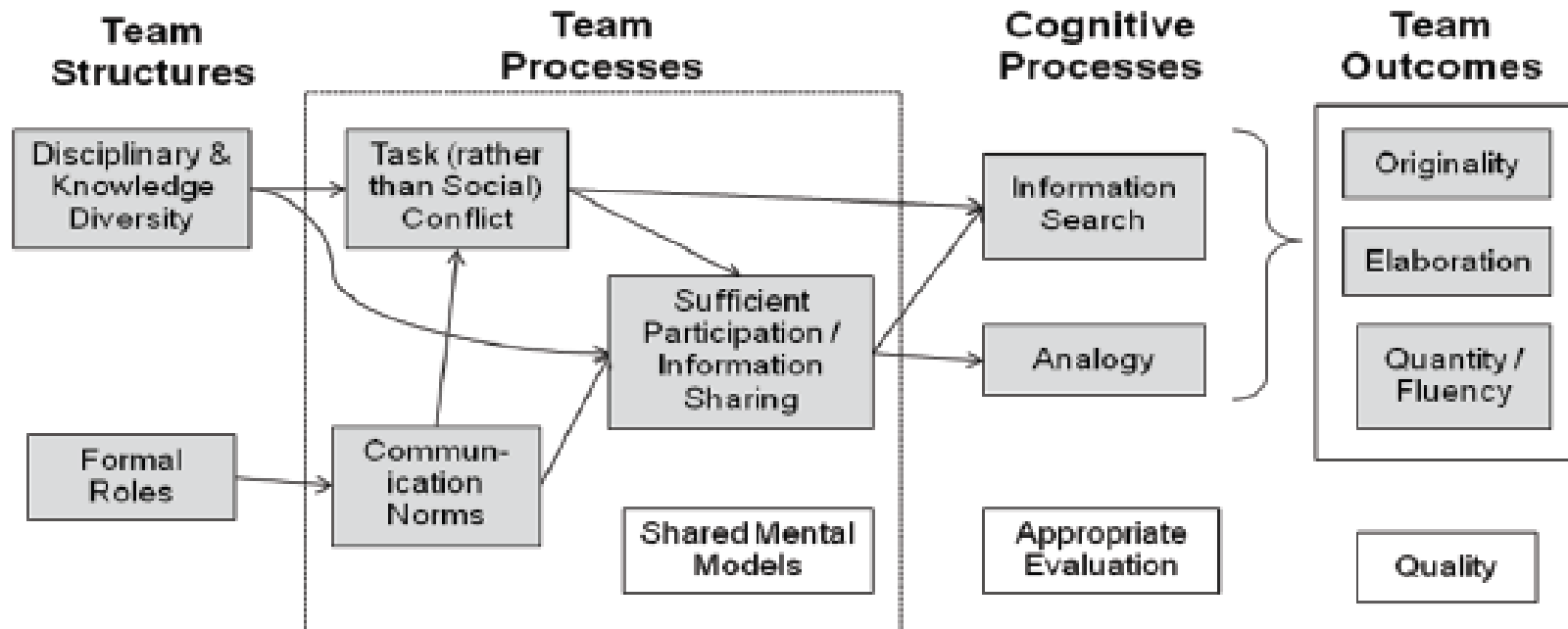


Figure 1: Hypothesized Social-Cognitive Pathways of Team Divergent Thinking

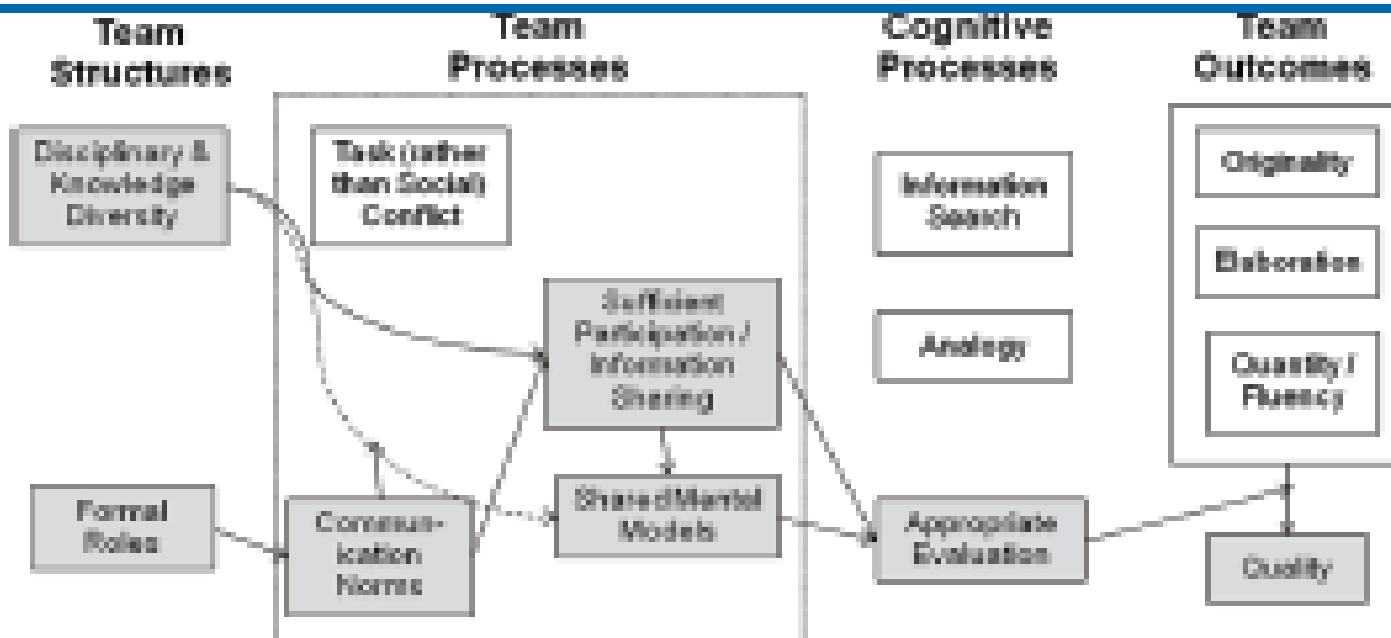
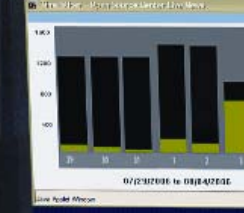
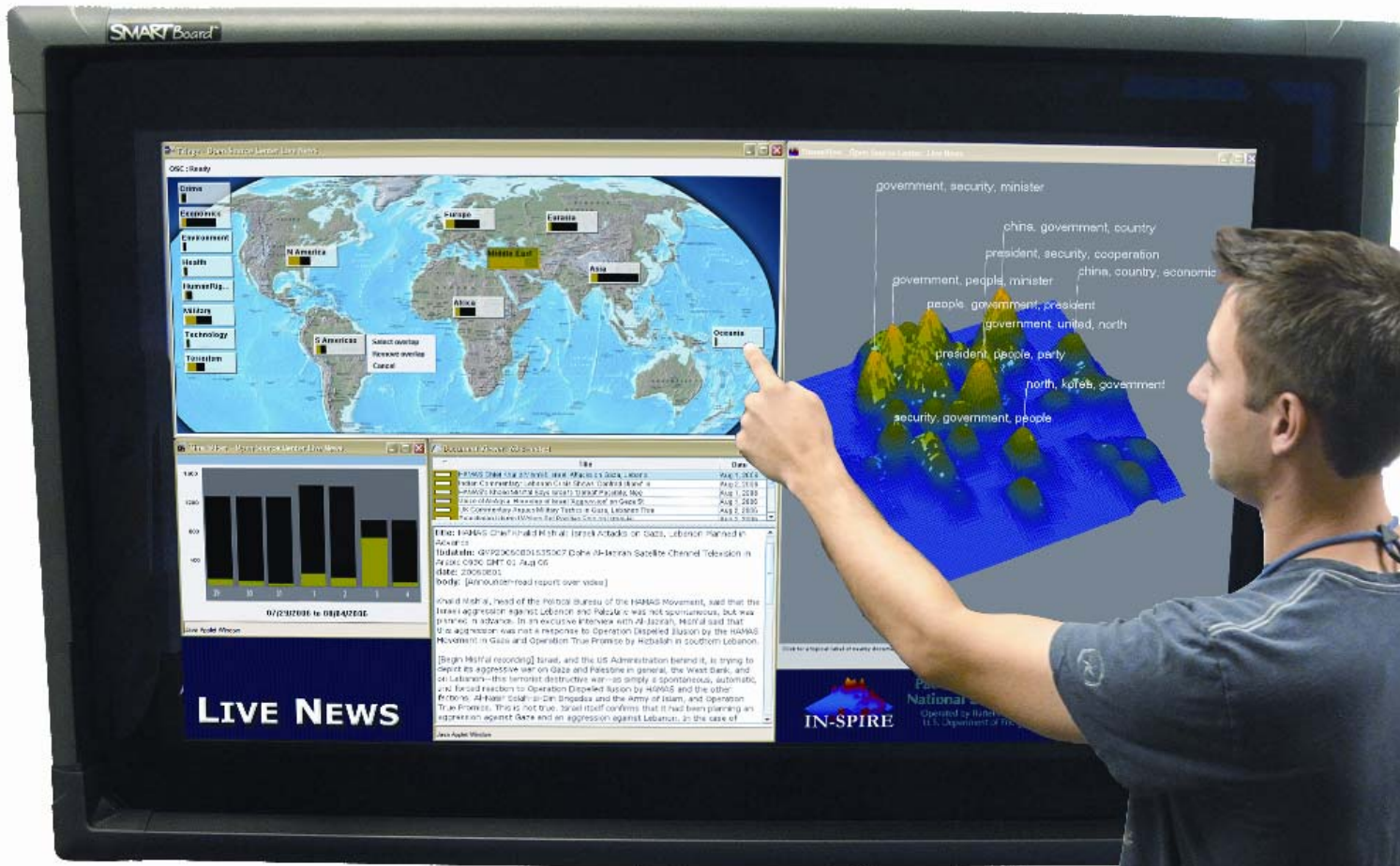


Figure 2: Hypothesized Social-Cognitive Pathways of Team Convergent Thinking



Solicitation III

- Testbeds on Organizations and Innovation
- Visualization (drawing particularly on visual analytics)
- International Collaborations



LIVE NEWS

government, security, minister
china, government, country
president, security, cooperation
government, people, minister
china, country, economic
people, government, president
government, united, north
president, people, party
north, kofes, government
security, government, people

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U.S. Department of Energy



SciSIP Milestones

➤ Longer term:

- An evidence-based understanding of the impacts of the S&E enterprise
- A capacity to better nourish and harness the capabilities of the national STEM workforce
- The development of a Community of Practice



Thank you!

Comments and questions invited.

For more information please contact:

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