Information/Knowledge Management

NIST 2010

Hratch G. Semerjian

VCAT Meeting

June 4, 2002

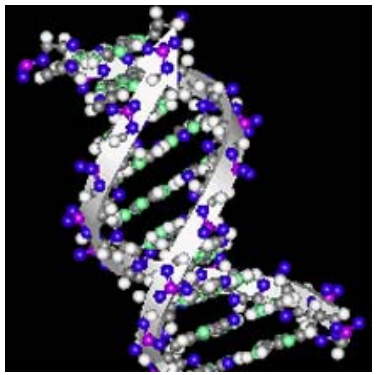
Scope

IKM is broadly viewed to include the future research and development needed for the general *creation and sharing of knowledge*. This would include the creation of new knowledge using a variety of data types and approaches, integrating intelligence into systems, and developing both interoperable and adaptable information systems.

IKM : Major External Trends

Trend 1: Demand for high-powered intelligent interconnected systems will be ubiquitous by 2010, impacting every sector of the economy

Trend 2: Sharing and collaboration will be of increasing importance as a competitive strategy



Trend 3: Dramatic increases in scientific data and information collection will constrain innovation unless advances in critically evaluated data, virtual measurements, and data management & mining co-evolve.

IKM Thrust Areas

- Address industry's future infrastructure needs for integrating applications and systems through standards and performance metrics
- Facilitate effective sharing and collaboration through interoperability standards and common semantics, metrics, tests, and reference implementations
- Advance critically evaluated data and data management technologies to meet current and future industry requirements

Comments from External Reviewers

- "Information standardization and interoperability enablement has the potential of accelerating our development activities and advancing the introduction of new advance technology from our research organization" *Johnny G. Barnes, VP, Global IT Infrastructure, Office of the IBM CIO*

- "This is important work ... if conducted it has the potential to keep us from strangling on our exponentially increasing data resources. I believe that we (Intel) are characteristic of a wide range of organizations that all suffer with the same data mining/information translation issues. To move us forward will be a significant impact to corporate America". *Jim Zurn, Intel*

- "Introducing a robust expert system to provide the "best" recommended values based on experimental data, validated estimation, molecular simulation, or whatever other appropriate resource is available, would be a huge step forward", *James Olson, Thermal Group, Analytical Sciences, The Dow Chemical Company*

- "I congratulate NIST for conceiving this focus project. I am confident that you would produce a product consistent with your [NIST] usual quality output, and that US industry would benefit immeasurably from its availability", *Kenneth R. Hall, Jack E. and Frances Brown Chair, Chemical Engineering Department, Texas A&M University*

Comments from External Reviewers (Cont'd)

- "The opportunities outlined for NIST by the 2010 timeframe are well targeted and directly apply to the need of the anticipated new generations of machines….. NIST's role in supporting and promulgating the standards is essential for the realization of the potential intelligent manufacturing systems of the future", *Anthony Barbera, Technical Director, Robotics and Automation Division, Advanced Technology and Research Corp*

- "Let me answer your second question first. The work proposed is critically needed. The role NIST must play is central, involving setting standards for shared knowledge networks, for shared ontologies, and for objective evaluation of competing approaches", *Gary Strong, Program Director, Experimental and Integrative Activities Division, and Intelligent Systems Division*, *NSF*

- "'Is there a unique role for NIST in this area? Yes, NIST has core competencies that it can leverage to impact America's (and the world we lead) ability to accelerate technology, commerce and profitability", *Jim Zurn, Intel*

- "I will answer your second question "is the work needed?" with a very emphatic yes. I believe in this effort as it is an all important aspect of my business", *James Etro*, *Verizon*

IKM: Strategic Opportunities

Infrastructural technologies for intelligent interconnected systems:

- standards, tools, and technologies to enable self-integrating systems of all types
- performance metrics and tests, and standards for intelligent systems and interfaces
- standards and test data for advanced device and human/computer displays and interfaces
- standards and security for autonomous and self-organizing software agent systems
- frameworks and standards for semantics within and across technical domains
- advanced high-capacity and adaptable network and communication technologies

Interoperability technologies for collaboration and sharing:

- performance metrics and tests, and standards for collaborative systems
- human/computer interface standards, test data, and reference implementations
- tools, semantics, reference implementations, and standards for data integration
- standards and specifications for autonomous discovery using software agent systems
- common frameworks for data integration with embedded metadata
- advanced high-capacity and adaptable network and communication technologies

Critically evaluated data, virtual measurements and intelligent data management:

- dynamic scientific data generation with embedded uncertainty measures and metadata
- intelligent scientific data management and data mining
- virtual scientific measurements through computational methods
- validated approaches using computational modeling and uncertainty estimation
- standards and methods for deriving meaning from incomplete or imperfect information
- performance metrics and tests, and standards for measurement systems using knowledge-based techniques

IKM: NIST Impact

- Improve R&D productivity
- Improve manufacturing productivity and reduced cycle time
- Improve health care quality and infrastructure
- Enhance general business productivity and decision quality
- Facilitate integration and resolve interoperability issues that are now dealt with by industry on a “spot” basis.
- Respond to immediate and long-term integration and interoperability challenges identified for homeland security and national defense

IKM: Potential Impact

Retrospective evidence of NIST's impact in this arena:

- NIST Alternative Refrigerants Research Program: Chemical data research from 1987-1996 resulted in a 433% internal rate of return.
- Economic Impact Assessment of STEP (in process): Manufacturers in the automotive supply chain are currently benefiting by approximately $67M annually from use of Standards for the Exchange of Product Model Data (STEP)
- In the automotive industry alone, which in 1998 accounted for $104B in the U.S. Gross Domestic Product, the cost of imperfect interoperability of design and manufacturing systems in its supply chain was found to be $1B/annum, conservatively

Prospective areas of future successes:

- Significant growth expected in bioinformatics from high-throughput techniques, genomics & proteomics, and homeland security and health care related activities
- Economic Impact Assessment of STEP reported future mitigation and cost avoidance savings of $390M (report in process) based on STEP standards currently in the pipeline and impact of intelligent control of machine tools at $30B over the 2010-2020 time frame

Leveraging the Federal R&D investment:

- Complements new Federal R&D investments in information exploitation for Homeland Security
- Fills a critical technology need in the Federal IT R&D portfolio ($1.6B)

External Reviewer's Comments on the Final IKM Report

- "The main challenges of Information Technology (IT) have been well articulated and identified. This field has become an area where often diverse solutions are being formulated and thus there is not uniform technology standards and language. NIST will have a challenge to insure they stay ahead of the curve in the IT area, so best practices and methodologies are developed at NIST which allow for maximum US industry and government impact", *Lou Ann Heimbrook,* ***Merck***

- "I'm very enthused about NIST taking a leadership role in research and standards setting in the area of information technology. Standards are imperative if we are to realize the full benefits of the information revolution", *Hal Varian,* ***U.C. Berkeley***

- "I found your report to be insightful and thorough and its goals to be right on target", *Andy Kirk, Rohm and Haas Knowledge Center,* ***Rohm and Haas***

- "Data management and the infrastructure of information technology is at the heart of all major high technology research, development, and manufacturing efforts", *Lou Ann Heimbrook,* ***Merck***

- "I am delighted that NIST has chosen Information/Knowledge Management as one of its strategic focus areas. This will be one of the critical technology areas for the US economy in the 2002-2010 time period. Please keep me informed on your progress", *Syed Shariq,* ***Stanford U.***