

Cyber-enabled Discovery and Innovation (CDI)

Objective:

Enhance American competitiveness by enabling innovation through the use of computational thinking



Cyber-enabled Discovery and Innovation

- Multi-disciplinary research seeking significant advancement of more than one field of science or engineering, through innovations in, or innovative use of, **computational thinking**
- Computational thinking refers to computational...
 - ...Concepts
 - ...Methods
 - ...Models
 - ...Algorithms
 - ...Tools

CDI is Unique within NSF

- five-year initiative
- all directorates, programmatic offices involved
- to create *revolutionary* science and engineering research outcomes
- made possible by innovations and advances in computational thinking
- emphasis on bold, multidisciplinary activities
- radical, paradigm-changing science and engineering outcomes through computational thinking

CDI Philosophy

- ▶ “Business as usual” need not apply
 - *“Projects that make straightforward use of existing computational concepts, methods, models, algorithms and tools to significantly advance only one discipline should be submitted to an appropriate program in that field instead of to CDI.”*
- ▶ No place for incremental research
- ▶ Untraditional approaches and collaborations welcome

NSF Review Criteria

- Intellectual Merit
- Broader Impacts
- **New on Transformative Research:** to what extent does the proposed activity suggest and explore creative, original, **or potentially transformative** concepts?

Additional CDI Review Criteria

- The proposal should define a bold multidisciplinary research agenda that, through computational thinking, promises paradigm-shifting outcomes in more than one field of science and engineering.
- The proposal should provide a clear and compelling rationale that describes how innovations in, and/or innovative use of, computational thinking will lead to the desired project outcomes.
- The proposal should draw on productive intellectual partnerships that capitalize upon knowledge and expertise synergies in multiple fields or sub-fields in science or engineering and/or in multiple types of organizations.
- Potential for extraordinary outcomes, such as
 - revolutionizing entire disciplines,
 - creating entirely new fields, or
 - disrupting accepted theories and perspectives
... as a result of taking a fresh, multi-disciplinary approach.

Special emphasis will be placed on proposals that promise to enhance competitiveness, innovation, or safety and security in the United States.

Long-term Funding for Cyber-enabled Discovery and Innovation

- ▶ All NSF directorates are participating in this activity (*subject to budget approval*)

Request FY 2008	FY 2009	FY 2010	FY2011	FY 2012
\$52M (min of \$26M in the solicitation)	\$100M	\$150M	\$200M	\$250M

Three CDI Themes

CDI seeks transformative research in the following general themes, via innovations in, and/or innovative use of, computational thinking:

- **From Data to Knowledge:** *enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data;*
- **Understanding Complexity in Natural, Built, and Social Systems:** *deriving fundamental insights on systems comprising multiple interacting elements;* and
- **Building Virtual Organizations:** *enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries.*

From Data to Knowledge

- Knowledge extraction, noise, statistics
- Modeling, data assimilation, inverse problems
- Validation; model/cyber/domain feedbacks
- Algorithms for analysis of large data sets, dimension reduction
- Visualization, pattern recognition

Understanding Complexity in Natural, Built, and Social Systems

Identifying general principles and laws that characterize complexity and capture the essence of complex systems

Attaining the breakthroughs, to overcome these challenges, requires transformative ideas in the following areas:

- Simulation and Computational Experiments
- Methods, Algorithms, and Tools
- Nonlinear couplings across multiple scales

Virtual Organizations (VOs)

Design, development, and assessment of VOs

Bringing domain needs together with algorithm development, systems operations, organizational studies, social computing, and interactive design

Flexible boundaries, memberships, and lifecycles, tailored to particular research problems, users and learner needs or tasks of any community, providing opportunities for:

- Remote access
- Collaboration
- Education and training

Types of Projects

- ▶ CDI defines research modalities
- ▶ Project size not measured by \$\$
- ▶ Projects classified by magnitude of effort
- ▶ Three types are defined: Types I (~2 PI, 2 GRA), II (~3 PI, 3 GRA, 1 post-doc), and III (center scale)
- ▶ Type III, center-scale efforts, will not be supported in the first year of CDI

Key Dates and URL:

- Letters of Intent (required) due: Nov 30, 07
- Preliminary Proposals due: Jan 8, 08
- Full proposals due: April 29, 08
 - Full proposals **by invitation only!**
- Awards: no later than October 2008

- For more information:
 - Solicitation:
<http://www.nsf.gov/pubs/2007/nsf07603/nsf07603.htm>
 - FAQ, examples, resources:
<http://www.nsf.gov/crssprgm/cdi>

Questions? Comments?

