# European Grid Adoption: Initial Findings

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# Goals of European Grid Adoption Study

- 1. To analyze the impact of European research initiatives including support from the European Commission, the Enabling Grids for E-Science (EGEE) and other European Grid efforts on Grid research, infrastructure evolution, and commercial grid adoption in Europe.

- 2. To identify future infrastructure needs in Europe based upon the growing adoption of Grids for research and business use.

- 3. To analyze the pattern of commercial Grid adoption that is likely to occur in Europe
  - What industries are likely to be the early adopters?
  - What impact Grid use will have on these industries and on Europe's economies?

# Groups Analyzed for Study

- 1. <u>Researchers</u> using new applications and that may require networks to offer higher levels of performance and increasingly sophisticated ways to manage bandwidth.

- 2. <u>Infrastructure providers</u>, both research networks and commercial service providers, that are planning to meet new demands from both the research and the business community.

- 3. <u>Commercial users</u> that are beginning to adopt Grids and will need either:

  - a. Managed Grid services that are provided by telcos and other vendors that provide an on-demand solution for Grids, or

  - b. Infrastructure that will support Enterprise Grids that link different groups within a single firm or connect Enterprise Grids in a single firm with an Enterprise Grid from one of its suppliers (creating a Partner Grid).

# Main Parts of Study

- Phase 1: <u>Grid application adoption</u> in autos, aerospace and financial services, and the impacts of this use on networks.
  - This work will last from June 2006 to September 2006.

- Phase 2: <u>Grid application adoption</u> on pharmaceuticals, telcos, and electronic design firms and their expected need for improved networks.
  - This work will last from October 2006 to December 2006.

- Phase 3: How research users and academic networks such as GEANT2 expect <u>Grids to place</u> <u>new demands on networking infrastructure.</u>
  - This work will last from January 2007 to April 2007.

# Deliverables/Products of Study

- A Special Report on how Grids will affect European communications infrastructure.
  - A first draft of this report will be available in November or December 2006. A final report should be completed by April 2007.
- A Written Report on how European Grid research is likely to evolve and the impacts it will have on infrastructure and commercial Grid adoption.
  - A draft of this report will be available by December 2006. A final report should be completed by May 2007.
- A Written Report on commercial Grid adoption in Europe based upon a study of industries that are leading European Grid adoption, such as financial services, aerospace, autos, electronic design automation health care, computers, and pharmaceutical industries.
  - A draft of this report will be available by January 2007. A final report should be published by June 2007
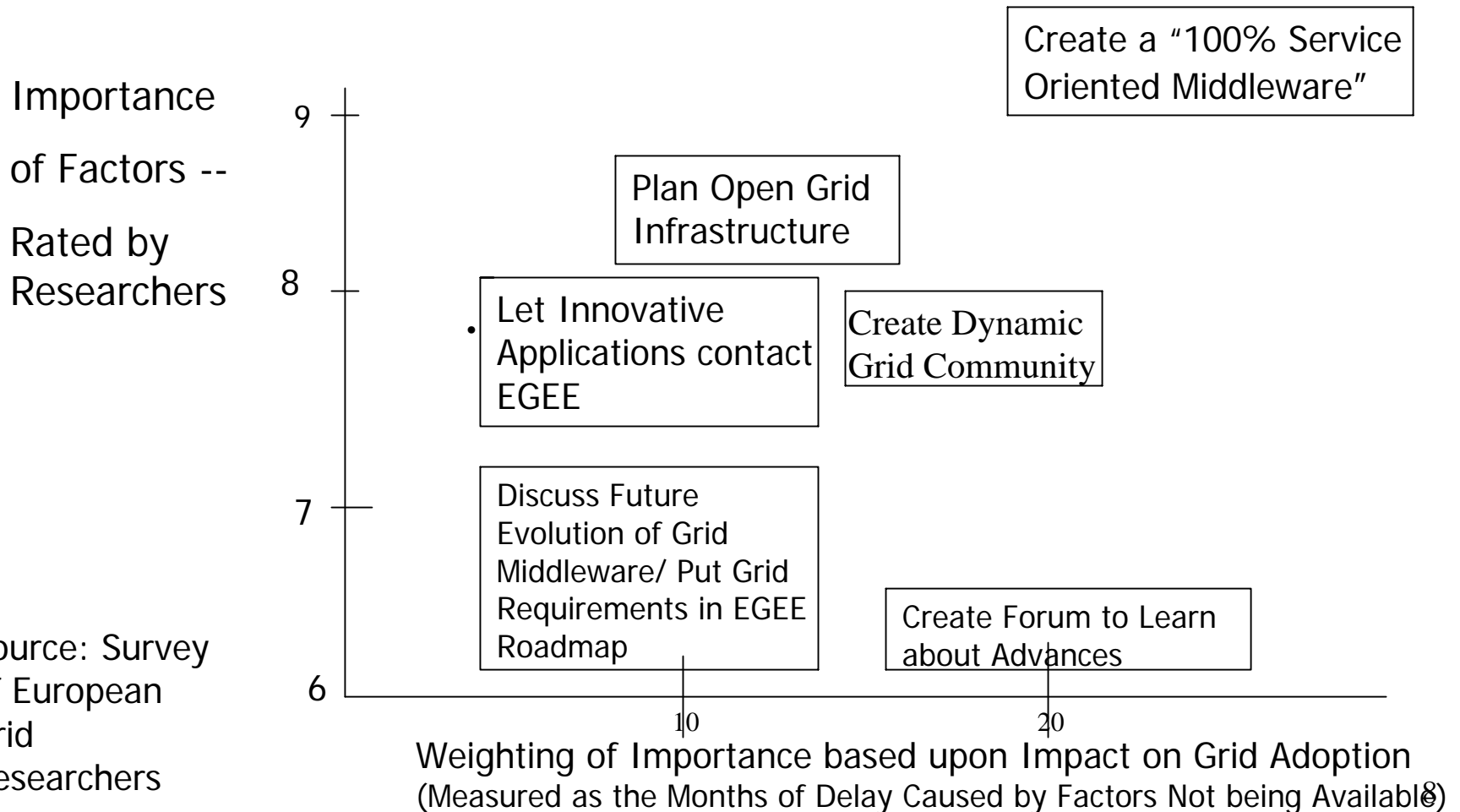
# What Factors Promote Grid Adoption?

- We developed a questionnaire to ask European Researchers what factors promote Grid adoption.

- We asked about how much of a delay not having these factors in place might cause - to identify their impact

  - The initial results show 4 factors are quite important
  - ***Adding the delay brings out the importance of one key factor, having an "Absolute 100% Service Oriented Middleware" that operates on Many Platforms.***

- This illustrates the importance of a basic, open platform that is needed before Grid adoption accelerates.

# Most Important Factors Driving Grid Adoption

- Rank (Out of 10)

- 1. Create an "Absolute 100% Service-Oriented Middleware" that operates on many platforms        9.2

- 2. Plan for future Usage of the EGEE Grid Infrastructure that operates on many platforms        8.2

- 3. Create a Dynamic Grid User Community        8.0

- 4. Provide an Opportunity for Innovative Applications to Establish Contacts with EGEE        7.8

# What Factors Drive Grid Adoption?

Importance

of Factors --

Rated by
Researchers

Source: Survey
of European
Grid
Researchers

Create a "100% Service Oriented Middleware"

9

Plan Open Grid Infrastructure

8

Let Innovative Applications contact EGEE

Create Dynamic Grid Community

7

Discuss Future Evolution of Grid Middleware/ Put Grid Requirements in EGEE Roadmap

Create Forum to Learn about Advances

6

10                    20

Weighting of Importance based upon Impact on Grid Adoption
(Measured as the Months of Delay Caused by Factors Not being Available)

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# Findings About Technologies and Applications

- We found that two main technologies for Grids would move most rapidly to commercial adoption:
    - Authentication and Authorization
    - Collaboration Tools and Environments
  - Researchers believe that the need for security and collaboration are key drivers
- We found that Grid applications were most likely to be commercialized most rapidly in two industries:
    - Life Sciences
    - Finance
  - These are two areas that have seen extensive commercial use of Grids

# Technologies That will Move Rapidly to Commercial Adoption

- 
                                                          Rank
- 1. Authentication and Authorization    8.5
- 2. Collaboration Tools and Environments                                7.3
- 3. Software Life Cycle Management    6.0
- 4. Grid Enabled Instruments           5.5
- 5. Middleware Repositories             5.3

Source: Survey of European Grid Researchers

# Applications that will Move Most Rapidly to Commercial Adoption

-                                                            Rank
- Life Sciences                               8.0
- Finance                                        7.7
- Computationally Intensive Chemistry          6.8
- Digital Libraries                        5.3
- High Energy Physics               4.6

Source: Survey of European Grid Researchers

# How Researchers Believe Grids will affect their Use of Bandwidth

- Grids will let Researchers use more collaborative environments and increase their demand better latency and QoS.

- Grids will result in considerable growth in bandwidth demand.

- Bandwidth demand will be driven by using Virtual Grids between different research centers and by apps requiring large data flows.

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# How will Grids, Virtualization and SOAs Affect the Way Research Groups Use Infrastructure?

- Score
- 1. Require better latency, QoS        8.5
- 1. Require collaborative environments keeping many points using Grids up at the same time                8.5
- 3. Require control of optical backplanes                7.0

Source: Survey of European Grid Researchers

# Grids will Increase Research Groups' Broadband Demand

- Change per year, 2005-6     10%
- Change per year, 2007-8     20%
- Change per year, 2009-10   30%
- Change per year, 2011-12   40%


- These dramatic changes in bandwidth imply far greater collaboration between research groups and more use of sensor/data collection networks. This is supported by the results from the next slide.

Source: Survey of European Grid Researchers

# Factors With the Biggest Impact on Research Groups' Broadband Use

- Rank

- Using Virtual Grids between different research and product development centers                7.5

- Use of Wide Range of applications requiring Large Data Flows          7.5

- Widespread Use of Grids Virtualization, SOAs                5.5

# Towards a New Grid Adoption Model

- Most analysts find that Grid adoption is based upon increasing IT complexity and Grids expanding across the organization. See the IBM Model.

- NEC has proposed a model where firms adopt Grids as part of an effort to move to on-demand compute resources and on-demand services.

- The Grid Pyramid is an alternative model. We have seen this model in the auto and aerospace industry, as well as in telecom. It suggests <u>Grid adoption is to manage complexity that arises because of the power that computational resources offer to the corporation.</u>

    - We present this model below.

# Accepted Model of Grid Adoption

**Increasing IT Complexity**

Virtualized Applications

Service Grid

Data Grid

Computing Grid

Infrastructure Optimization

PARTNER GRIDS let firms interact/transact with customers, suppliers and partners. Permit work with same data between firms.

ENTERPRISE GRIDS let firms improve business processes

COMPUTE GRIDS let organizations gain more value from IT

Departmental Grid   Campus Grid   Enterprise Grid   Partner Grid
Infra-Grid          Intra-Grid    Extra-Grid        Inter-Grid

**Increasing Organizational Complexity**

# NEC Model of Grid Adoption:
## Services and Compute Resources On-Demand



Source: NEC slide provided to author for Japan Grid Adoption study.
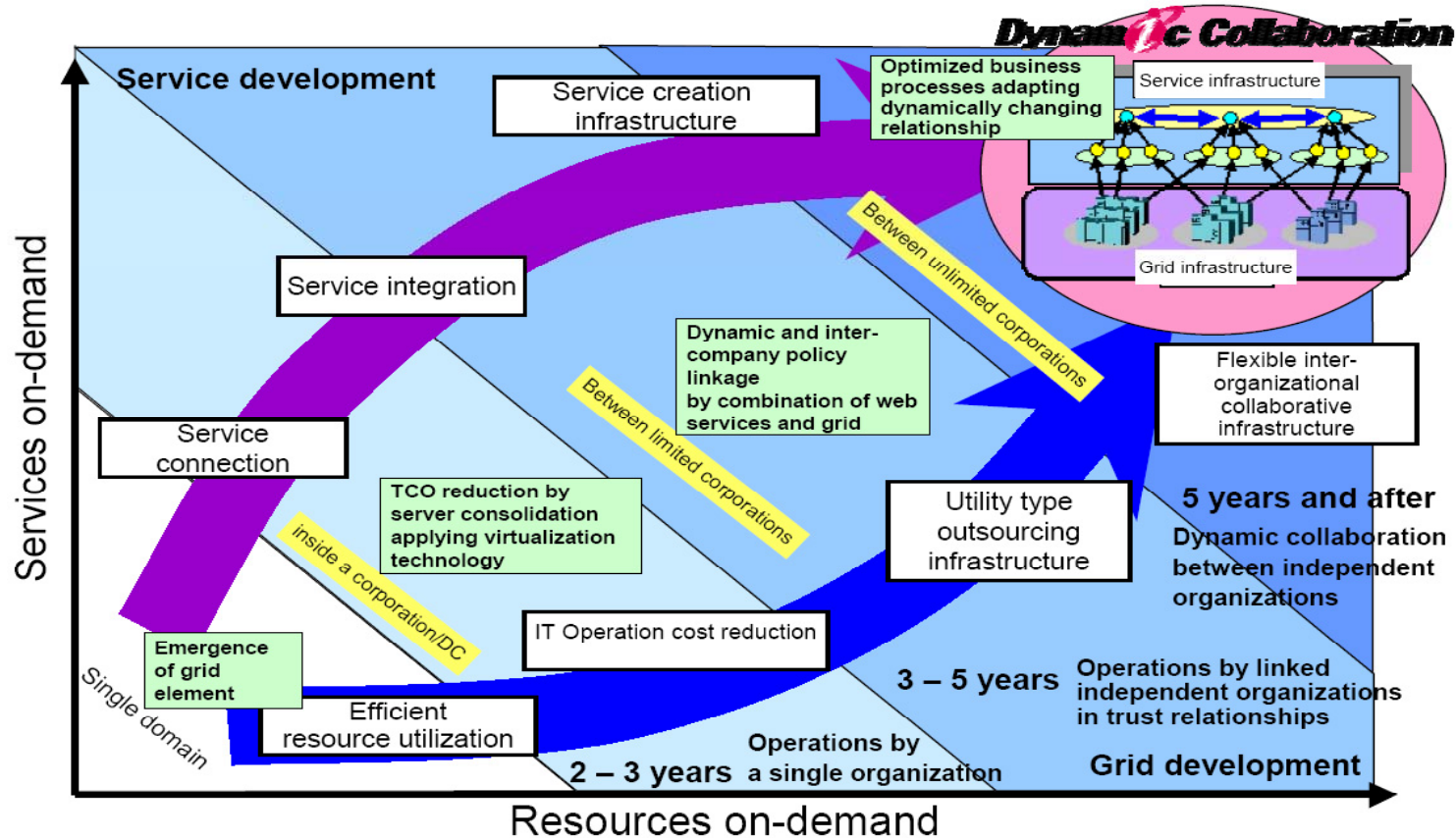
# The Grid Pyramid

Layer 3: Management of Most Complex Tasks. Links to Semantic Web and More Logical Services

Layer 2: Management for More Complex Tasks: Links into SOAs and Web Services

Layer 1: Grid Computing Layer -- Plugs into other Grid Products and Grid Enabled Applications

# Grid Pyramid for Aerospace Firms



Increasing Complexity and Management Requirements

Layer 3. NOT YET CREATED. A "Master Coordinator" for computational and product development.

Layer 2. NOT YET CREATED. To handle more complex tasks, such as identifying critical parameters that need to be changed in an overall model of the aircraft or a subsystem.

Layer 1. Design and Performance Simulations Using Grids at the Department Level. Thousands of Simulations Performed Each Day but Isolated from "Master Product Model."

# Initial Conclusions

- Analysis of European researchers' views suggests that:

- 1. Grid commercialization will move ahead rapidly once an "Absolute 100% Service Oriented Middleware" is created.

- 2. Security and collaboration tools are among the most important technologies that will speed Grid adoption.

- 3. Grids will have considerable impacts on how Researchers use broadband, creating a growth in demand of 40% a year by 2011-12.

- 4. A Grid Pyramid may be a better way to model Grid Adoption than previous models. It deals with the management of complexity more explicitly.