prepared for WETICE96

Value-added Services on the WEB

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Abstract

To exploit existing and potential resources on the Web for effective engineering a number of services are needed.

We will indicate some of the opportunities and prerequisites for such services.

Collaboration, security, and payment schemes are some of the issues.

Many traditional relationships among consumers and vendors will change.

Reliable predictions are not possible, but exploring the range of choices is a challenge in itself.

Industry Needs Information

- Engineering and Manufacturing
  ✔own capability ↑ suppliers' capabilities
  ✔demand ↑ global demand
- Distribution and Transportation
  ✔costs for alternate means of shipping
- Finance
  ✔project demand ✓ project cost of funds
- Marketing and Service
  ↑taste and style ↑ demographics

more from remote sources

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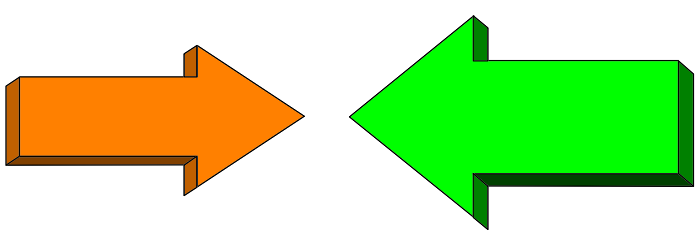
Information Leverage

Tactical
- Customers
- Inventory
- Suppliers

Strategic
- Planning
- Capabilities
- Opportunities



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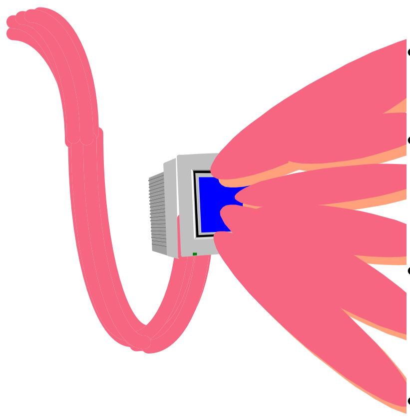
Information Data overload starvation



- More databases
  - public & corporate
- Faster communication
  - digital
  - packeting: TCP-IP, ATM
- World-wide connectivity
  - internet
  - world-wide web
- Disintermediation
  - ubiquitous publishing

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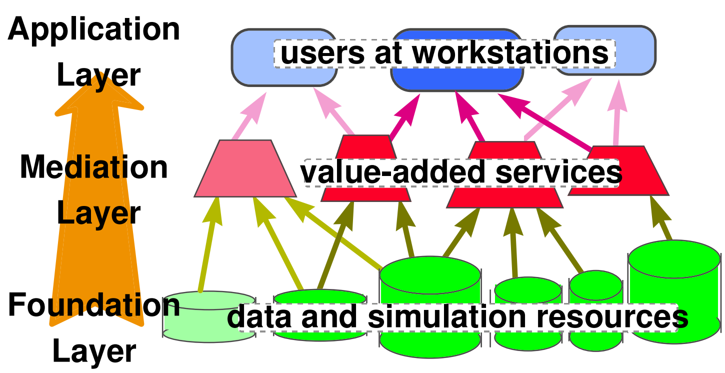
Transforming Data to Information



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Definition*

A *mediator* is a software module that exploits encoded knowledge about certain sets or subsets of data to create information for a higher layer of applications.

It should be small and simple, so that it can be maintained by one expert or, at most, a small and coherent group of experts.

* Wiederhold: IEEE Computer March 1992

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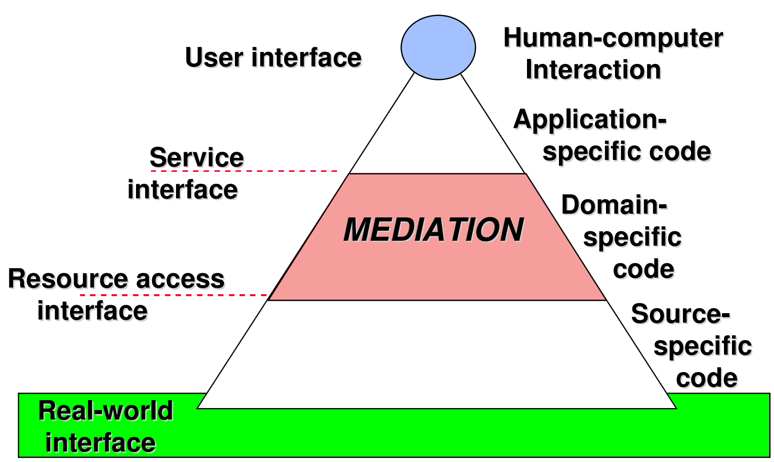
Functional Layer



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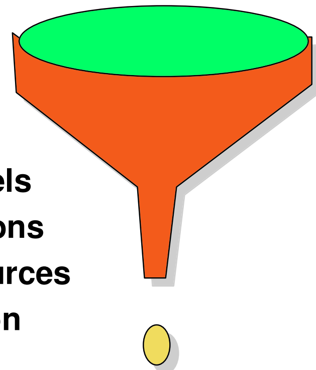
Function of Mediation

Apply *Domain-specific* Specialist Knowledge to add value

- to locate data sources
- to describe data for use
- to convert for consistency
- to abstract for insight / models
- to extrapolate to new situations
- to integrate from diverse sources
- to re-abstract for presentation

➜ ***INFORMATION***



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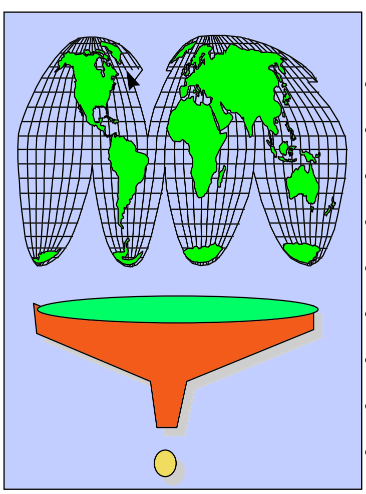
Mediation exploits *Knowledge*



- *Discover* sources
- Search *likely files*
- Obtain *descriptions*
- Scan texts
- Select *relevant data*
- Abstract *to right level*
- Integrate from all
- Validate *consistency*
- Apply *to problem model*
- Test *stability* of extrapolations

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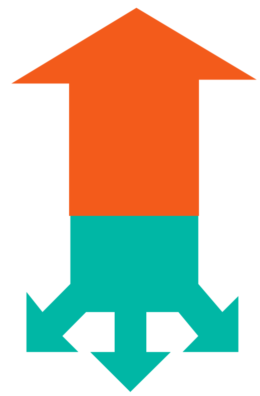
Making data relevant

- Data reduction
- Data abstraction
  – Summarization
  – Exception search
  – Level change to integrate with other data sources
- Follow Customer Model: hierarchical, divide-and-conquer, *a common paradigm*



Mediator Design Principle

Transform Data into Information

Match

Costumer Model

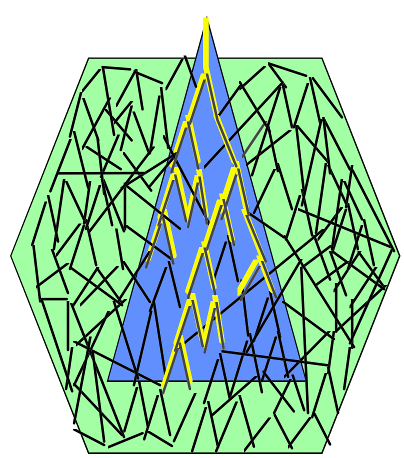
Hierarchical

to

Resource Model

General network

(and maintain models)



Access Maintenance Tasks

- Selection of relevant source material
  - using Yahoo, Knowbots, Harvest, federated schemas, GLOSS
  - evaluate descriptions. meta-data
- Focused access to the variety of resources
  - using SQL, wrappers, CORBA, . . .
- Caching
  - to resolve asynchrony in sources
  - create consistent histories
- Tracking Resources, their cost, and response

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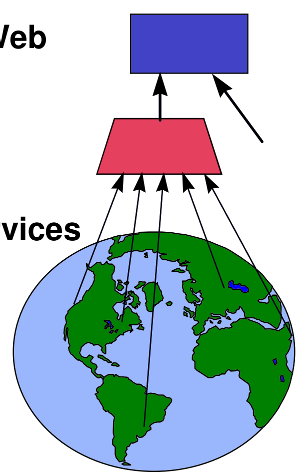
Mediation on the WWW

- Resources on the World-Wide-Web
  - are plentiful
  - autonomous
  - incoherent
- Opportunity for value-added services
  - select best source
  - improve coverage
  - minimize overlap
  - resolve inconsistencies
  - summarize results



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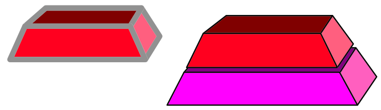
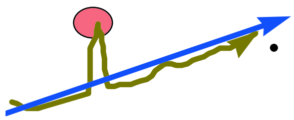
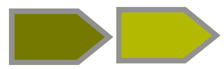
Abstraction / Summarization

- Abstraction to match levels of granularity





- Seeking exceptions from expected values or trends
- Assessment of quality of diverse sources



- Omission of replicated or known information

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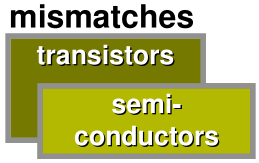
Integration

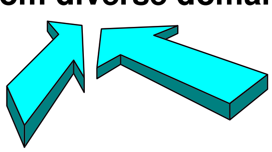
- Resolution of scope mismatches



- Ranking of material from diverse sources

1. 45
2. 43
3. 33
4. 28
.. . .

- Integration of material from diverse domains



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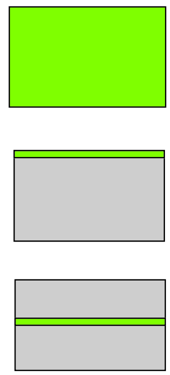
Result modes for ranking

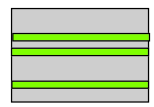
Databases:
- Completeness
- All the answers

Prolog
- Correctness
- The first answer

Optimization
- The best one
- Assumes all factors are known, no human decision



Customer:
- wants choices



- explanation
- background

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Ranking

Qualitative Significant Differences:
in terms of the customer model

Plan 1. UA59 dep.Wash.Dulles 17:10, arr. LAX 19:49
Plan 2. AA75 dep.Wash.Dulles 18:00, arr. LAX 20:10
Plan 3. UA119 dep.Wash.Dulles 9:25, arr. LAX 12:00

Busy Joe:
P1= P2, P3

Speedy Mike:
P2, P1=P3

Greedy Pete:
P1=P3, P2

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Opportunities in Engineering

- **On-line presentation services,** appropriate for audience
- **Integration of documents and figures** for WWW access
- **Abstraction services:** summaries of papers, reports (with references to base mat.)
- **Review services** over suppliers, technologies, services
- **Alternative ranking** of suppliers, parts, materials, . . .
- **Active documents** with function evaluation, plotting
- **Test generators and checkers** (people, equipment)

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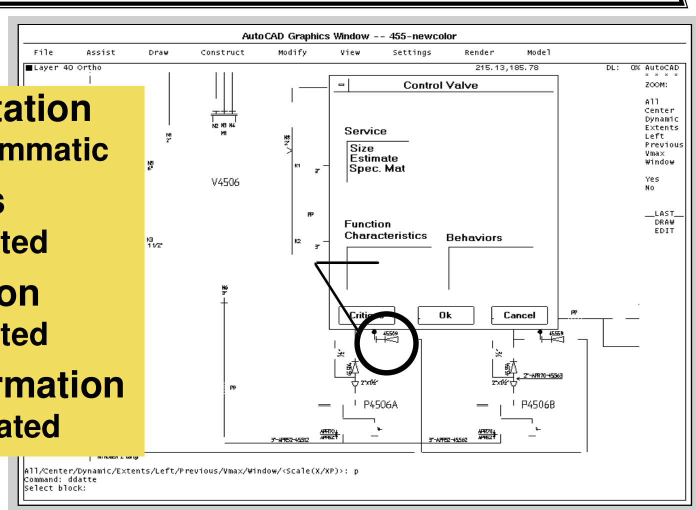
From Andrew Arnold: Civ. Eng. Qualification Exam

Control Valve Sizing, *Future*

- **Interpretation**
  - Programmatic
- **Analysis**
  - Integrated
- **Evaluation**
  - Integrated
- **Transformation**
  - Automated



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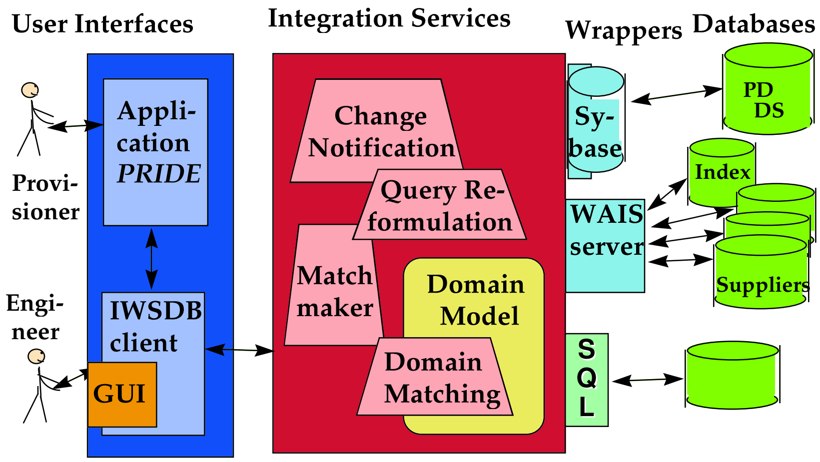
F-22 IWSDB Phase 6



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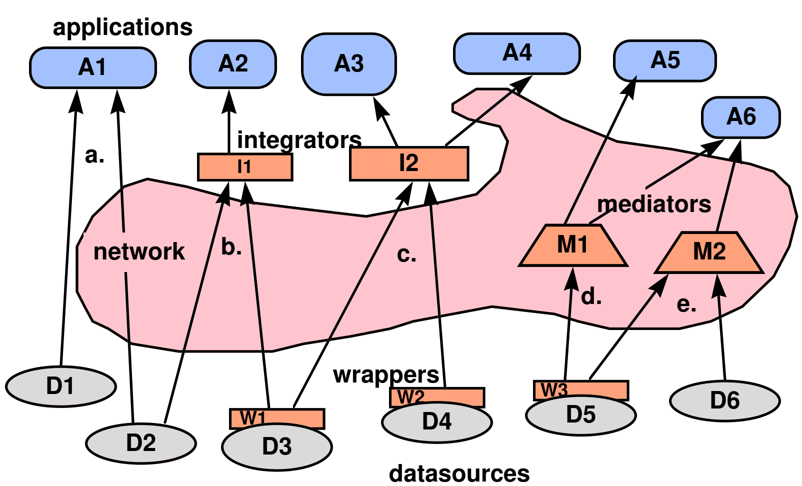
Evolution of mediation



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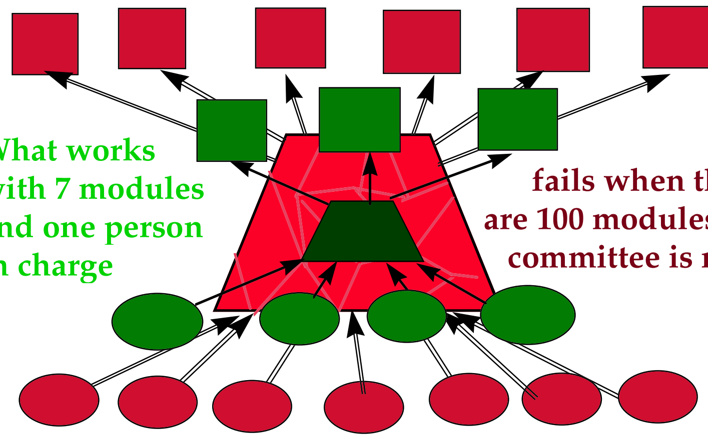
Central Solutions do not Scale

What works
with 7 modules
and one person
in charge



fails when there
are 100 modules and a
committee is needed

Any changes in resources affect the central module

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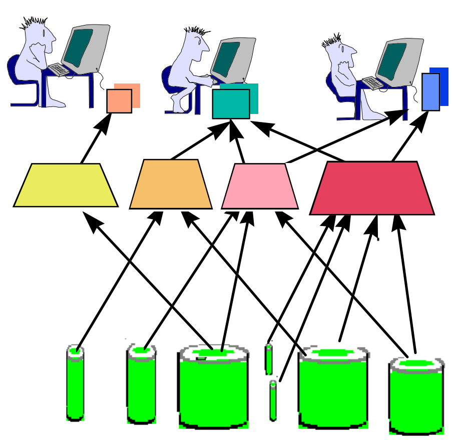
Domain-specific Mediation



- User application
  - Workstations
- Mediator
  - Expert-owned nodes
- Data sources
  - Remote primary and byproduct services

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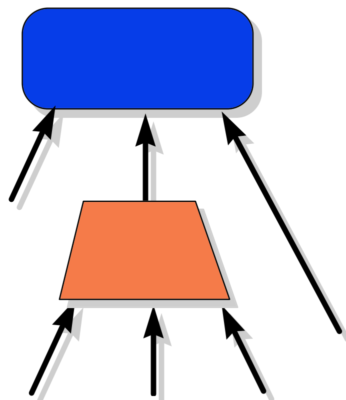
Integration at two levels

Application
- Informal, pragmatic
- User-control

Mediation
- Formal service
- Domain-Expert control



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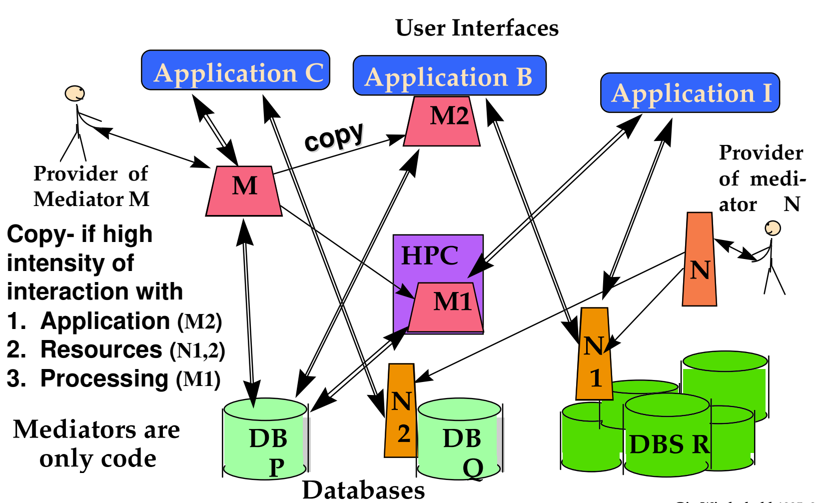
Allocation Flexibility



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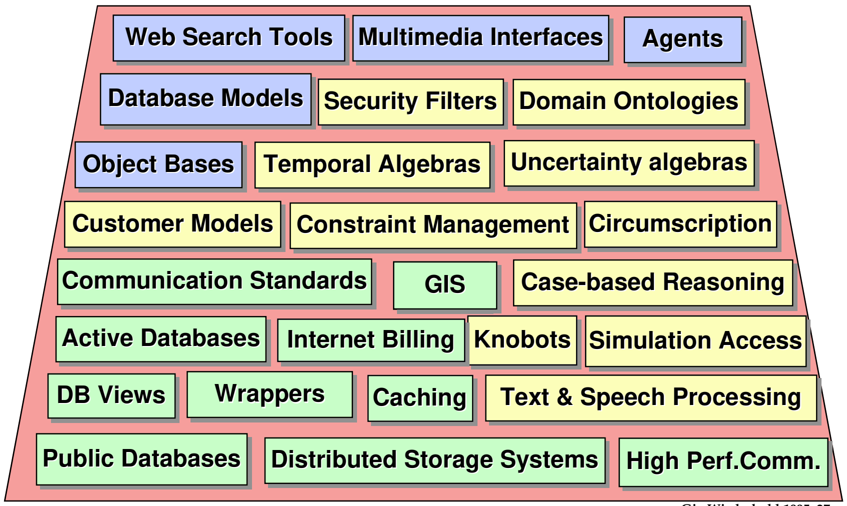
Getting there: Available Technology/Science



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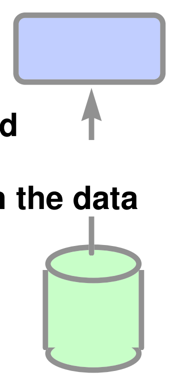
Current Technologies

- SQL
  - One Verb - SELECT with primitive aggregation
  - One Database at a time
  - One Datatype: Tables
- Object-orientation
  - Group data into objects = predefined aggregation
  - Program snippets -- methods -- with the data
- Midleware (ex.: CORBA)
  - Fetch objects from server
  - Assume coherent domains



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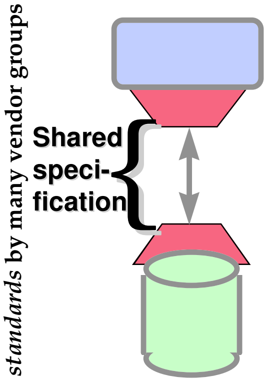
Middleware

CORBA (Common Object Request Broker)
  – *IBM* SOM, DSOM
- DOE (Distributed Objects Everywhere)
  – SunSoft
- DOME
- EZ-bridge
  – System Strategies inc.
- ILU (InterLanguage Unification) *Xerox*
- ISIS
- KQML (Knowledge Query & Manipulation Lang.)
- MQM (Message Queing Middleware)
  – IBM (for mainframe connections)
- OLE (Microsoft: Object embedding and Linking)
- OpenDOC (*Apple*)
- PDES (Product Data Interchange using STEP)
- TIB (Teknekron Information Bus)

Many *standards* by many vendor groups



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Status of Mediation Technology

Today
- Handcrafted
- Expert consults with programmer
- Programmer codes the knowledge needed
- Resource changes require advise, program update

Future
- Generated from models
- Domain Expert maintains models
- Specification determines functions
- Resource changes trigger regeneration

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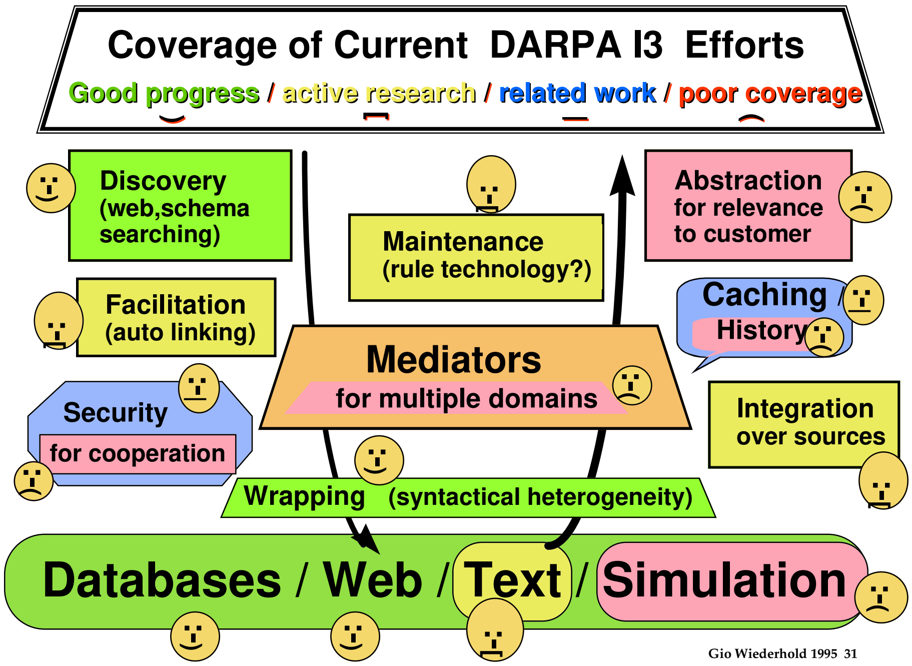

Coverage of Current DARPA I3 Efforts
Good progress / active research / related work / poor coverage
Discovery (web,schema searching)
Maintenance (rule technology?)
Abstraction for relevance to customer
Facilitation (auto linking)
Caching / History
Mediators
for multiple domains
Security
for cooperation
Integration over sources
Wrapping (syntactical heterogeneity)
Databases / Web / Text / Simulation
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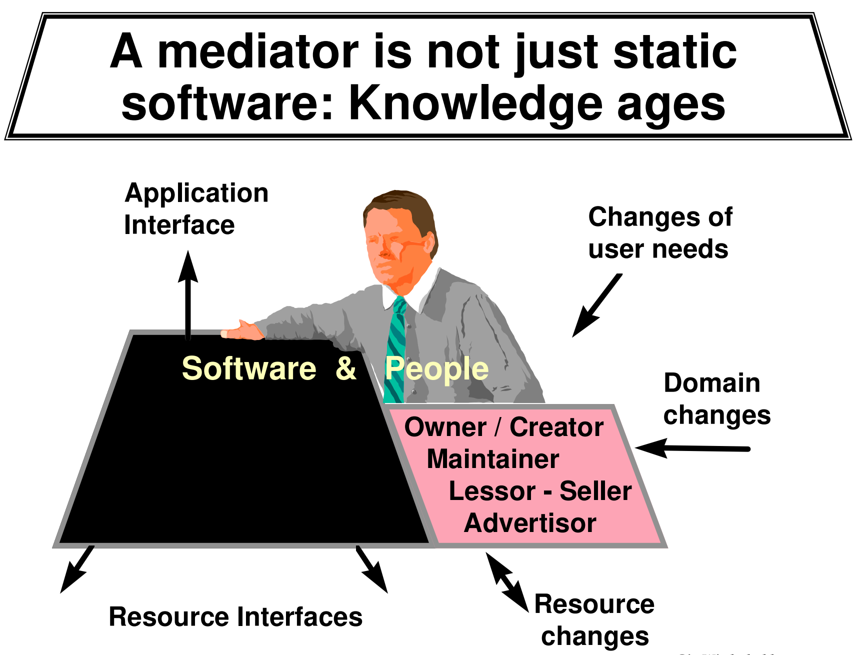

A mediator is not just static software: Knowledge ages
Application Interface
Changes of user needs
Software & People
Domain changes
Owner / Creator
Maintainer
Lessor - Seller
Advertisor
Resource Interfaces
Resource changes
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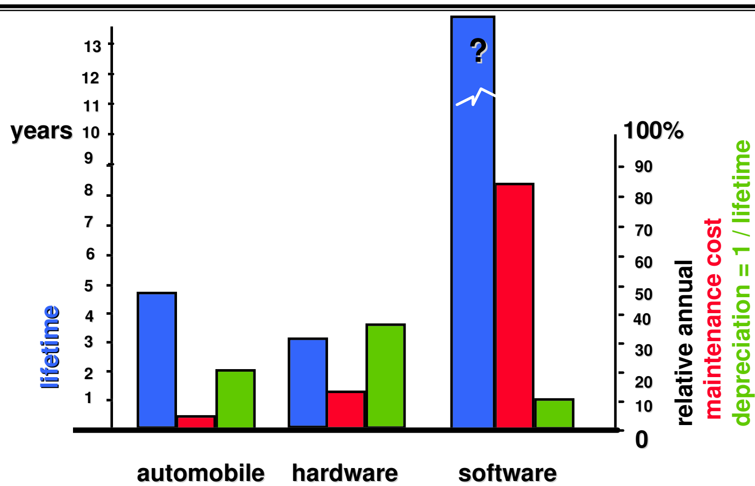
Maintenance is good for you



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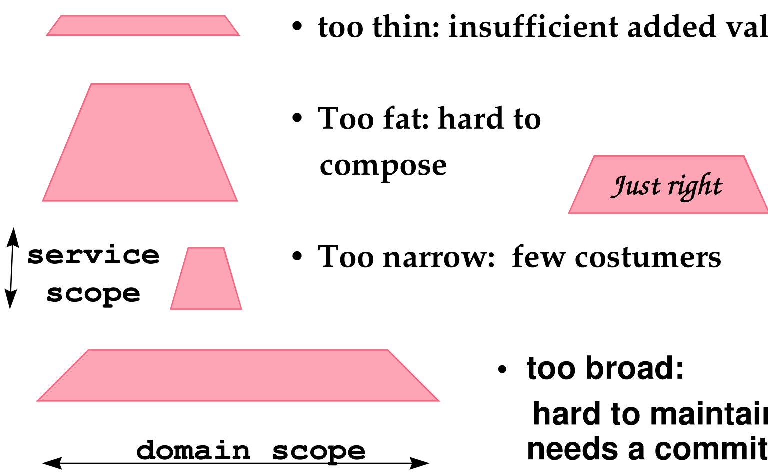
Fat versus thin mediators



- too thin: insufficient added value
- Too fat: hard to compose
- Too narrow: few costumers
- too broad:
  hard to maintain,
  needs a committee

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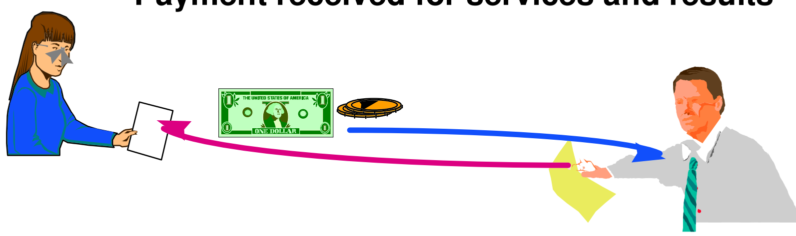
Mediation as a Service

Service Paradigm

- **Customer views understood within server domain**
- **Processes use stored and maintained knowledge**
- **Processing adds value to data objects accessed**
- **Payment received for services and results**



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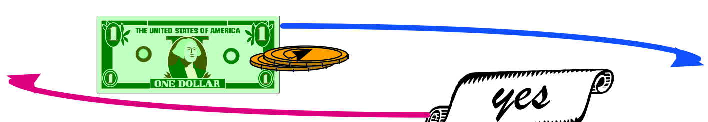
E-money

Services must be paid for

- **Incentive for creation and improvement**
- **price proportional to value added**
- **profit *f* (cost, market, price, overhead)**
- **Price low per item, so overhead must be low**

Simple payment (no credit accounts, checks)



Enabled through secure signatures

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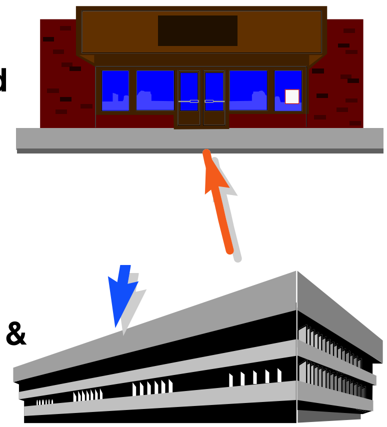
CommerceNet Vision

Purchase components
- initially electronics and electro-mecanical

Rapid, economical building of equipment

Get good choice
- competent supplier
- resolve variety of term & classifications

Use e-mail, e-money



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Simulation services

1. **Continously executing**: weather prediction
   – SimQL result reports best match samples
2. **Execution specific to query**: what-if assessment, spreadsheets
   – may require HPC power for adequate response
3. **Complement base data**: materials data, assembly
   – performs inter- or extra-polations to match query parameters
4. **Combinations of 2. and 3.**: top layer simulation using stored partial lower level results: weapon performance in setting
5. **Human-in-the-loop** (mediated by an agent program): SAFs

Note
- A simulation service program can be written in any language
- A simulation service must be compliant to the interface

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Domain Specialization

- Knowledge Acquisition &
- Knowledge Maintenance

require

- Domain specialists
- Professional organizations

Empowerment

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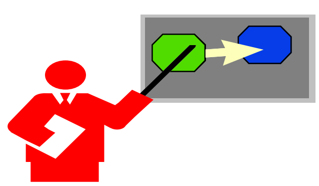
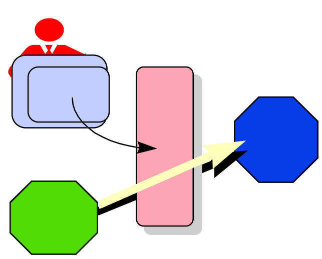
New Role for Consultants



Old

- Used at Design Time
  and
- To Explain Failures



Future

- Available as a Service
- Responsible for Knowledge Maintenance

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Industrial Needs Served

NEEDS

- Access to relevant Information
- Rapid response to changing situations
- Remain current with global conditions
- External services can be shared effectively

FEATURES

- Linkages to networks and resources
- Incremental update of information systems avoids legacy problem
- Equal access to local and remote sources
- Value-added services live *in* the network

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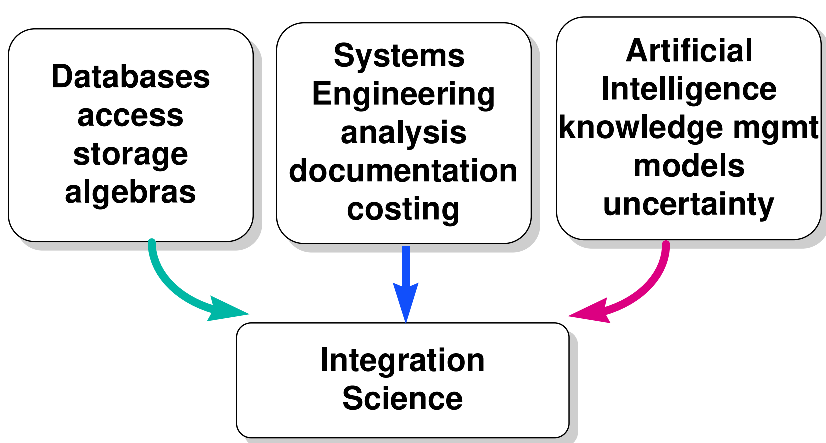
Integration Science



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