prepared for WETICE96

Value-added Services on the WEB

June 1996

Gio Wiederhold
Stanford University

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

Gio Wiederhold 1995 3

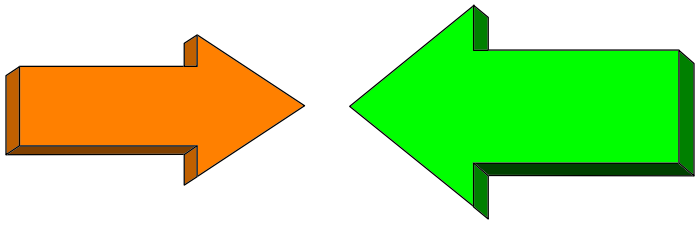
Information Leverage

Tactical

- **Customers**
- **Inventory**
- **Suppliers**

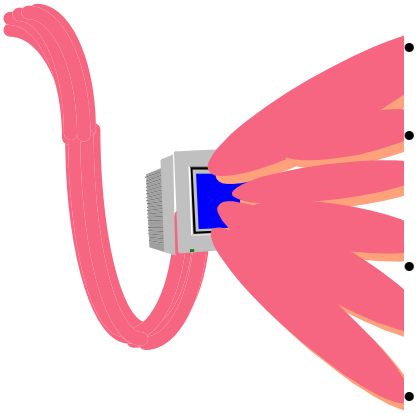
Strategic

- **Planning**
- **Capabilities**
- **Opportunities**



Gio Wiederhold 1995 4

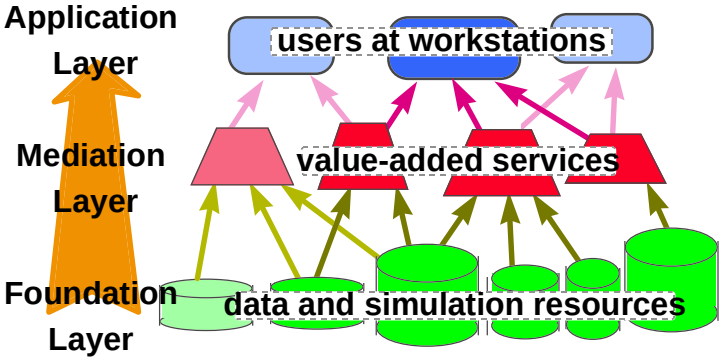
Information Data overload starvation



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

Gio Wiederhold 1995 5

Transforming Data to Information



Gio Wiederhold 1995 6

Definition*

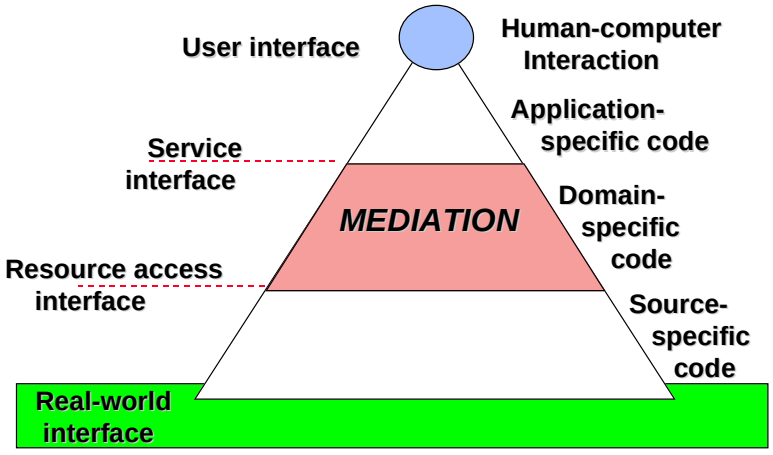
A *mediator* is a software module that exploits encoded knowledge about certain sets or subsets of data to create information for a higher layer of applications.

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**

Gio Wiederhold 1995 7

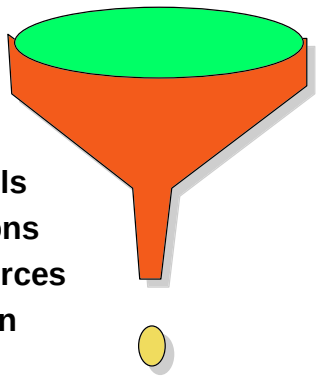
Functional Layer



Gio Wiederhold 1995 8

Function of Mediation

Apply *Domain-specific* Specialist Knowledge to add value

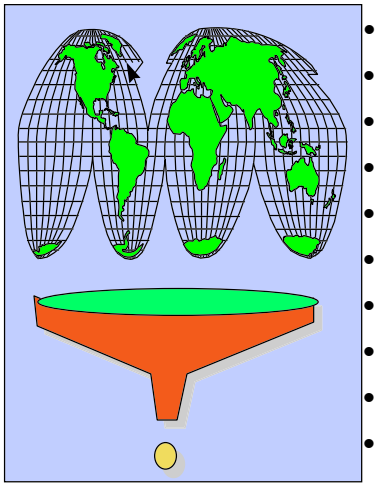


- **to locate data sources**
- **to describe data for use**
- **to convert for consistency**
- **to abstract for insight / models**
- **to extrapolate to new situations**
- **to integrate from diverse sources**
- **to re-abstract for presentation**

➜ ***INFORMATION***

Gio Wiederhold 1995 9

Mediation exploits *Knowledge*

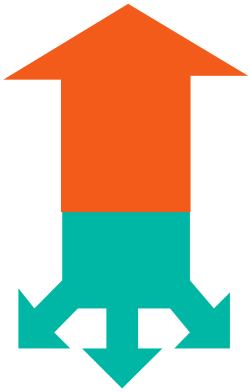


- ***Discover* sources**
- **Search *likely files***
- **Obtain *descriptions***
- **Scan texts**
- **Select *relevant data***
- **Abstract *to right level***
- **Integrate from all**
- **Validate *consistency***
- **Apply *to problem model***
- **Test *stability* of extrapolations**

Gio Wiederhold 1995 10

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*



Gio Wiederhold 1995 11

Mediator Design Principle

Transform Data into Information

Match

Costumer Model

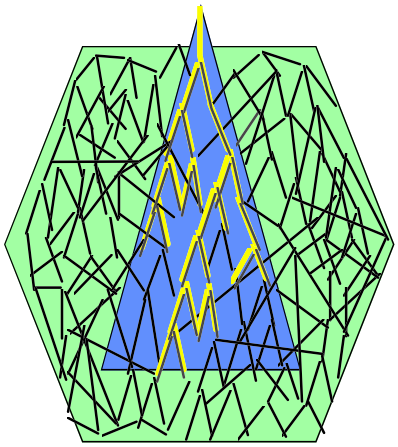
Hierarchical

to

Resource Model

General network

(and maintain models)



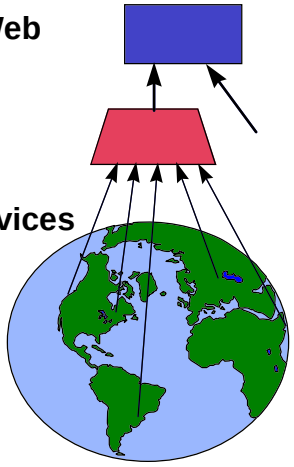
Gio Wiederhold 1995 12

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**

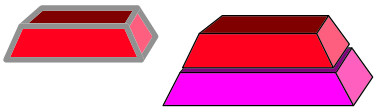
Mediation on the WWW

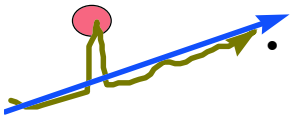
- **Resources on the World-Wide-Web**
  - **are plentiful**
  - **autonomous**
  - **incoherent**
- **Opportunity for value-added services**
  - **select best source**
  - **improve coverage**
  - **minimize overlap**
  - **resolve inconsistencies**
  - **summarize results**



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

Gio Wiederhold 1995 15

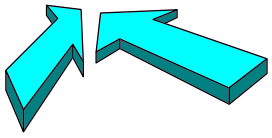
Integration

- Resolution of scope mismatches

- Ranking of material from diverse sources

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

- Integration of material from diverse domains



Gio Wiederhold 1995 16

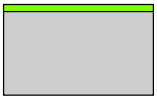
Result modes for ranking

Databases:

- **Completeness**
- **All the answers**

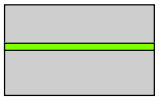
Prolog

- **Correctness**
- **The first answer**



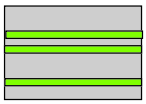
Optimization

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



Customer:

- **wants choices**

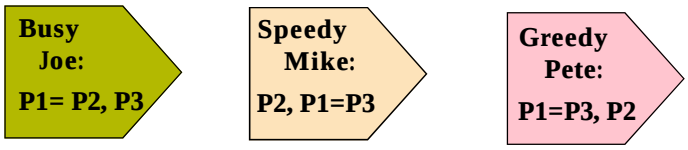


- **explanation**
- **background**

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



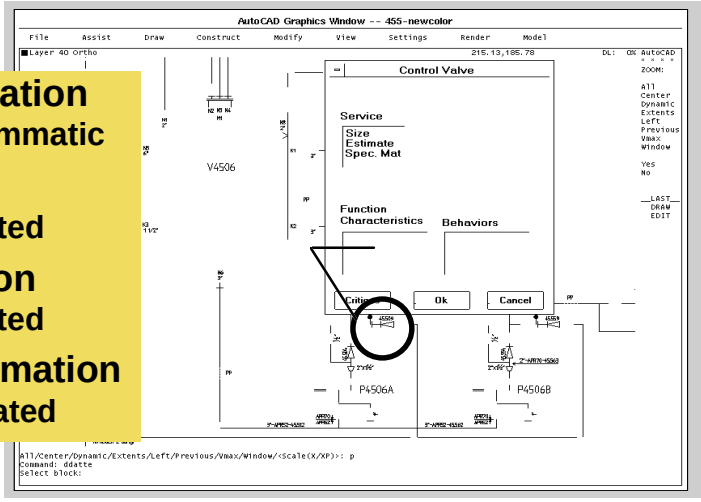
Opportunities in Engineering

- **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)**

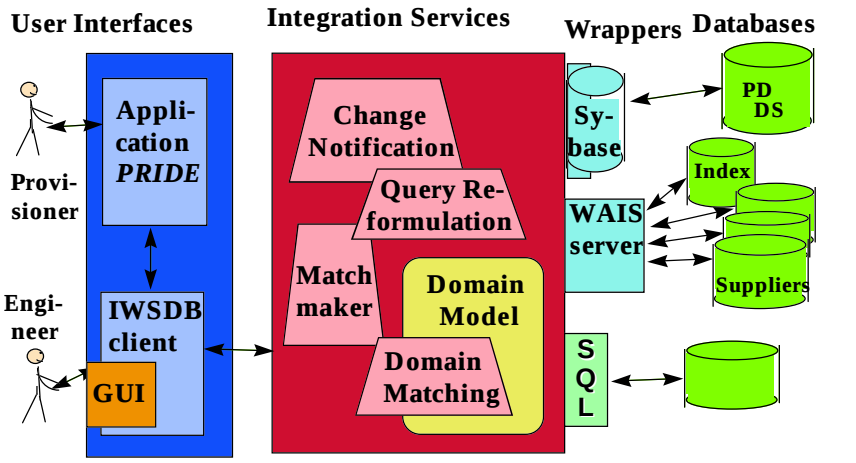
From Andrew Arnold: Civ. Eng. Qualification Exam

Control Valve Sizing, *Future*

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

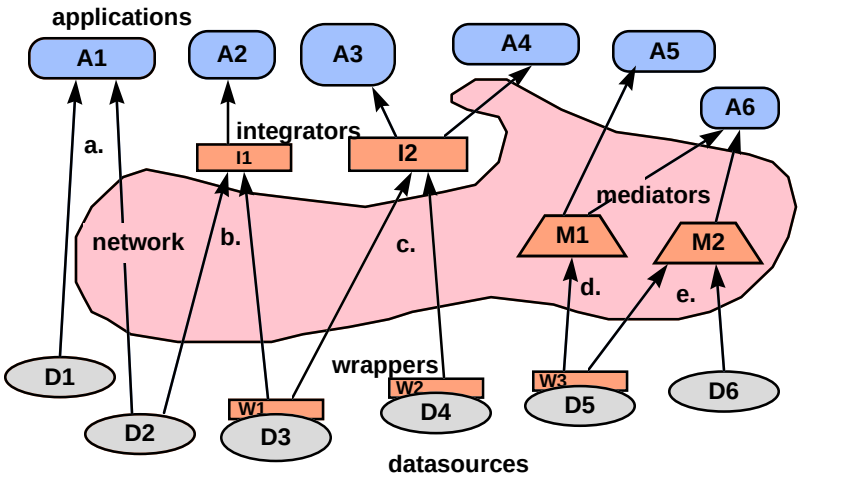


F-22 IWSDB Phase 6



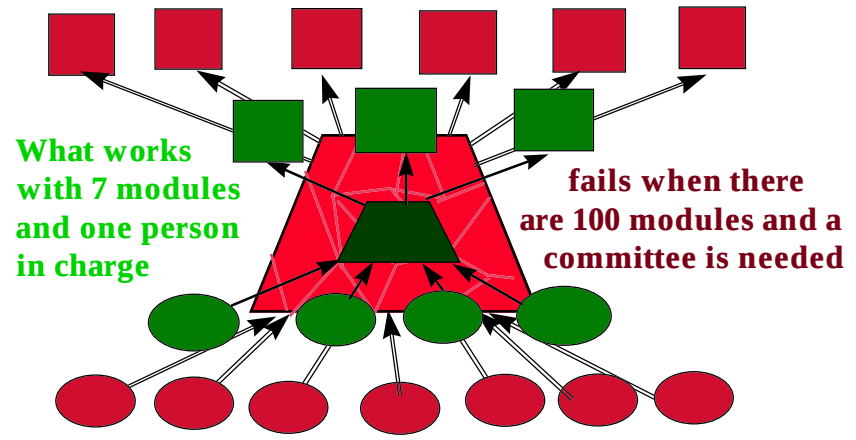
Gio Wiederhold 1995 21

Evolution of mediation



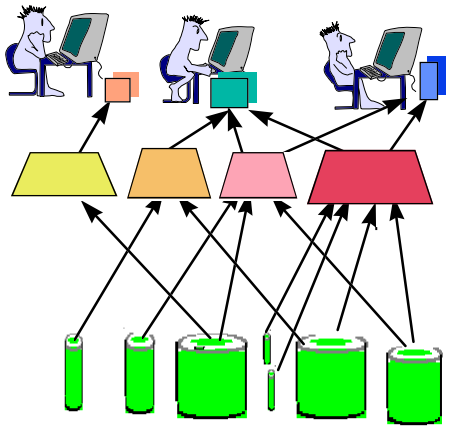
Gio Wiederhold 1995 22

Central Solutions do not Scale



Gio Wiederhold 1995 23

Domain-specific Mediation



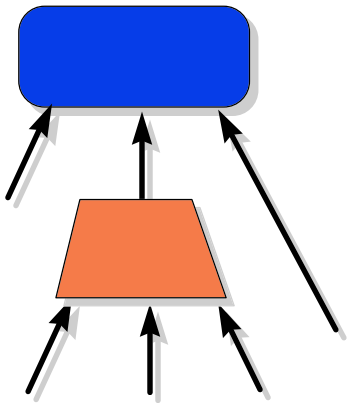
- User application
  - Workstations
- Mediator
  - Expert-owned nodes
- Data sources
  - Remote primary and byproduct services

Gio Wiederhold 1995 24

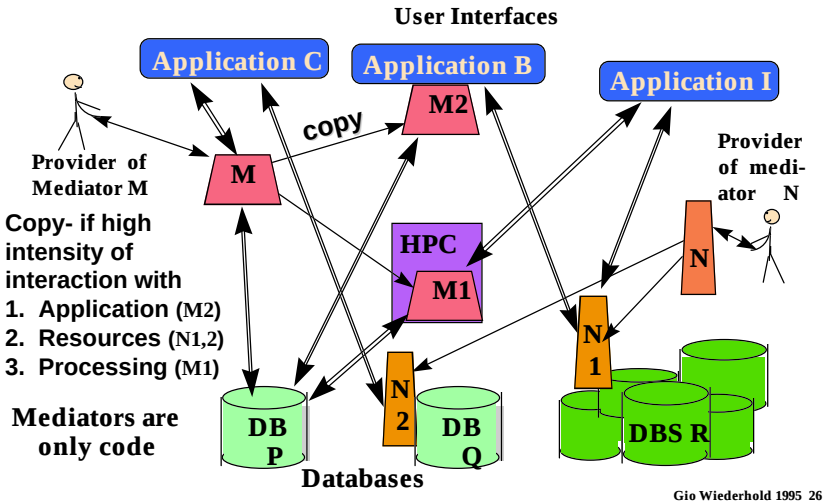
Integration at two levels

Application
- **Informal, pragmatic**
- **User-control**

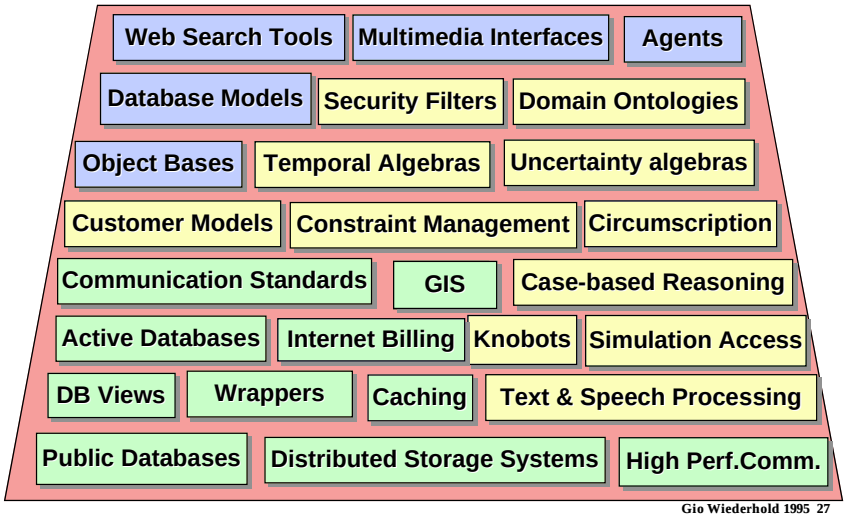
Mediation
- **Formal service**
- **Domain-Expert control**



Allocation Flexibility



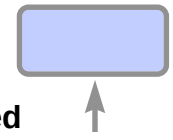
Getting there: Available Technology/Science

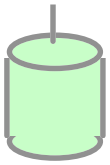


Gio Wiederhold 1995 27

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

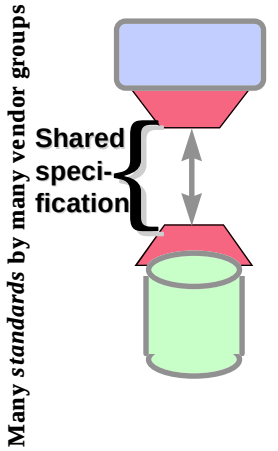




Gio Wiederhold 1995 28

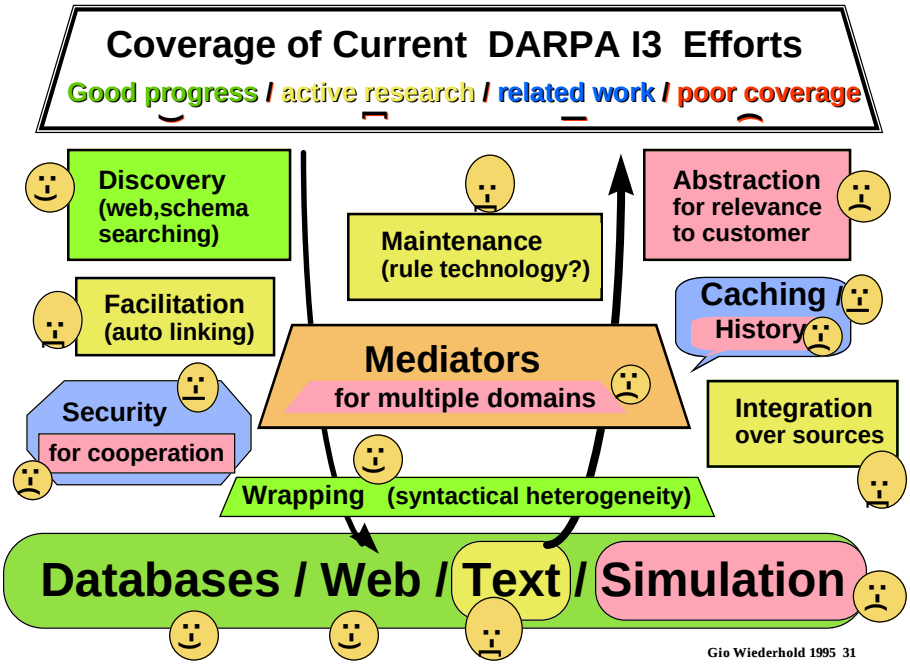
Middleware

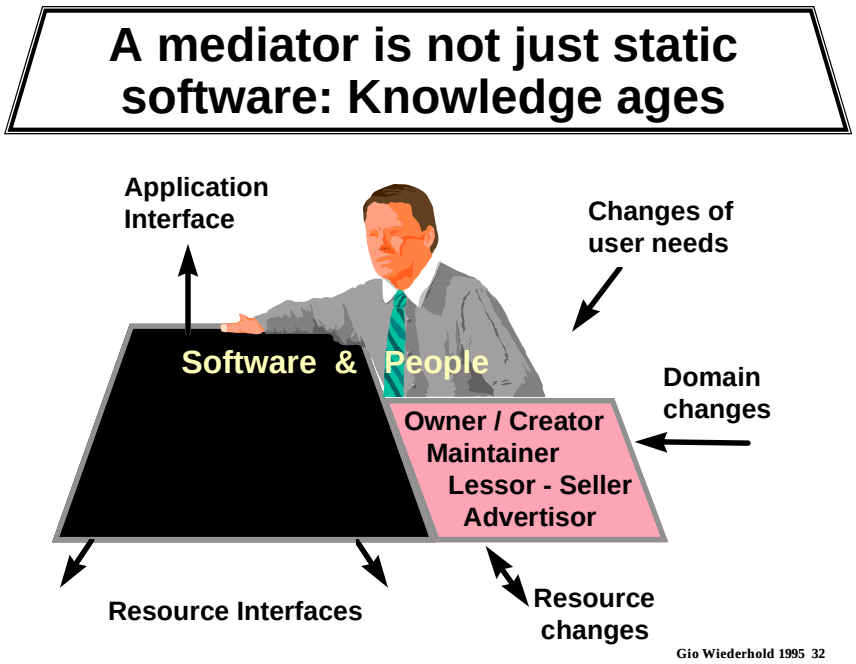
- **CORBA** (Common Object Request Broker)
  - *IBM* SOM, DSOM
- **DOE** (Distributed Objects Everywhere)
  - SunSoft
- **DOME**
- **EZ-bridge**
  - System Strategies inc.
- **ILU** (InterLanguage Unification) *Xerox*
- **ISIS**
- **KQML** (Knowledge Query & Manipulation Lang.)
- **MQM** (Message Queing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



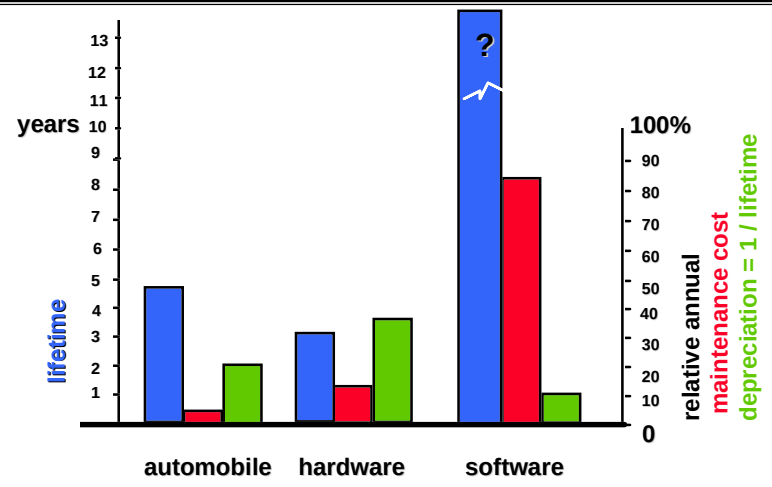
Status of Mediation Technology

Today	Future
• Handcrafted	• Generated from models
• Expert consults with programmer	• Domain Expert maintains models
• Programmer codes the knowledge needed	• Specification determines functions
• Resource changes require advise, program update	• Resource changes trigger regeneration


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
Gio Wiederhold 1995 31

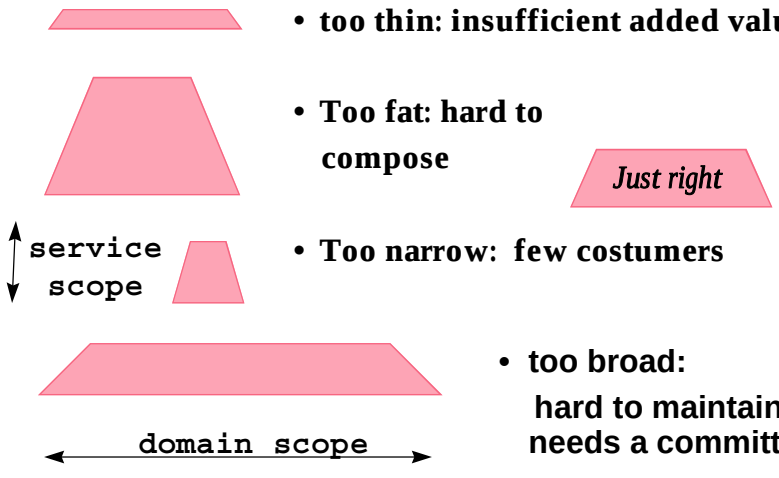

A mediator is not just static software: Knowledge ages
Application Interface
Changes of user needs
Software & People
Domain changes
Owner / Creator
Maintainer
Lessor - Seller
Advertisor
Resource Interfaces
Resource changes
Gio Wiederhold 1995 32

Maintenance is good for you



Gio Wiederhold 1995 33

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

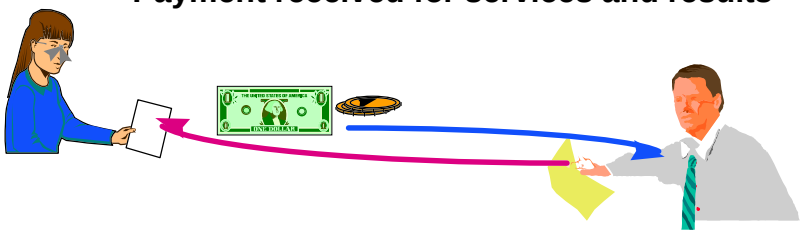
Just right

Gio Wiederhold 1995 34

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**



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

CommerceNet Vision

Purchase components

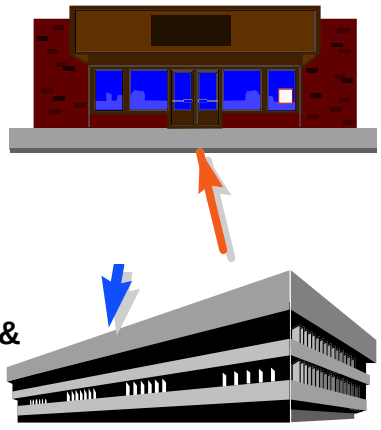
- initially electronics and electro-mecanical

Rapid, economical building of equipment

Get good choice

- competent supplier
- resolve variety of term & classifications

Use e-mail, e-money



Gio Wiederhold 1995 37

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

Gio Wiederhold 1995 38

Domain Specialization

- Knowledge Acquisition &
- Knowledge Maintenance

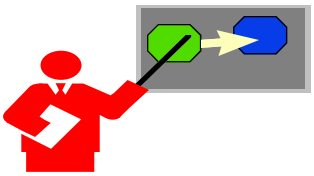
require

- Domain specialists
- Professional organizations

Empowerment

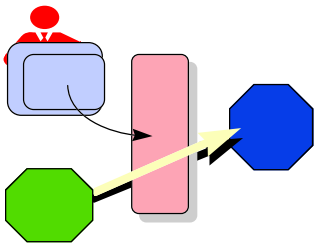
Gio Wiederhold 1995 39

New Role for Consultants



Old

- Used at Design Time
  and
- To Explain Failures



Future

- Available as a Service
- Responsible for Knowledge Maintenance

Gio Wiederhold 1995 40

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

Integration Science