Information Technologies Enabling New Modes of Learning

Alice Agogino
Associate Dean for Special Programs
Professor of Mechanical Engineering

Brandon Muramatsu
NEEDS Project Manager

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Synthesis Coalition Goals

- Reform curricula
- Improve retention
- Link to K-14
- Develop digital infrastructure (NEEDS database & quality review of courseware)

Synthesis Coalition Strategy

- Introduce multidisciplinary systems design
  - Mechatronics
  - Architecture/Engineering/Construction
- Bring industry and research into the classroom
- Enhance laboratory/hands-on learning
- Increase social context of technology
- Improve student's communication and teaming skills
- Introduce new delivery/learning styles

Lower Division Strategy

- Mechanical (Artifact) dissection.
- Multidisciplinary, multimedia case studies.
- Integrated design projects.
- Early introduction of embedded computing (mechatronics design).

DISSECTION

SYNTHESIS

- is an approach to teaching students about engineering concepts and design principles by having them explore the engineered products around them.
- involves having students work in small teams to disassemble and reassemble machines.
- leads to insight on materials, function, design alternatives, human factors and manufacturing.
- motivates and promotes integrative thinking.

Multidisciplinary, Multimedia Case Studies

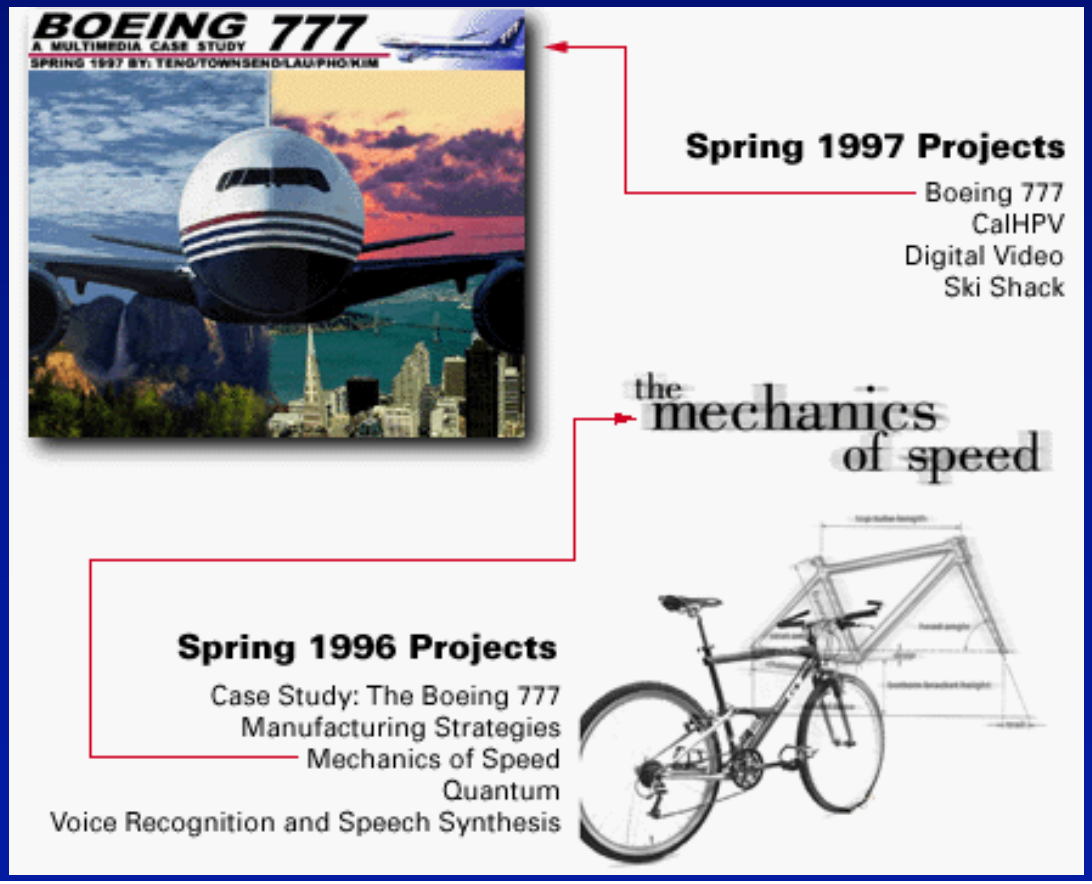
- highlight examples of successfully engineered design products.
- brings “best practices” from industry into the classroom:
  - customer-driven design
  - quality and continuous improvement
  - multifunctional teams
  - design for ‘x’ (assembly, environment, service, etc.)
- complements dissection and design activities.
- promotes integrative thinking.

ME39C: Multimedia Case Studies of Engineering Design

SYNTHESIS

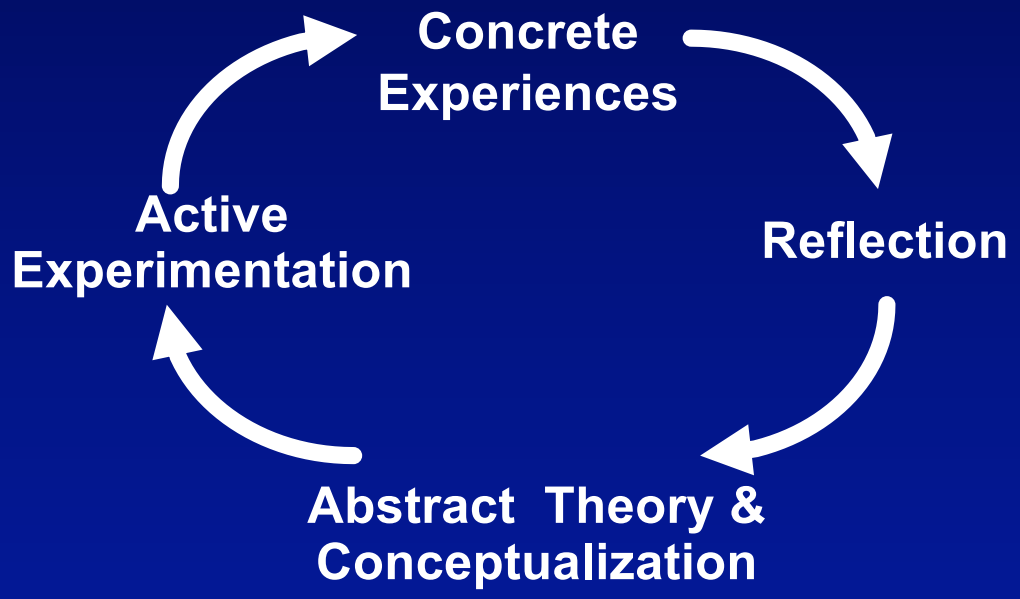
http://maclab.me.berkeley.edu/ME39C/

- Freshman/Sophomore Class
- Design and develop a Multimedia Case Study



Multimedia Cases & Dissection Promote Integrative Learning

QuickTime™ and a
Cinepak decompressor
are needed to see this picture.



QuickTime™ and a
Video decompressor
are needed to see this picture.

Mattel Color Spin Example

Integrates multimedia case, dissection and design activities

Multidisciplinary Mechatronic Cases and Dissection Exercises

Some of the Disciplines Involved:

- Mechanical Engineering
- Electrical Engineering
- Computer Engineering
- User Interface
- Manufacturing
- Industrial/Process Engineering
- Business and Management of Technology

Synthesis Courseware Integrates Research, Education and Industry

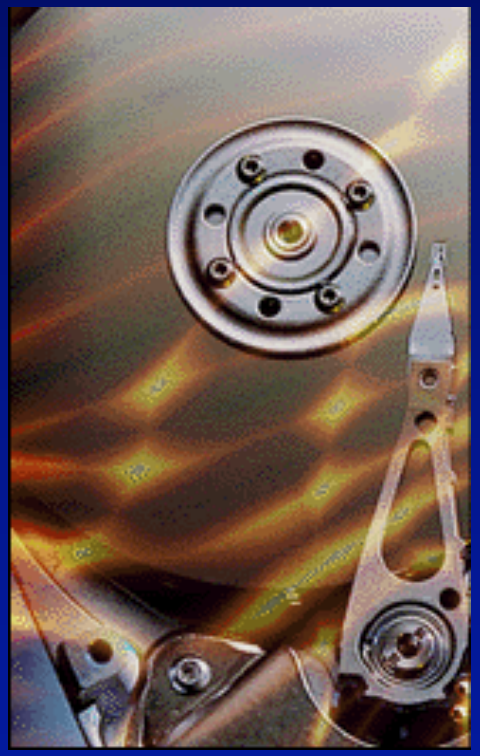
SYNTHESIS

Technical Research

Disk Drive
High Speed Networks
Multimedia & Video Servers
Design & Manfg. Integration

Industry

Western Digital
IBM Almaden Research
Berkeley Computer Mechanics Lab



Education Research

peer, scaffolded & experiential learning

Virtual Disk Drive Case Study - Game, Dissection Example

THE VIRTUAL

DISK DRIVE DESIGN STUDIO

Virtual Disk Drive Case Study - Game, Dissection Example

The Multimedia Virtual Disk Drive Design Studio is a project aim to develop multimedia interactive courseware for undergraduate engineering and science students. This project is funded by the Synthesis Coalition, a national engineering coalition supported by the National Science Foundation. The purpose of the Synthesis Coalition is to design, implement and assess new approaches to undergraduate engineering education that emphasize multidisciplinary synthesis, teamwork and communication, hands-on and laboratory experiences and open-ended problem formulation and solving.

The Multimedia Virtual Disk Drive Design Studio is an example of courseware that integrates interactive multimedia with hands-on dissection and design exercises.

> message 1

From: Ms. Elliott, president of ACME Engineering
To: chief project engineer
Subject: new product design

status:

incoming messages

day: 1

DESIGN LOGBOOK

INTRO TUTORIAL

DP HSA PCB

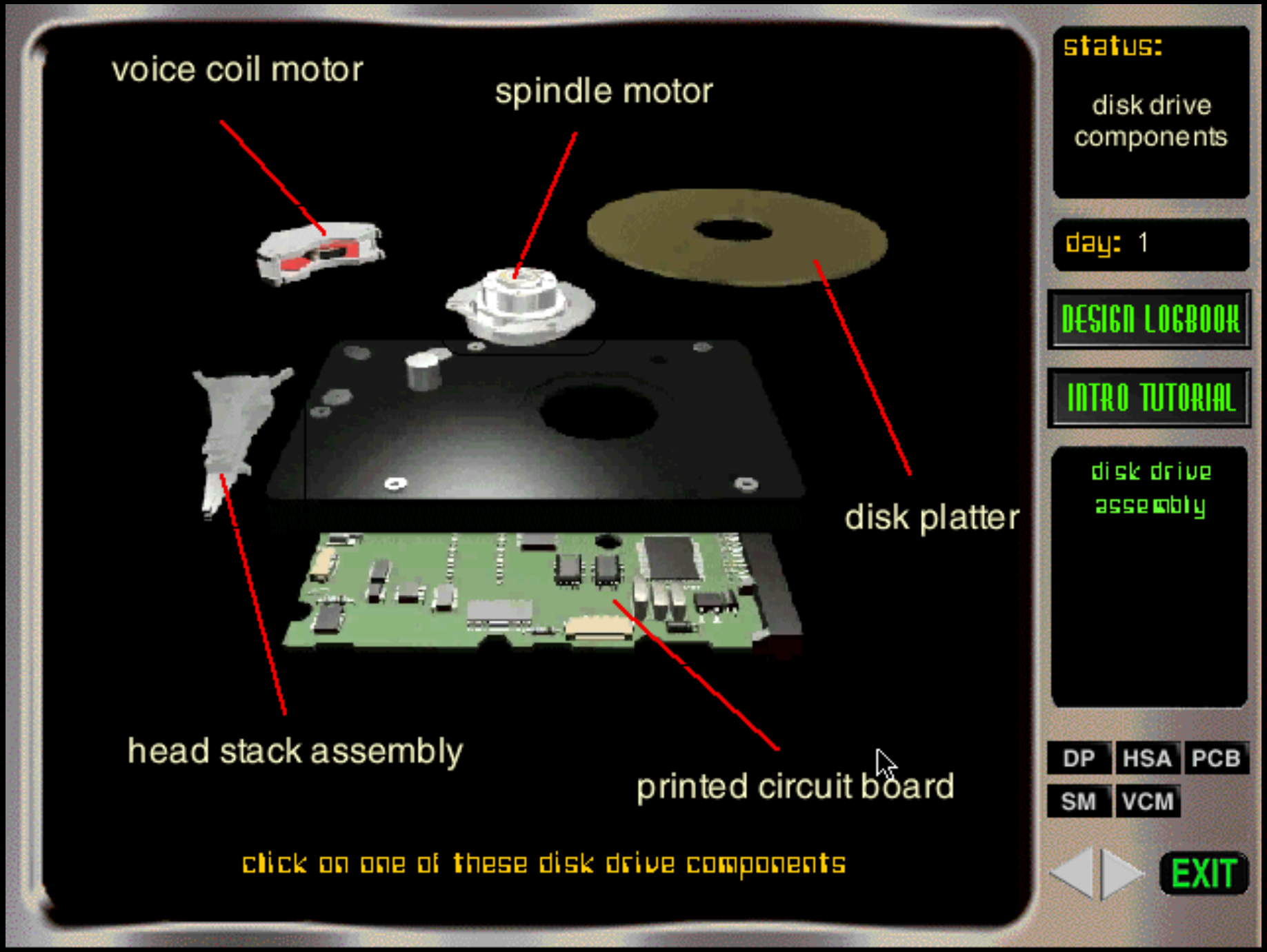
SM VCM

EXIT

“REAL LIFE” ENGINEERING

The purpose of this multimedia project is to introduce students to the world of mechatronics and "real-life" engineering practices. This piece of role-playing interactive software allows students to become design engineers in a fictitious disk drive design firm. Obviously, most students will not have any in-depth knowledge of disk drives and will have to mine out the necessary information from a multimedia archives. Subsequently, they will have to select from various design options and construct their own disk drives.

At the same time, students will have to keep track of the development and production cost. They will also be asked to launch their new disk drives in a certain time frame, simulating the idea of time-to-market. ACME President Eliot gives the initial design goals and final product evaluation.


voice coil motor
spindle motor
disk platter
head stack assembly
printed circuit board
click on one of these disk drive components
status:
disk drive components
day: 1
DESIGN LOGBOOK
INTRO TUTORIAL
disk drive assembly
DP
HSA
PCB
SM
VCM
EXIT

NAVIGATION AND USER INTERFACE DESIGN

The user interface allows students to feel like they are sitting in front of a computer terminal. The right side of the screen is the navigation panel. It displays the current status and allows users to access a design logbook or visit the tutorial at anytime. This is a screen shot of the assembly view. A 3-D animation movie disassembles the hard drive and introduces individual components.

The disk drive components form the main navigational path. As the user clicks on different components, more information will appear. The component layout also provides an ideal link to a disk drive dissection exercise.

SPINDLE MOTOR

status:

spindle motor

day: 1

DESIGN LOGBOOK

INTRO TUTORIAL

disk drive assembly

SM

Literature Search

Consult Experts

Design Studio

DP HSA PCB

SM VCM

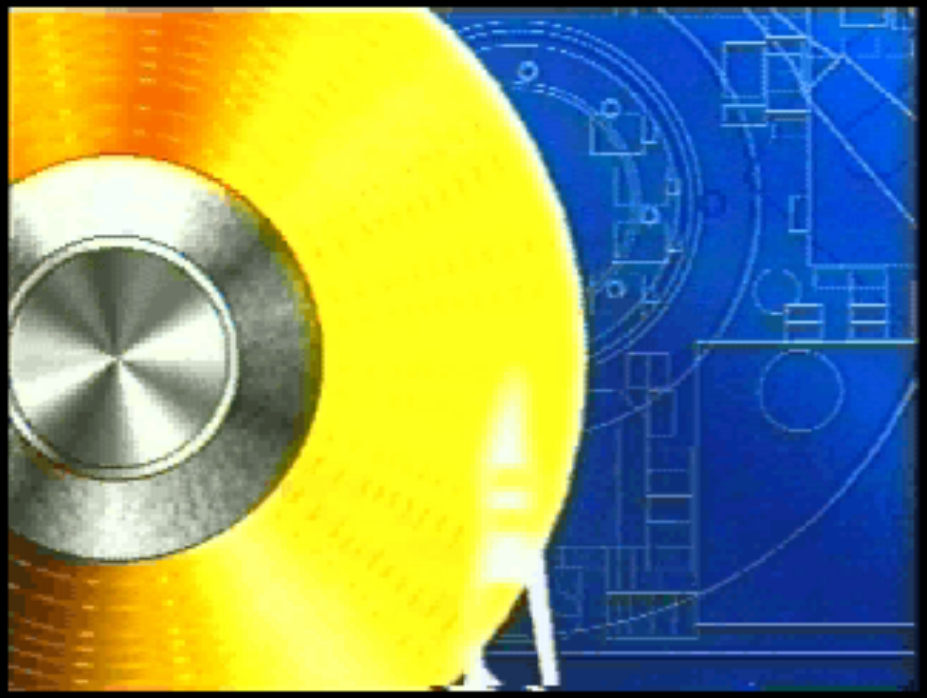
EXIT

LEARNING STYLE FLEXIBILITY

As the user clicks on the motor, this screen will appear. At the top left is a 3-D animation of the spindle motor rotating in space, giving the users a 3-D feel of the motor.

From this point on, there are three choices: to perform a literature search on spindle motors, consult experts on motor related issues or head straight to the virtual motor design studio. The student can choose which mode of learning he or she prefers at any point.

When the drive controller issues a read or write command, the voice coil motor rotates the entire HSA to the position where data is stored or needs to be encoded. To minimize seek time, or the time for the HSA to align itself to the correct data track, a critical factor in actuator body design is to minimize inertia.



status:
head stack asembly literature search

day: 1

DESIGN LOGBOOK

INTRO TUTORIAL

disk drive assembly
▼
HSA
▼
literature search

DP HSA PCB
SM VCM

EXIT

LITERATURE SEARCH

This is a screen shot of the literature search section for the head stack assembly. The literature search sections contain text, images, 3-D animations and video clips related to the components of interest.

The web version will point to related on-line links.

Matlab and spreadsheet exercises which integrate math and physics equations are under development.

head stack assembly parameter selection

	Read-write Head Type	Cost	Max. TPI	Max. BPI	Pre-amp Cost
☐	MIG	$8	5000	90000	$2
☑	Thin-film Inductive	$10	6000	100000	$2.50
☐	MR	$18	8000	110000	$5

	Actuator Body Material	Cost	Inertia
☐	Aluminum	$4	45
☑	Magnesium	$7	38
☐	Hybrid	$3	40

status:
head stack assembly design studio

day: 11

DESIGN LOGBOOK

INTRO TUTORIAL

disk drive assembly
▾
HSA
▾
design studio

DP HSA PCB
SM VCM

EXIT

DESIGN STUDIO

This is a screen shot of the head stack assembly design studio. Students are asked to choose from several design options based on the information they have gathered in the literature and expert consultation sections. The design information is automatically recorded in the design logbook.

Similar options must be determined in the design studio for the other components — voice coil motor, spindle motor, disk platter and printed circuit board. Students soon realize the multiobjective performance goals and design trade-offs.

DESIGN PARAMETERS

HSA	Head Type	Thin-film Inductive
	Actuator Body Material	Magnesium
DISK	Number of Platters	3
PCB	Channel Type	Peak Detect
	Power Driver Type	Medium
	Controller Type	Mid-range
VCM	Coil Turns	300
	Flux Density	8000
MOTOR	RPM	5400

click here for perfomance evaluation

status:

design logbook

day: 36

DESIGN LOGBOOK

INTRO TUTORIAL

DP HSA PCB

SM VCM

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DESIGN LOGBOOK

Students can access this design logbook at anytime. The logbook not only restates the design goals but also displays the design parameters as determined at that point.

Students can periodically visit the logbook to review the design. Once the design is finalized, the user can click on the "Performance Test" icon and the program will evaluate the disk drives performance.

DESIGN PARAMETER	CURRENT DESIGN	DESIGN GOALS
Capacity	2556	1200 MB
Access Time	0.0128	0.015 sec
Cost	186.0000	$150.00
Power (used/available):	6.5000 / 8	

product launch

fix it...
redesign

frustrated?
take a break

status:

performance evaluation

day: 57

DESIGN LOGBOOK

INTRO TUTORIAL

DP HSA PCB

SM VCM

EXIT

PERFORMANCE EVALUATION

This section evaluates the disk drive's performance. After reviewing its performance, the user can decided whether to launch the product, redesign or simply give up and take a coffee break!

If the student decides to launch the product, the “time to market” will be determined along with a technical evaluation of the design. The President of ACME Disk Drive logs on to give a final performance review.

VDDS - Future Work

- Develop Web Version
- Add New Features
  - Link to Matlab or spreadsheet exercises to allow changes in the design parameters, introduce new design goals and link to math and physics equations
- Continue User Testing and Case Study Revision

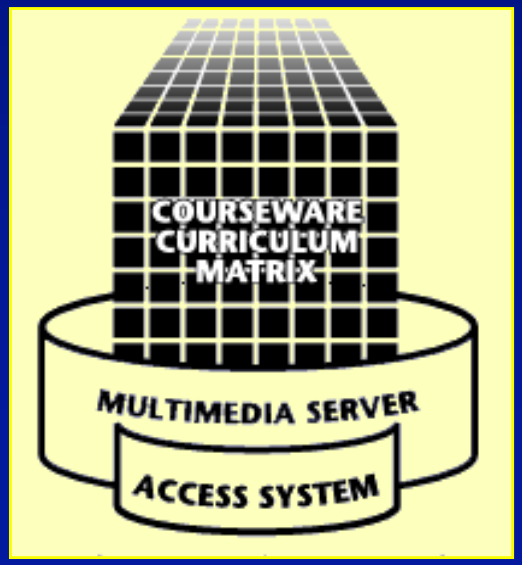
National Engineering Education Delivery System (NEEDS)

SYNTHESIS

Three Components Connected Through the Internet

Delivery

- Classrooms
- Instructional Labs
- Small Study Groups
- Residences
- Libraries
- Anywhere



Development

- Courseware Studios
- Instructional Labs
- Faculty Offices & Residences
- Libraries
- Anywhere

Synthesis Courseware is on the NEEDS Database

Search, Browse, Display and Download Courseware

NEEDS Database: www.needs.org

Quality Review of Courseware on the NEEDS Database

- Establish Credibility of NEEDS as a Source of Quality Educational Material
- Enhance Recognition of Scholarly and Creative Effort of Courseware Developers
- Three Levels of Review
  - Non-reviewed
  - Gestalt Peer Review: Endorsed Courseware
  - National Competition: Premier Courseware

The NEEDS Database of Multimedia Courseware and Quality Review

- Integrated Database of Multimedia Engineering Courseware
  - Bibliographic records with downloadable courseware
  - Multimedia elements - downloadable movies, images, and text
- Multilevel Courseware Evaluation System
  - Peer Review of Courseware
  - Premier Award for Excellence in Engineering Education Courseware

Long Term Vision

Global Digital Library of Science, Math, Engineering and Technology Courseware

NEEDS

COURSEWARE CURRICULUM MATRIX

MULTIMEDIA SERVER

ACCESS SYSTEM

www.needs.org