NASA Conference Publication 3225

Transportable Applications Environment (TAE) Tenth Users' Conference

Edited by
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Presentations from a conference sponsored by the
NASA Goddard Space Flight Center
and held at the Goddard Space Flight Center
Greenbelt, Maryland
June 14–17, 1993

National Aeronautics
and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

1993

PREFACE

Goddard Space Flight Center sponsored the Tenth TAE Users' Conference on June 14-17, 1993 held at Goddard.

This document represents the proceedings of the Tenth TAE Users' Conference. The presentations included in these proceedings were published as received from the authors with little modification and editing.

Message From the TAE Project Manager

This was the first TAE conference that followed an informal workshop format with panel discussions, demonstrations, tutorials and working sessions. It provided a chance for all attendees to participate - and they did! The informal format worked extremely well and helped to create a very interactive environment. Attendees actively participated, and there was a good exchange of information and experiences between TAE users and developers. This feedback from many of you will help us plan future directions for TAE Plus.

The Tenth TAE Conference is the last TAE Users' Conference that Goddard Space Flight Center will coordinate. With the software being transferred into the private sector, all future user conferences will be managed by Century Computing, Inc., the commercial developers/distributors of TAE Plus. On this note, the conference offered a great opportunity for the TAE Project Office, the TAE Support Office and Century Computing to respond to TAE users' questions, concerns and comments about the commercialization of TAE. Several of the presentations discussed more details about the transfer and described what will be available in TAE Version 5.3, the first commercial release. I think we all came away with a better understanding of what the technology transfer "means to me".

Many thanks to each and everyone who participated in the conference.

Chris Rouff
TAE Project Manager
NASA/Goddard

Acknowledgements

The TAE Project would like to express its appreciation to everyone who demonstrated their application at the conference and to all those who participated in the panel sessions. In addition, we would like to thank the following individuals for their significant roles in planning and organizing the conference:

Elfrieda Harris, TAE Support Office, RMS Technologies, Inc.
Arleen Yeager, TAE Support Office, RMS Technologies, Inc.

TAE is a NASA software project within the Data Systems Technology Division at Goddard Space Flight Center with contract support by Century Computing, Inc. The work is sponsored by NASA's Office of Space Communications.

Presentations from the
Tenth TAE Users' Conference
June 14-17, 1993

Sponsored by
Goddard Space Flight Center

Held at
Goddard Space Flight Center
Greenbelt, Maryland

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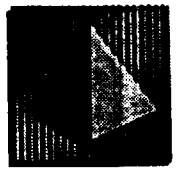
David Fout
Century Computing Inc.

Elizabeth Wei
Siemens Corp. Research



Tenth TAE Users' Conference '93

TAE Plus v5.2 User's Experiences with C++

David Fout

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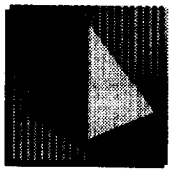
tae+



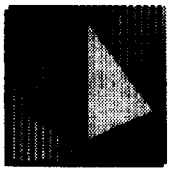
Outline

- Using the GNU g++ compiler
- Using the ObjectCenter Environment
- Data Manipulation in a TaePanel constructor
- TaePanelFile
- Examples of TAE and C++

Using the GNU g++ Compiler

- On Sun platforms, TAE Plus v5.2 is delivered with libraries built with the Sun C++ 2.0 C++ compiler.

- However, it also tested with g++ 1.40.3 on a Sun. If you want to use g++, you must recompile the entire tree. See *Building TAE Plus from Source* . (g++ can't link with Sun C++ compiled object code.)



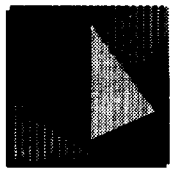
Using the ObjectCenter Environment

- Due to a bug in ObjectCenter 1.2, many items will not appear in the panels when running a debug session. (You can get a tedious workaround from the TAE Support Office if necessary.)
- This bug was fixed in ObjectCenter 2.0.

Data Manipulation in a TaePanel Constructor

- When dynamically changing information about a panel or its items in the panel's constructor, you must use the TaeVar or TaeVarTable classes.
- The TaePanel and TaeItem class can't be used because the Wpt panels have not been created yet. They are created by the TaePanel::Show method.

```
panel1C::panel1C (TaeCollection *collect) : TaePanel ("panel1",
    collect)
     {
     // create an instance of each item in the panel.
     new TaeItem (this, "button1", &button1_React);
    TaeVarTable* viewTable = this->ViewTable();
    TaeVar* panelVar = viewTable->GetTaeVar("_panel");
    TaeVar* itemVar = viewTable->GetTaeVar("button1");
    itemVar->Set("fg","black");
    panelVar->Set("bg","white");
    }
```



TaePanelFile

- TaePanelFile objects allow the user to register and field event sources such as file and socket descriptors.
- C++ binding to Wpt_AddEvent.
  - Subclass to give virtual methods your own functionality.

```
class PanelFileC : public TaePanelFile
    {
public:
    PanelFileC (int);
protected:
    virtual int HandleEvent (const TaeEventHandler&);
    };
```

TaePanelFile (cont)

```
int PanelFileC::HandleEvent(const TaeEventHandler& )
    {
#define BUFFER_SIZE 132
#define MIN_BYTE 1
    char buffer[BUFFER_SIZE];
    int n;
// NOTE: There are a few extra file events that can and are
   being ignored
    int fd = this->Descriptor();
    n = read(fd, buffer, BUFFER_SIZE-1);
    while (n>=MIN_BYTE)
        {
        printf("data byte = %s \t returned block size = %d byte
   \n", buffer, n);
        n = read(fd, buffer, BUFFER_SIZE);
        }
    return 0;
    }
```

TaePanelFile (cont)

- Create an instance

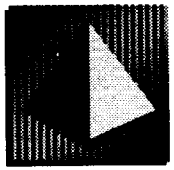
```
PanelFileC* PanelFile = new PanelFileC(fd);
```

- Now you must register the instance with the TaeEventHandler. One option is to register the instance in the subclass' constructor.

```
PanelFileC::PanelFileC (int d) : TaePanelFile (d)
    {
    eventHandler->Register(this, (int) WPT_UPDATE_READMASK);
    }
```

- De-register the object with TaeEventHandler. This is often done in the subclass' destructor.

```
eventHandler->Deregister(PanelFile);
```



Examples of TAE and C++

- $TAEDEMOSRC/ddodemo.cc and $TAEDEMOSRC/timerdemo.cc are two C++ programming examples delivered with TAE v5.2.
- New v5.2 Tips and Tricks document (coming soon)

Object Cloning

Elizabeth T. Wei

Object (Tae Item) Cloning

Instead of creating some maximum number of items on the panel, create only a sample in the workbench. At run time, based on certain information at hand, dynamically create needed new items by making each a clone of the sample item.

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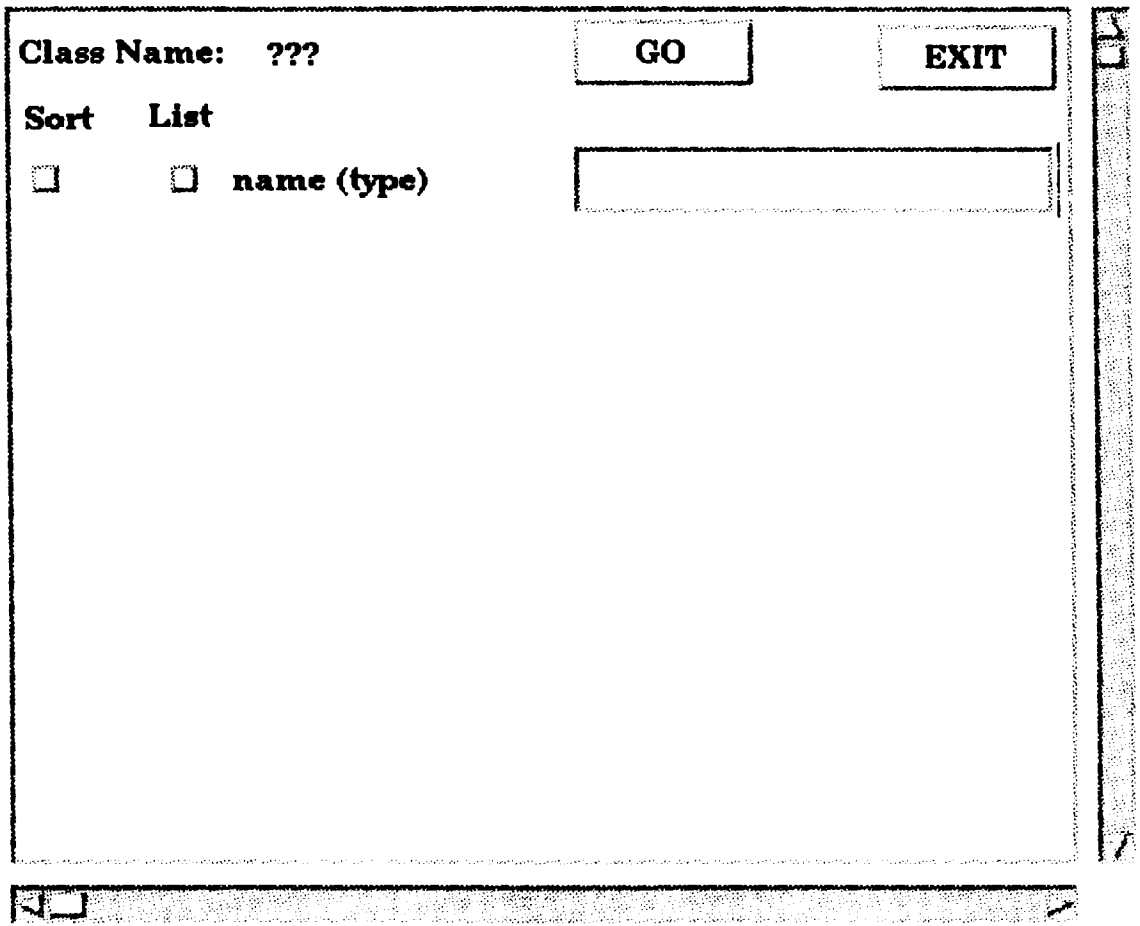
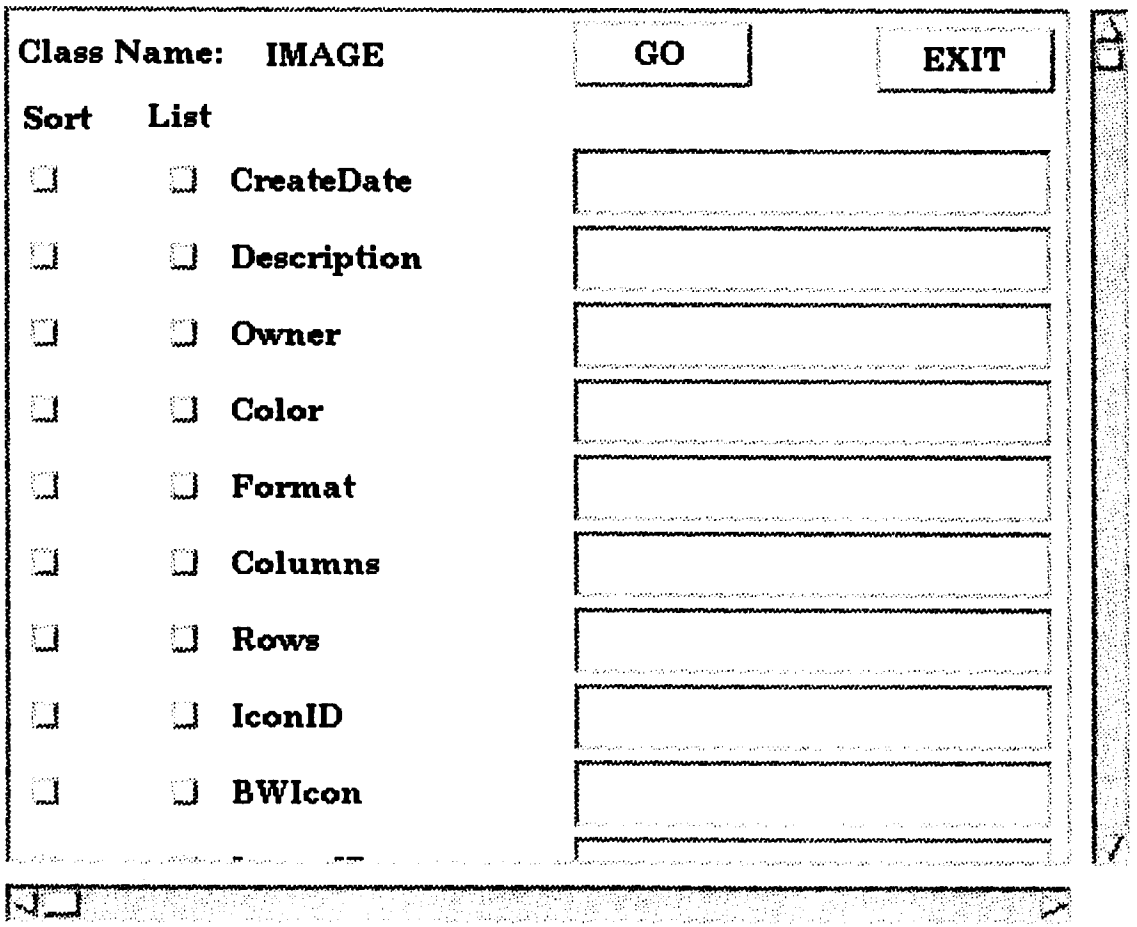
Rationale

- Number of items is unknown until run time.
- One event handler for all items.

Sample Objects Created using the Workbench



Objects Created At Run Time Through Cloning



Problems Encountered

Proctected clone method(s) (5.2 beta)

Work-around/Solution

My own 'clone' function

Much Better Solution

TAE+ 5.2

Work-around/Solution: my own 'clone' function

1. instantiate a new item:

   new_item = new sample_item_class (panel,new_item_name)

2. furnish the new item:

   - extract from the sample the resource values (both commom to all presentation types and specific to the type being dealt with)

   - set these resources for the newly instantiated item with extracted values except for a new location (i.e., the 'origin')

The Better Solution: official TAE+5.2

1. instantiate a new item:

```
new_item = new sample_item_class(panel,new_item_name,
                                 &react_func)
```

2. furnishing:

```
View/TargetTable()->Add(sample_item->GetView/TargetVar()
                        ->Clone(new_item_name))
```

User Experiences with Ada

Christina L. Langford
Coastal Systems Station

Roger Sheldon
Loral AeroSys

COMBAT SYSTEM TRAINING SIMULATOR

OPERATOR-MACHINE INTERFACE DEVELOPMENT

Using TAE+ and Ada

Christina L. Langford

Coastal Systems Station

Panama City Beach, FL

email: langford@phoebus.ncsc.navy.mil

SYSTEM OVERVIEW

Combat System Training Simulator:

Shipboard simulator to provide training for different combat systems.

Operator-Machine Interface (OMI):

Enables person on-board ship to

- Build scenario files for exercise
- Initiate a simulation exercise
- Monitor trainee performance during exercise
- Perform database management functions

DEVELOPMENT ENVIRONMENT

Silicon Graphics 4D/440VGX

IRIX 4.0.5

NCD 19" X-Terminal

Verdix Ada Compiler

TAE+ v5.1

resupgrade to v5.2

STARS Ada/X Bindings

TAE+ With STARS Ada/X Bindings

TAE+ libraries contain "X_Windows"

TAE code generator generates "X_Windows"

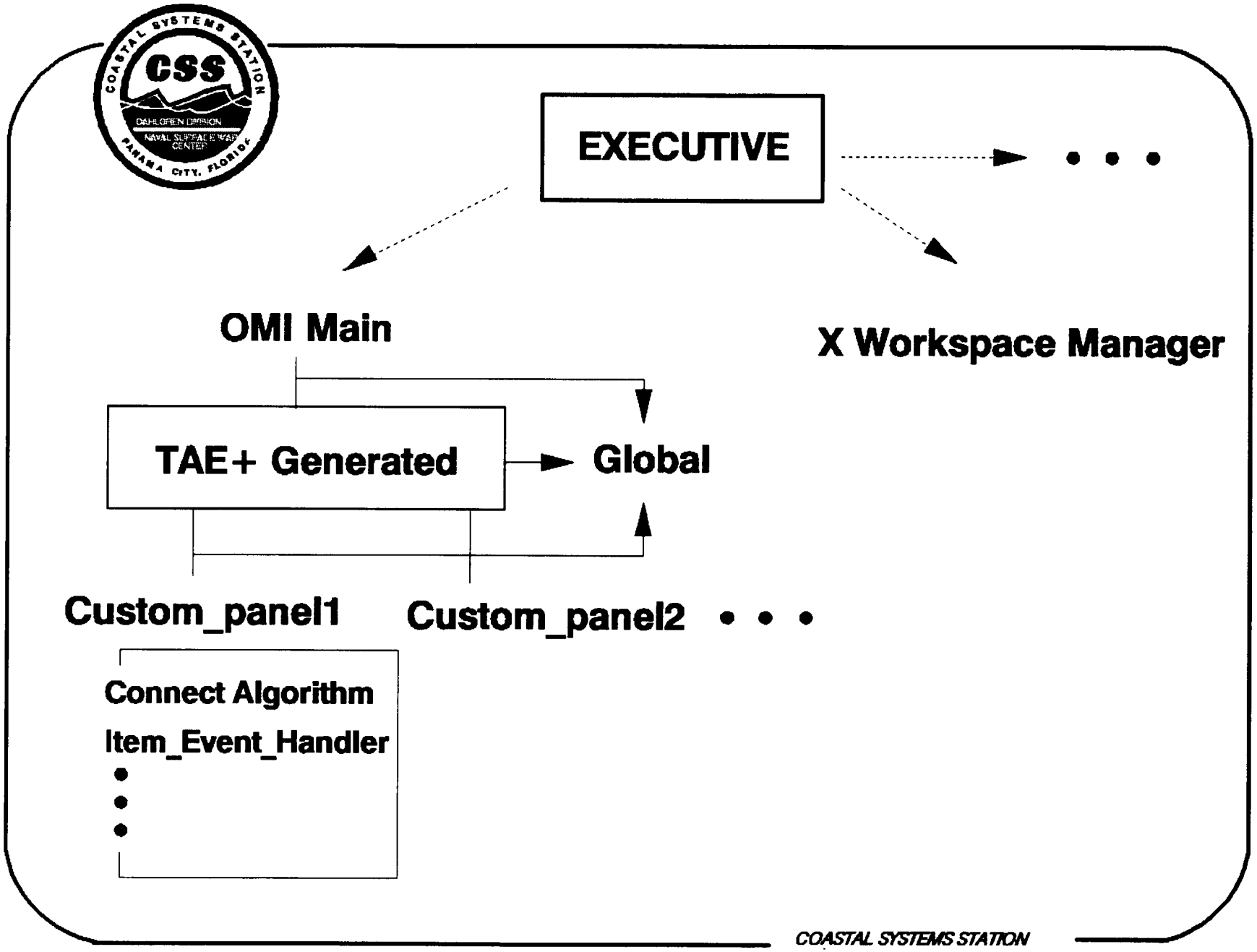
STARS Ada/X Bindings contain "X_Lib"

Modification of TAE+ libraries

*** replaced "X_Windows" with "X_Lib"**

Modification of TAE generated code

*** replaced occurrences of "X_Windows" with "X_Lib"**

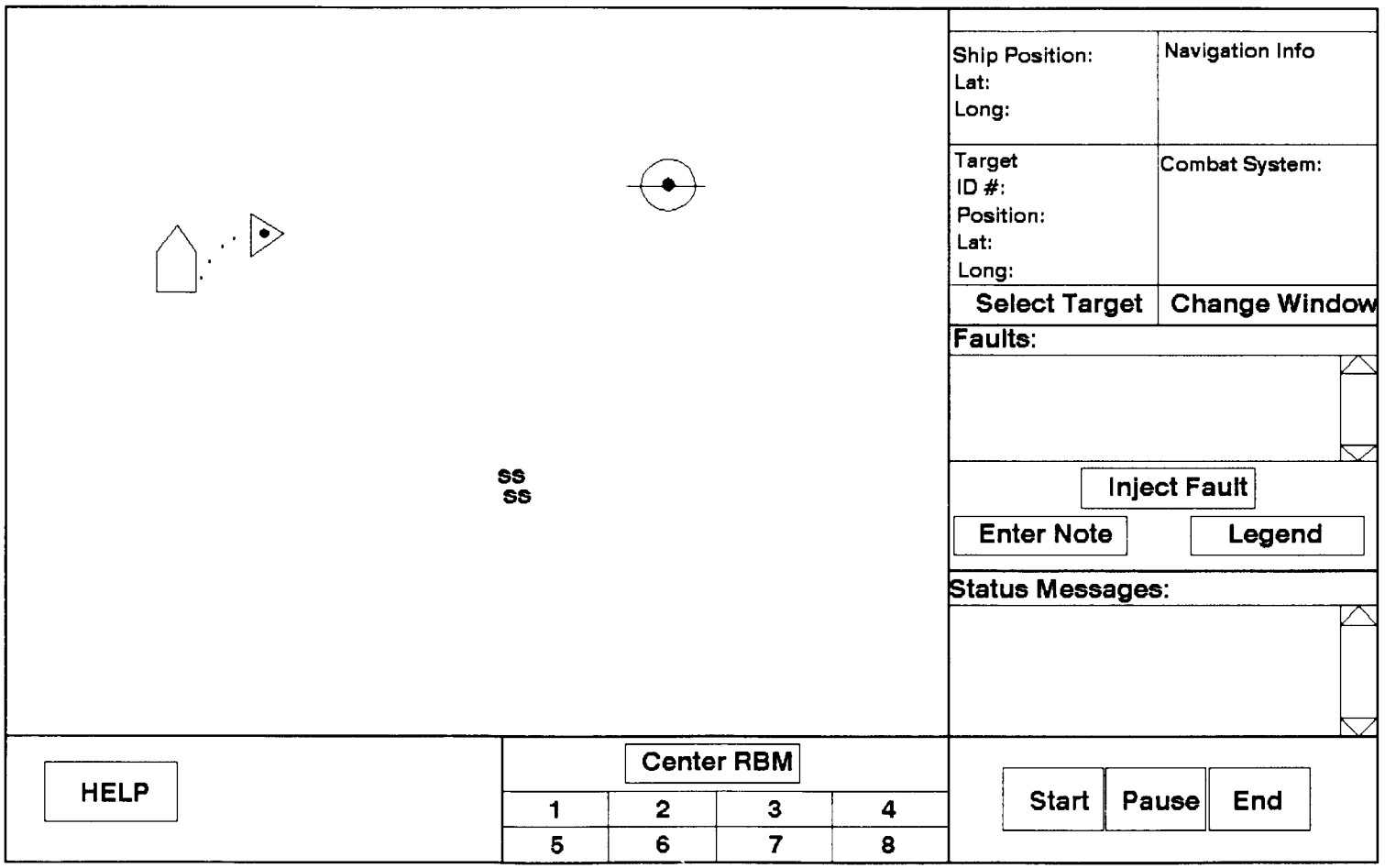

EXECUTIVE
OMI Main
X Workspace Manager
TAE+ Generated
Global
Custom_panel1
Custom_panel2
Connect Algorithm
Item_Event_Handler

OMI MAIN

MODIFICATION TO EVENT_LOOP

```
If SW error,
    Display Error Panel;
    -- Selections are "IN_PROGRESS" or "NOT_IN_PROGRESS"
    Set Selection to "NOT_IN_PROGRESS";
Else if Selection is "NOT_IN_PROGRESS"
    If an event is pending (Wpt_Pending)
        When Event_Type is WPT_PARM_EVENT =>
            Set up User_Context_Ptr;
            Set Event_Code;
            Set Selection to "IN_PROGRESS";
    Endif
 Else  if Selection is "IN_PROGRESS"
    Dispatch_Panel;
    Set Selection to "NOT_IN_PROGRESS";
Endif
```

Exercise Situation Display



EXERCISE SITUATION DISPLAY UPDATES

- **Update Dynamic Text Fields**

  Wpt_SetIntg, Wpt_SetReal, Wpt_SetString

- **Update Status Message Area**

```
message_vec : TAE.s_vector(1..n);
Vm_SetString_vec(Info.View,"item", n, message_vec, P_UPDATE);
Wpt_ViewUpdate(Info.Panel_Id, "item", Info.View, "item");
```

- **Update Label and Color of Pushbutton**

```
Vm_SetString(Info.View, "item", 1, "newlabel",P_UPDATE);
Vm_SetString(Info.View, "item.bg", 1, "color", P_UPDATE);
Wpt_ViewUpdate(Info.Panel_Id, "item", Info.View, "item");
```

EXERCISE SITUATION DISPLAY UPDATES (cont.)

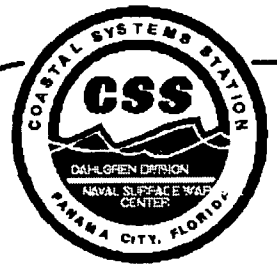
Extracting Multiple Selections from Selection List

```
ptr_to_selections : variable_ptr
sel_count : taeint
selections : array (1..1) of (1..tae_taeconf.STRINGSIZE)
my_list : array (1..n) of string (1..s)
my_count : integer

Vm_Find(Info.target, "item", ptr_to_selections)
Vm_Extract_Count(ptr_to_selections, sel_count)
my_count := integer(sel_count)
For J in 1..sel_count loop
    Vm_Extract_SVAL(ptr_to_selections, J, selections(J))
    my_list(integer(J)) := selections(J)(1..s)
end loop
```

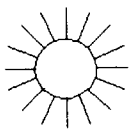
EXERCISE SITUATION DISPLAY UPDATES (cont.)

Retrieving User Selected Position in X Workspace

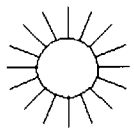
```
-- This code is in X Workspace event handler
X_Event : X_Lib.Events.Event
X_Window_Id : X_Lib.Window
X_Window_X, X_Window_Y : X_Lib.Coordinate

Wpt_ItemWindow(Info.Panel_Id, "xworkspace", X_Window_Id);
Wpt_Extract_Parm_xEvent(Global.Event_Ptr, X_Event)
When X_Event.Kind is Button_Press or Button_Release =>
XQueryPointer(...,X_Window_Id,...,X_Window_X, X_Window_Y,..)

-- X_Window_X and X_Window_Y contain the user
-- selected position in the X Workspace.
```



CONCLUSION



TAE PROVIDES RAPID DEVELOPMENT AND EASY MAINTENANCE OF USER INTERFACE



TAESO AND BULLETIN BOARD ARE ALWAYS HELPFUL

TAE ON-LINE MAN PAGES (V5.2) LACK ADA SPECIFIC LIBRARY ROUTINES

NOT ALL TAE LIBRARY ROUTINES WORK CORRECTLY

TAE+ in Ada

Using Ada with TAE+

Roger Sheldon

Loral AeroSys

Agenda

- Describe application
- Discuss Pros and Cons of using TAE+ and Ada
- Summary

Overview of Application

- Developed a planning and scheduling tool, SORTIM, for the US Air Force.
- Performs resource scheduling for student pilot training. Resources include students, instructor pilots, aircraft, simulators, and classrooms.
- SORTIM is based on ROSE, the Request Oriented Scheduling Engine. ROSE was developed by Loral AeroSys for NASA Goddard Space Flight Center. ROSE has it's own GUI developed in Ada using TAE+, Motif, and X Windows.

Overview of Application, cont.

- SORTIM is based on ROSE, but has a completely different user interface, also developed using TAE+, Motif, and X Windows.

Pros of Using TAE+ and Ada

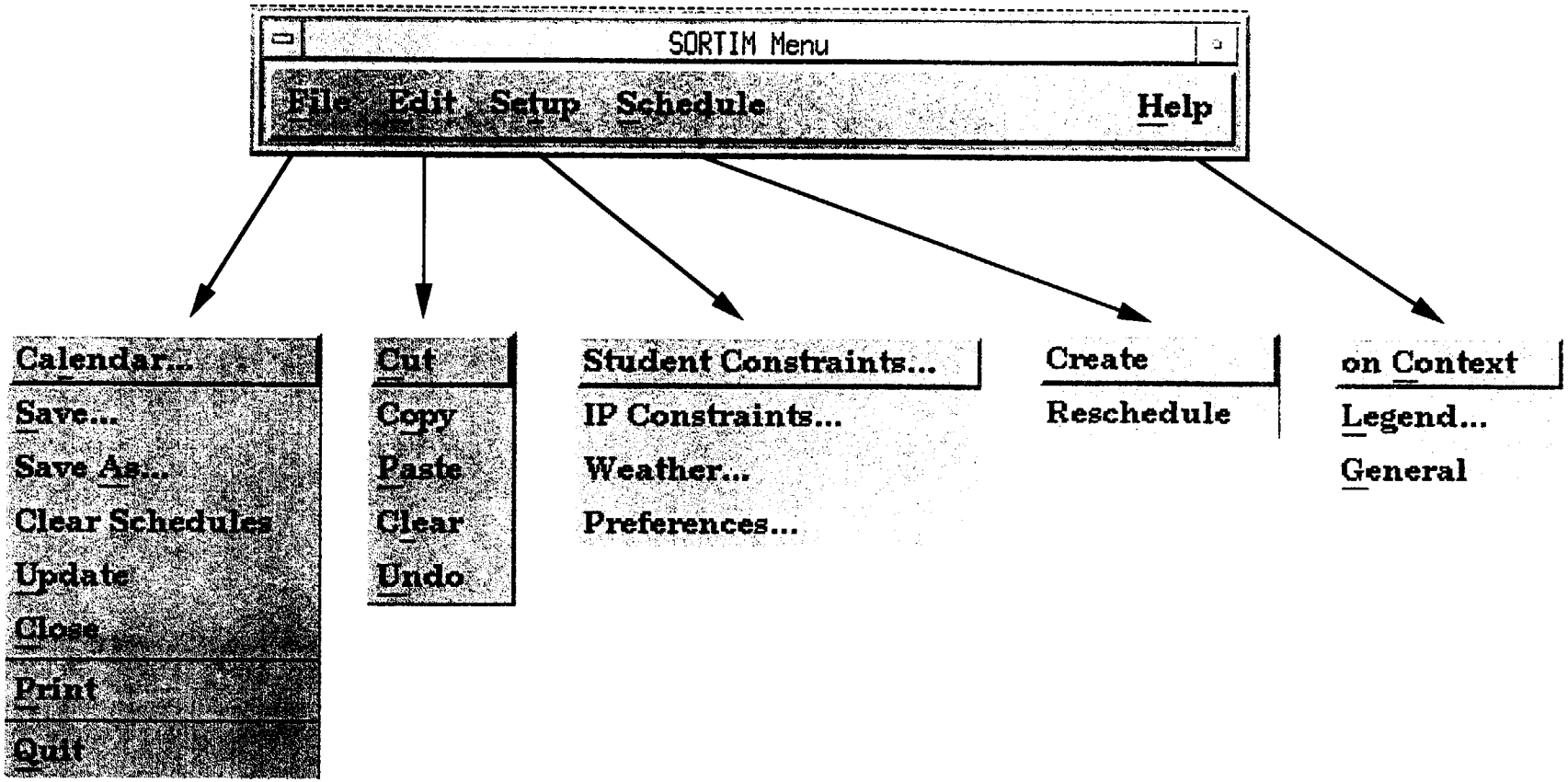
- By using Ada, the programmer is less likely to write buggy code due to Ada's strong type checking.

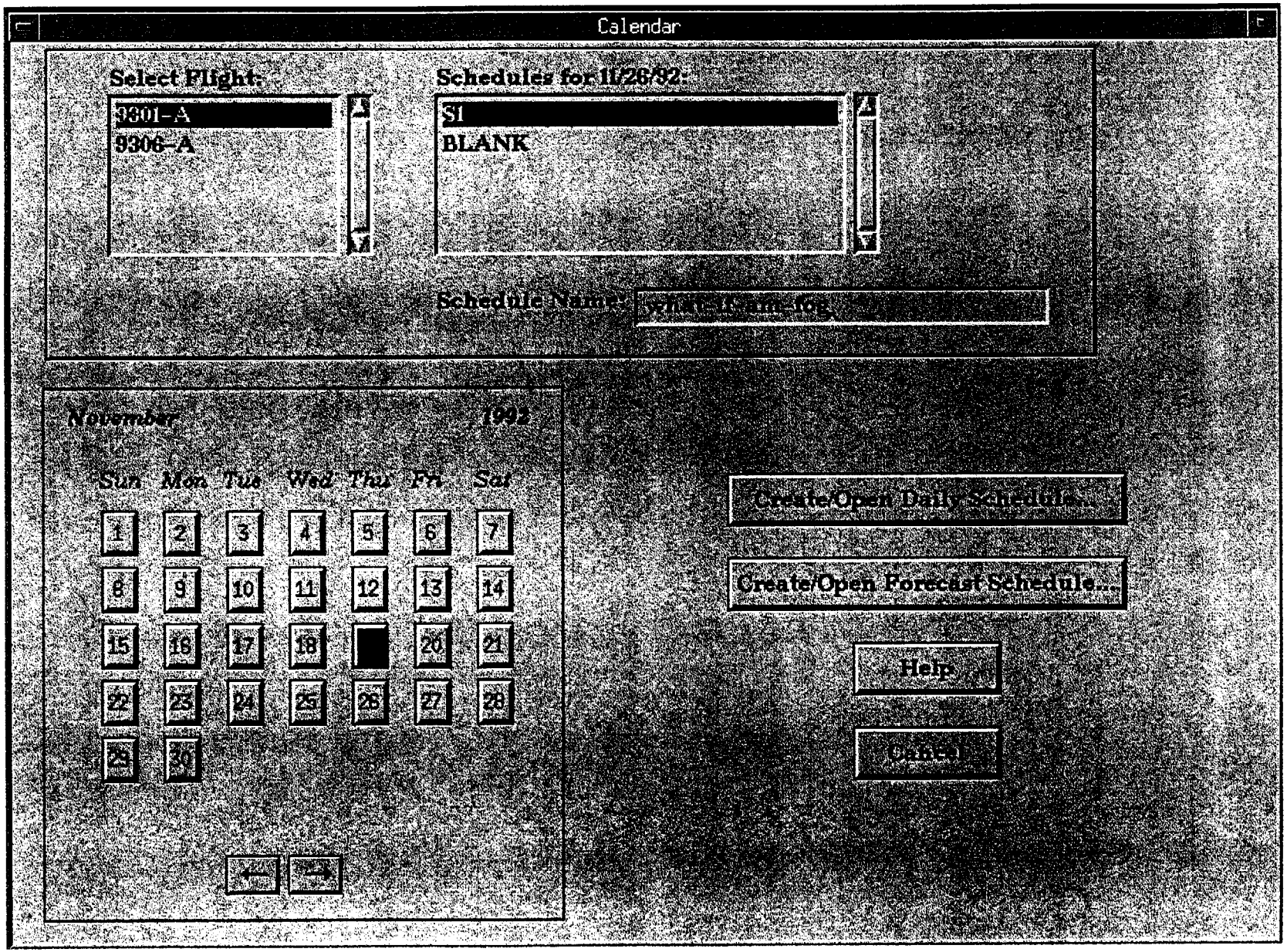
Cons of Using TAE+ and Ada

- TAE+ was written in C++. The Ada bindings to TAE+ do not match exactly with the programmer's interface available to the C++ programmer.
- The underlying Ada bindings to Motif and X Windows also fail to provide all the features available to the C programmer.
- Some of the Ada bindings are broken.

Summary

- Using TAE+ to develop the SORTIM GUI saved considerable time.
- Given a choice, the best language to use with TAE+ is C++.


SORTIM Menu
File Edit Setup Schedule Help
Calendar...
Save...
Save As...
Clear Schedules
Update
Close
Print
Quit
Cut
Copy
Paste
Clear
Undo
Student Constraints...
IP Constraints...
Weather...
Preferences...
Create
Reschedule
on Context
Legend...
General


Calendar
Select Flight:
3801-A
9306-A
Schedules for 11/26/92:
SI
BLANK
Schedule Name:
November
1992
Sun Mon Tue Wed Thu Fri Sat
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 20 21
22 23 24 25 26 27 28
29 30
Create/Open Daily Schedule...
Create/Open Forecast Schedule...
Help
Cancel

Keynote Address

Managing the Design of the User Interface

Deborah Mayhew
Deborah Mayhew and Associates

DJMA

Managing the Design of the User Interface

Prepared for

TAE
Tenth Users' Conference

June 1993

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508-693-7149

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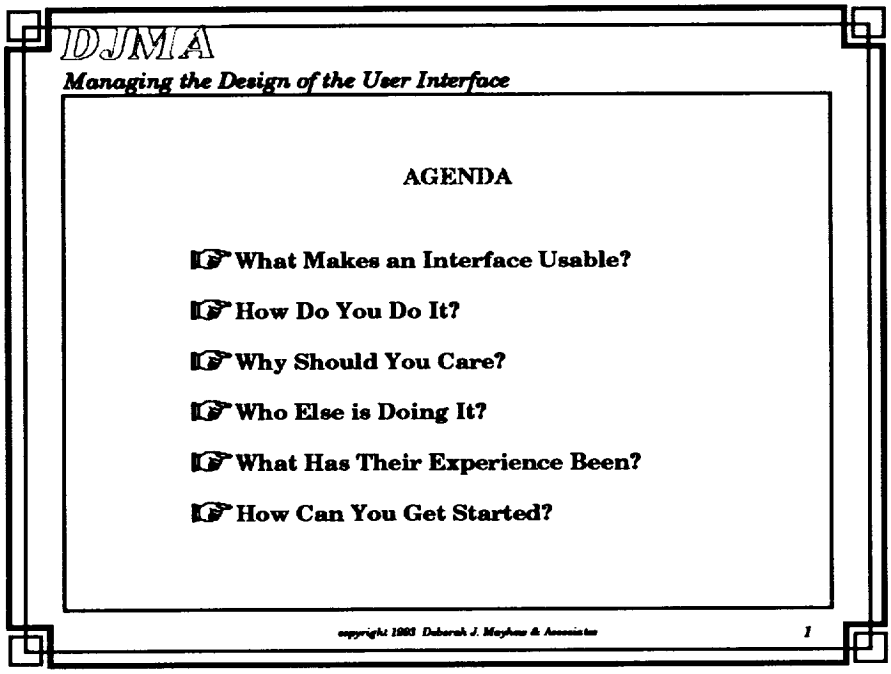
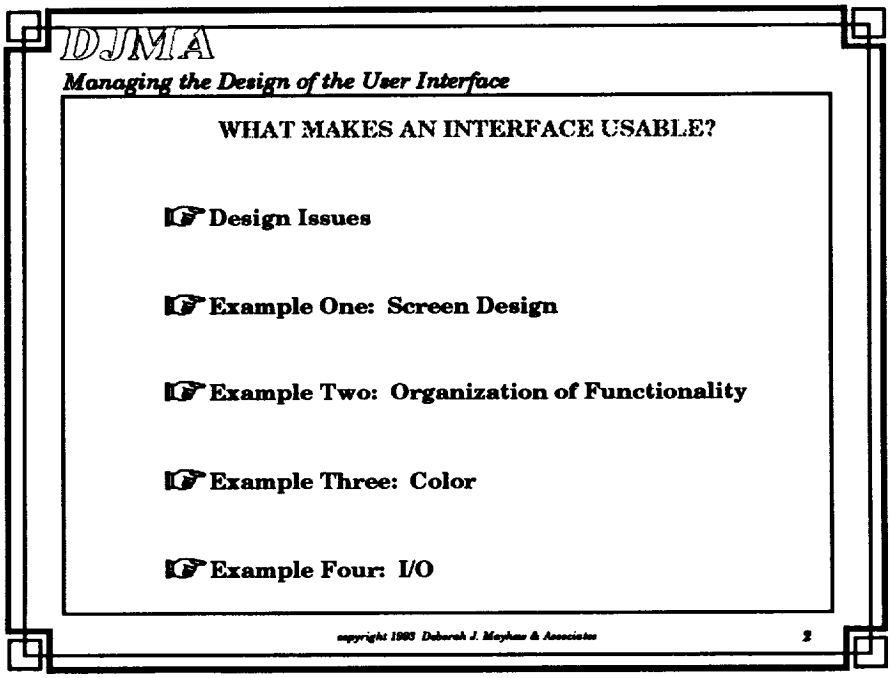
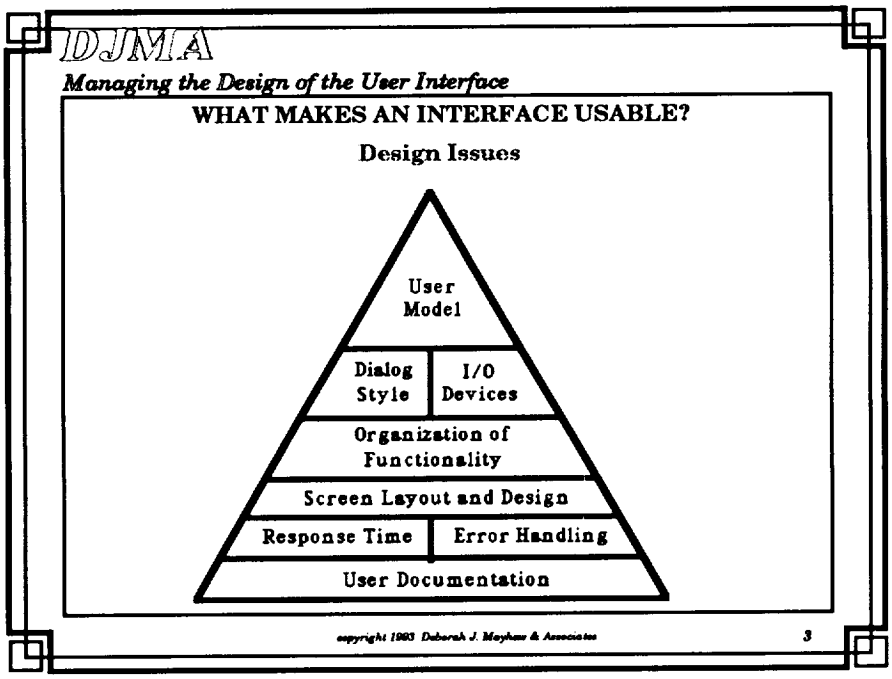
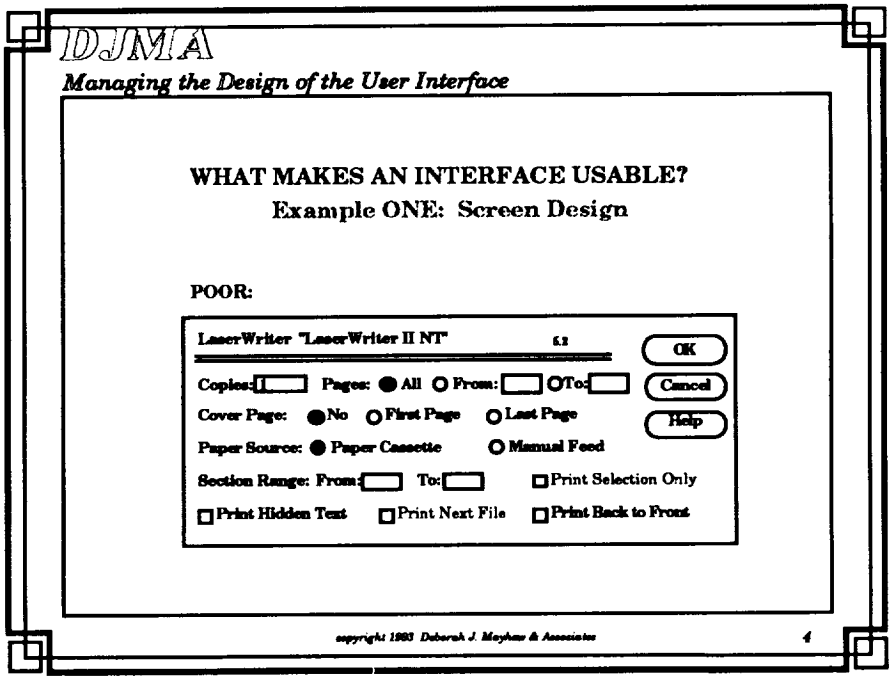




Managing the Design of the User Interface





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Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?
Example ONE: Screen Design

PRINCIPLES:

- **Poor use of white space**
- **No grouping**
- **Group titles not distinguished from captions - hard to find**
- **Horizontal orientation of menus - hard to read**
- **Poor ordering**
- **Inconsistent button location**

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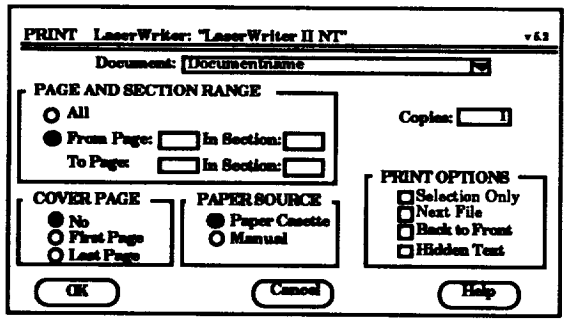
Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?
Example ONE: Screen Design

IMPROVED:



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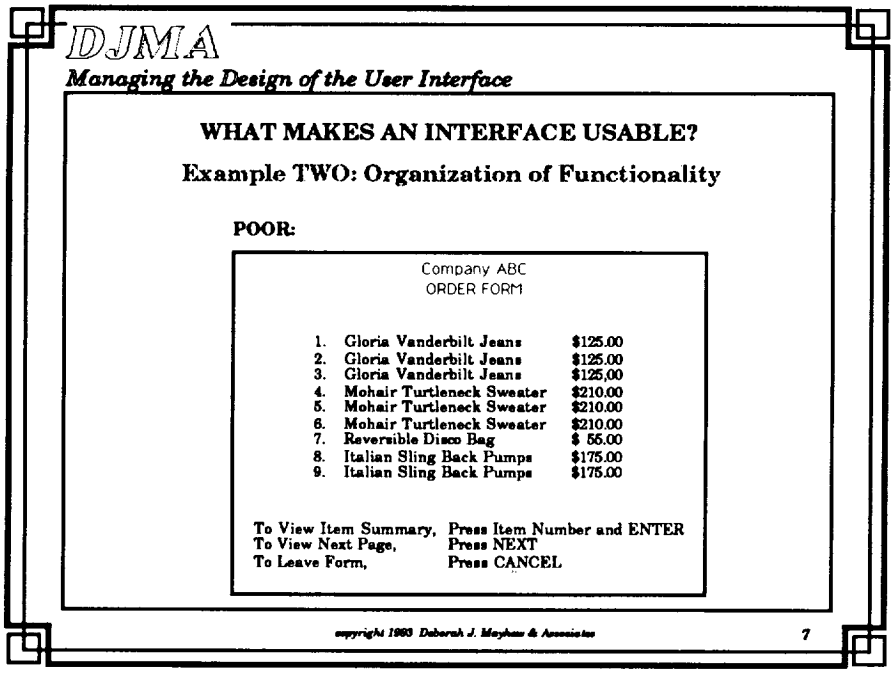
DJMA
Managing the Design of the User Interface
WHAT MAKES AN INTERFACE USABLE?
Example TWO: Organization of Functionality
POOR:
Company ABC
ORDER FORM
1. Gloria Vanderbilt Jeans $125.00
2. Gloria Vanderbilt Jeans $125.00
3. Gloria Vanderbilt Jeans $125.00
4. Mohair Turtleneck Sweater $210.00
5. Mohair Turtleneck Sweater $210.00
6. Mohair Turtleneck Sweater $210.00
7. Reversible Disco Bag $ 55.00
8. Italian Sling Back Pumps $175.00
9. Italian Sling Back Pumps $175.00
To View Item Summary, Press Item Number and ENTER
To View Next Page, Press NEXT
To Leave Form, Press CANCEL
copyright 1993 Deborah J. Mayhew & Associates
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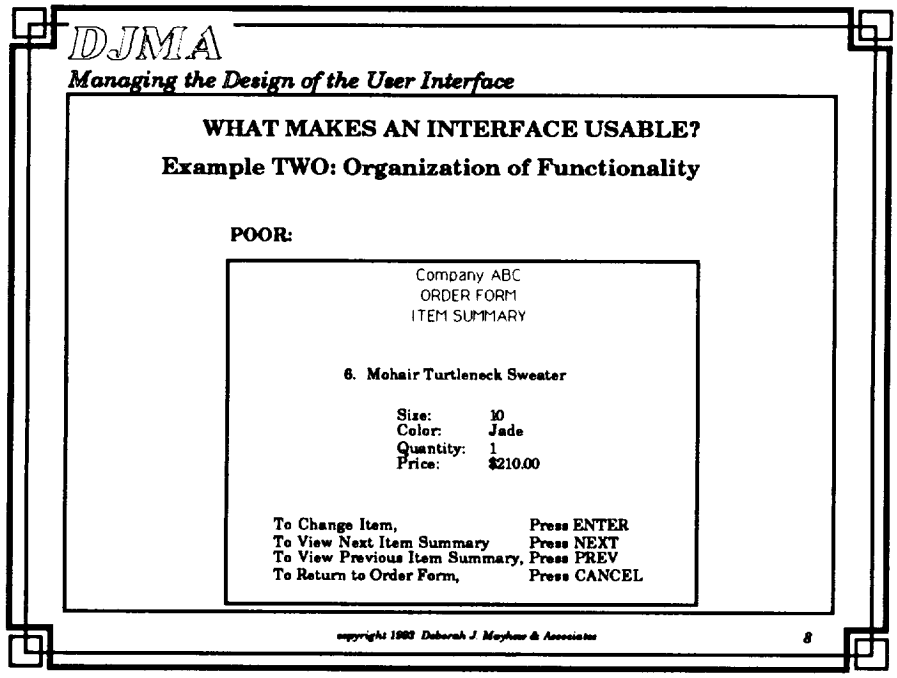
DJMA
Managing the Design of the User Interface
WHAT MAKES AN INTERFACE USABLE?
Example TWO: Organization of Functionality
POOR:
Company ABC
ORDER FORM
ITEM SUMMARY
6. Mohair Turtleneck Sweater
Size: 10
Color: Jade
Quantity: 1
Price: $210.00
To Change Item, Press ENTER
To View Next Item Summary Press NEXT
To View Previous Item Summary, Press PREV
To Return to Order Form, Press CANCEL
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Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?

Example TWO: Organization of Functionality

PRINCIPLES:

Overtaxes human short-term memory

Tedious navigation

Organization does not support user task

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Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?

Example TWO: Organization of Functionality

IMPROVED:

Company ABC
ORDER FORM

NO.	ITEM	COLOR	SIZE	PRICE	QUANTITY
1	Jeans	Black	8	$125.00	1
2	Jeans	Black	10	$125.00	1
3	Jeans	Black	12	$125.00	1
4	Sweater	Red	8	$210.00	1
5	Sweater	Blue	8	$210.00	1
6	Sweater	Orange	8	$210.00	1
7	Disco Bag			$ 55.00	1
8	Pumps	Black	81/2M	$175.00	1
9	Pumps	Black	9M	$175.00	1

To View Item Summary, Press Item Number and ENTER
To View Next Page, Press NEXT
To Leave Form, Press CANCEL

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Managing the Design of the User Interface

DJMA

Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?

Example THREE: Color

POOR:

4/13/93 XYZ SYSTEM 3:30 pm

Accounts Payable

NAME	ACCT #	DUE DATE	PAID
Alberts, S.	123-45	4/ 1/93	Yes
Camon, S.	418-44	4/ 1/93	No
Fisher, S.	334-01	4/15/93	No
James, R.	214-91	4/26/93	No
Jones, P.	987-23	4/ 7/93	Yes
March, K.	441-88	4/12/93	No

To scroll forward Press DOWN To exit, Press CANCEL
To scroll back, Press UP

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Managing the Design of the User Interface

WHAT MAKES AN INTERFACE USABLE?

Example THREE: Color

PRINCIPLES:

- **Use color sparingly**
- **Use color to support the user's task**
- **Use color consistently**
- **Provide good foreground/background contrast**
- **Color contrasts better with black or white than with other colors**
- **Use lighter (vs. darker) colors to draw attention**
- **Avoid saturated blue for text**
- **Exploit cultural color associations**
- **"Warm" colors appear larger than "cool" colors**
- **Allow users to turn color coding off or ask for different coding criteria**

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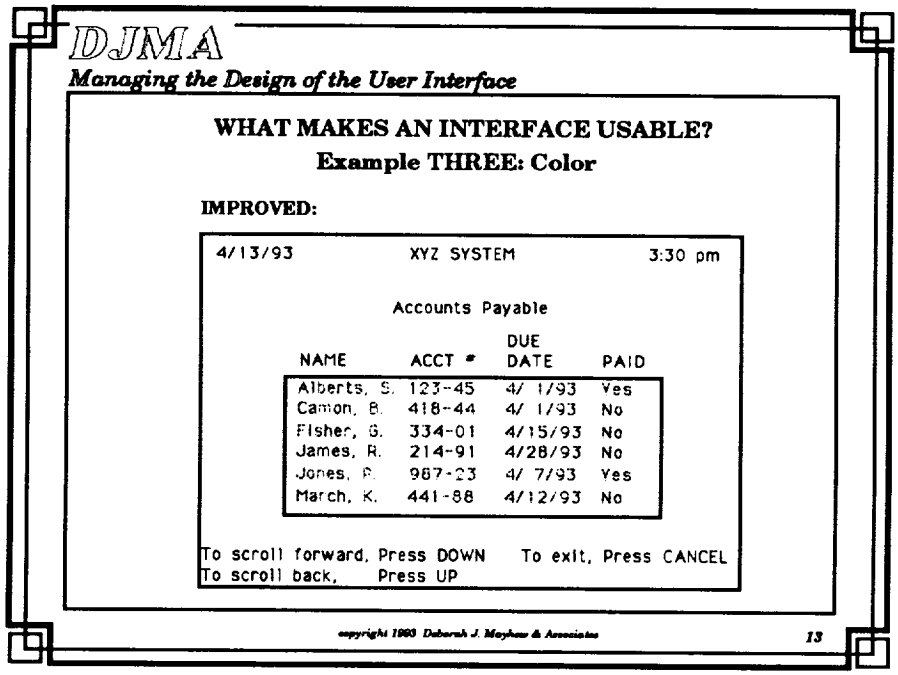
DJMA
Managing the Design of the User Interface
WHAT MAKES AN INTERFACE USABLE?
Example THREE: Color
IMPROVED:
4/13/93 XYZ SYSTEM 3:30 pm
Accounts Payable
NAME ACCT # DUE DATE PAID
Alberts, S. 123-45 4/ 1/93 Yes
Camon, B. 418-44 4/ 1/93 No
Fisher, G. 334-01 4/15/93 No
James, R. 214-91 4/28/93 No
Jones, P. 987-23 4/ 7/93 Yes
March, K. 441-88 4/12/93 No
To scroll forward, Press DOWN To exit, Press CANCEL
To scroll back, Press UP
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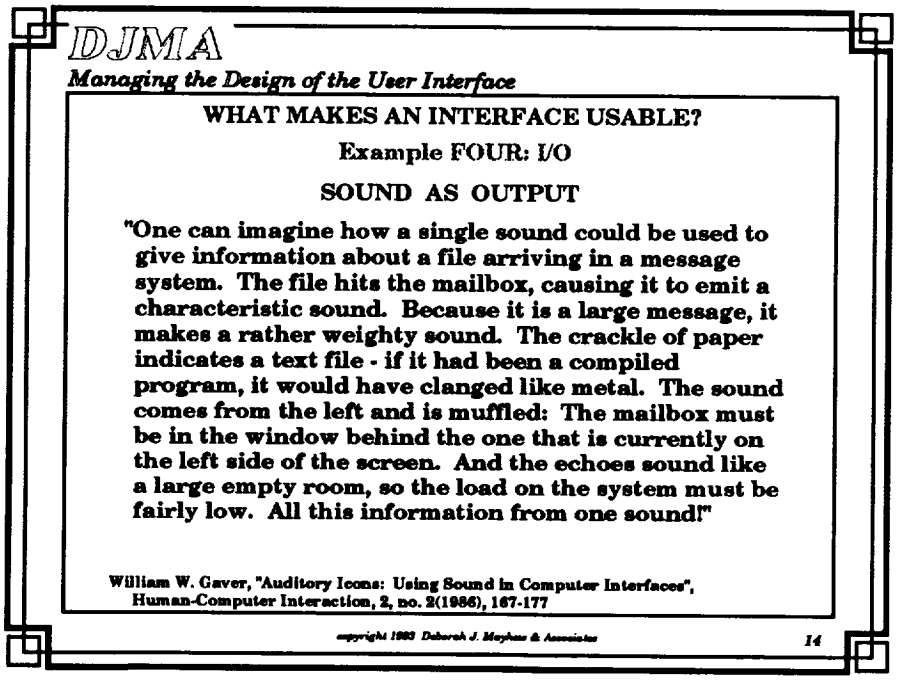
DJMA
Managing the Design of the User Interface
WHAT MAKES AN INTERFACE USABLE?
Example FOUR: I/O
SOUND AS OUTPUT
"One can imagine how a single sound could be used to give information about a file arriving in a message system. The file hits the mailbox, causing it to emit a characteristic sound. Because it is a large message, it makes a rather weighty sound. The crackle of paper indicates a text file - if it had been a compiled program, it would have clanged like metal. The sound comes from the left and is muffled: The mailbox must be in the window behind the one that is currently on the left side of the screen. And the echoes sound like a large empty room, so the load on the system must be fairly low. All this information from one sound!"
William W. Gaver, "Auditory Icons: Using Sound in Computer Interfaces", Human-Computer Interaction, 2, no. 2(1986), 167-177
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Managing the Design of the User Interface

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Managing the Design of the User Interface

HOW DO YOU DO IT?

☞ **Principles and Guidelines**

☞ **Methods**

☞ **Expertise**

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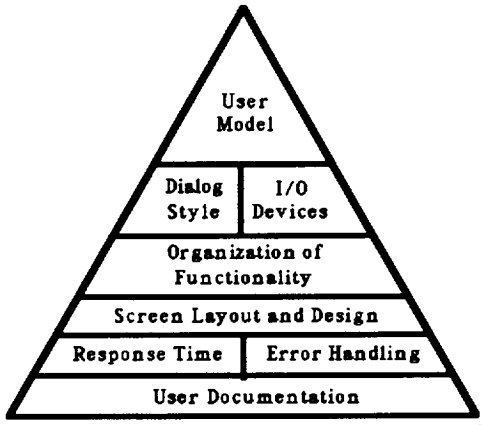
HOW DO YOU DO IT?

Principles and Guidelines



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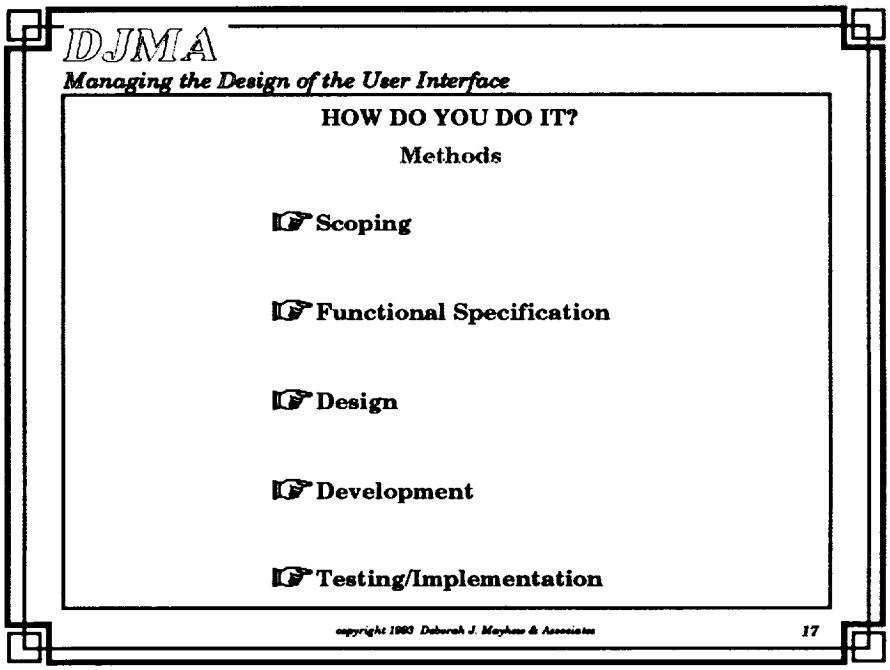

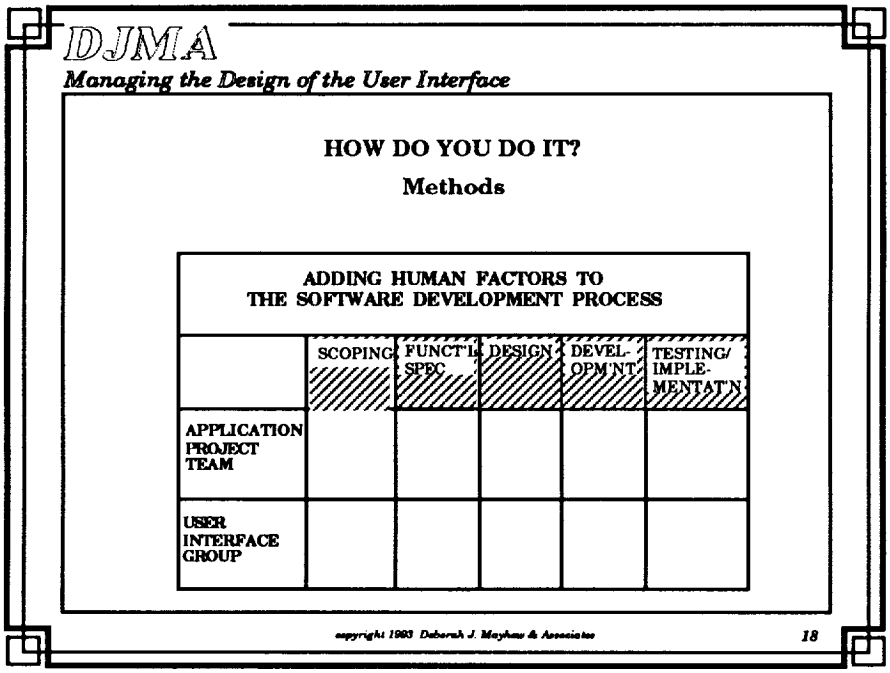

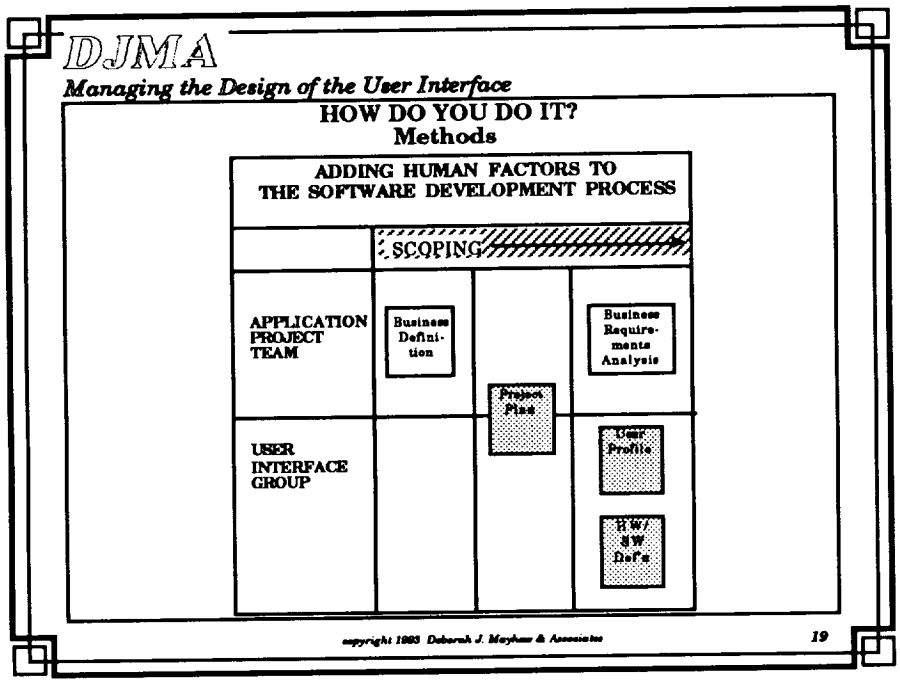
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Managing the Design of the User Interface
HOW DO YOU DO IT?
Methods
ADDING HUMAN FACTORS TO THE SOFTWARE DEVELOPMENT PROCESS
SCOPING
APPLICATION PROJECT TEAM
USER INTERFACE GROUP
Business Definition
Project Plan
Business Requirements Analysis
User Profile
H/W S/W Def'n
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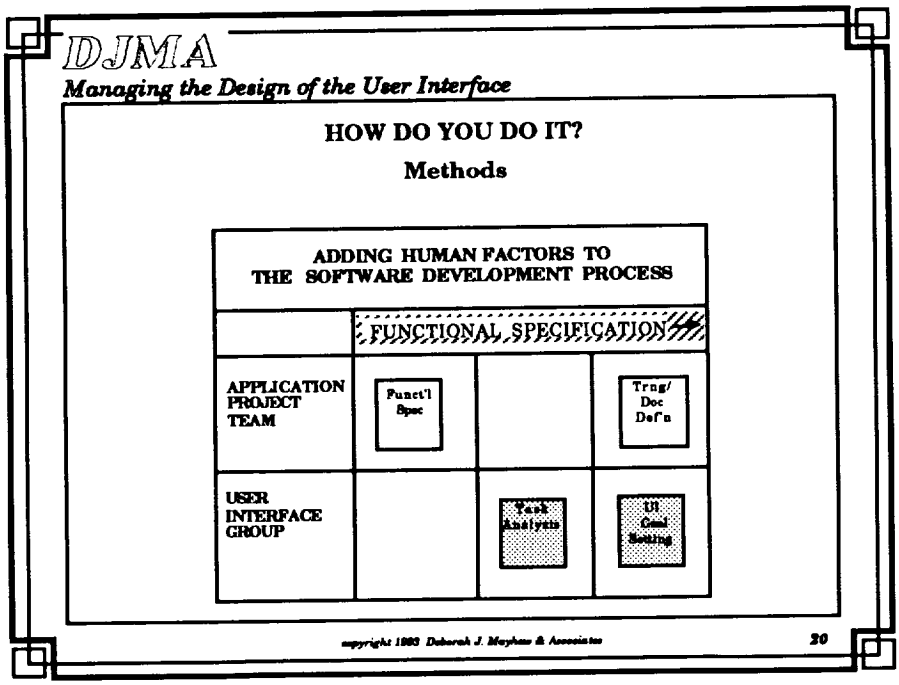
DJMA
Managing the Design of the User Interface
HOW DO YOU DO IT?
Methods
ADDING HUMAN FACTORS TO THE SOFTWARE DEVELOPMENT PROCESS
FUNCTIONAL SPECIFICATION
APPLICATION PROJECT TEAM
USER INTERFACE GROUP
Funct'l Spec
Trng/ Doc Def'n
Task Analysis
UI Cmnt Testing
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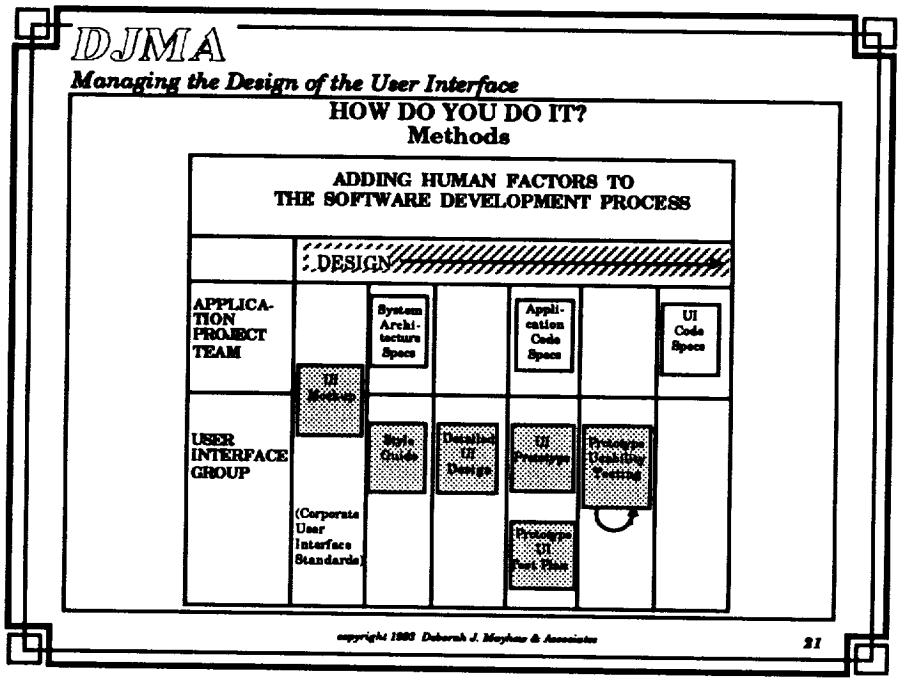

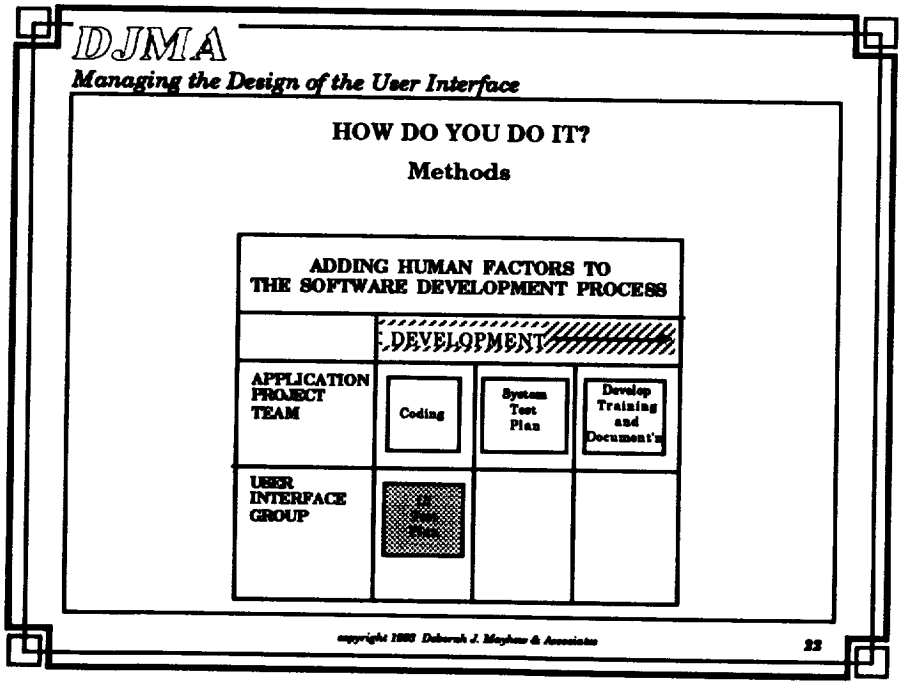

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Managing the Design of the User Interface

HOW DO YOU DO IT?

Methods

ADDING HUMAN FACTORS TO THE SOFTWARE DEVELOPMENT PROCESS			
	TESTING/IMPLEMENTATION		
APPLICATION PROJECT TEAM	Software Testing	Hardware/ Installation Testing	Production Testing
USER INTERFACE GROUP		UI Testing	UI Production

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Managing the Design of the User Interface

HOW DO YOU DO IT?

Expertise

Senior Human Factors Engineer

Minimum Requirements:

- Ph.D. or Masters degree in Cognitive Psychology or Human Factors
- Minimum 3-5 years experience as a human factors professional
- Minimum 3-5 years experience in a software development environment
- Experience managing human factors/user interface projects
- Experience conducting user profiles
- Experience performing task analyses
- Experience designing user interfaces
- Experience developing style guides
- Experience designing and implementing usability tests
- Strong interpersonal skills
- Strong negotiating skills

On-The-Job Training:

- Send to short courses on advanced topics in user interface design
- Send to annual SIGCHI and Human Factors Society conferences

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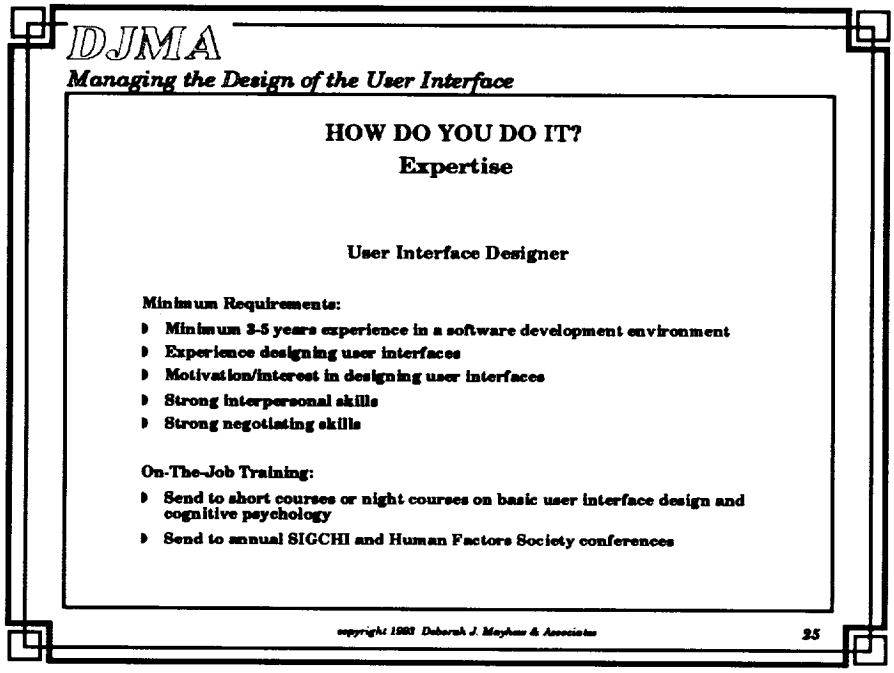
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Managing the Design of the User Interface
HOW DO YOU DO IT?
Expertise
User Interface Designer
Minimum Requirements:
Minimum 3-5 years experience in a software development environment
Experience designing user interfaces
Motivation/interest in designing user interfaces
Strong interpersonal skills
Strong negotiating skills
On-The-Job Training:
Send to short courses or night courses on basic user interface design and cognitive psychology
Send to annual SIGCHI and Human Factors Society conferences
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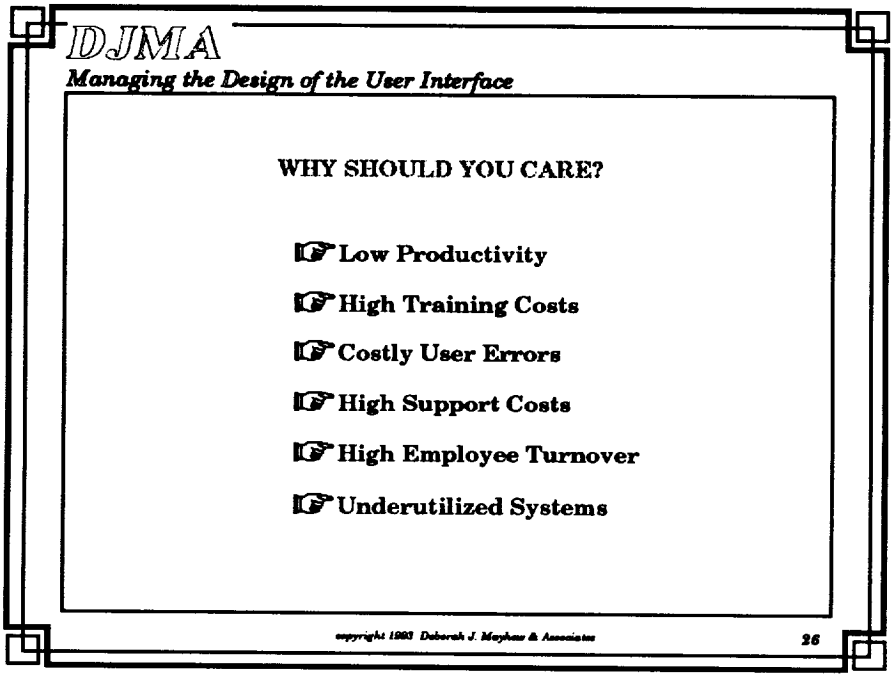
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WHY SHOULD YOU CARE?
Low Productivity
High Training Costs
Costly User Errors
High Support Costs
High Employee Turnover
Underutilized Systems
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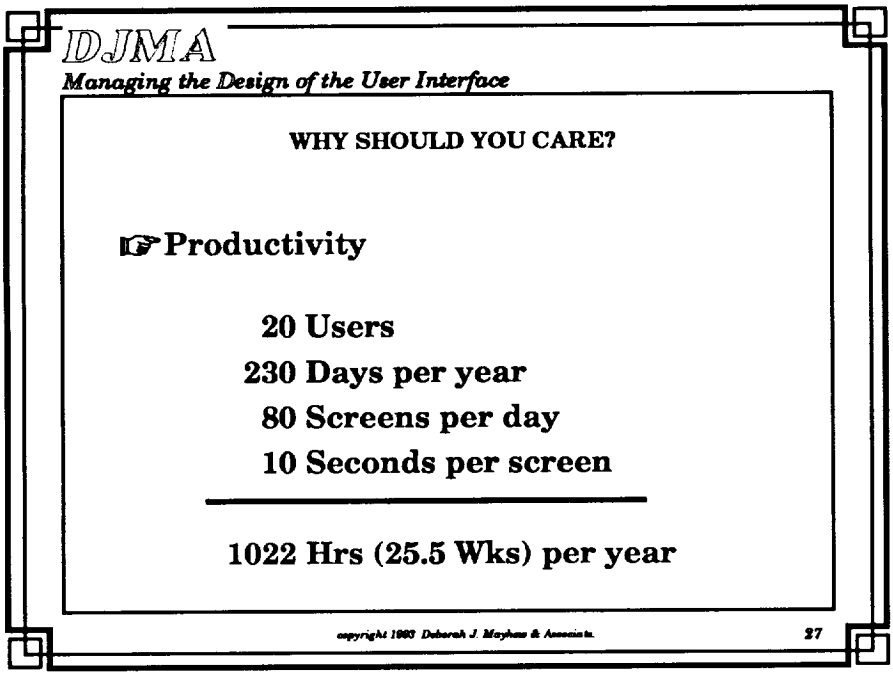
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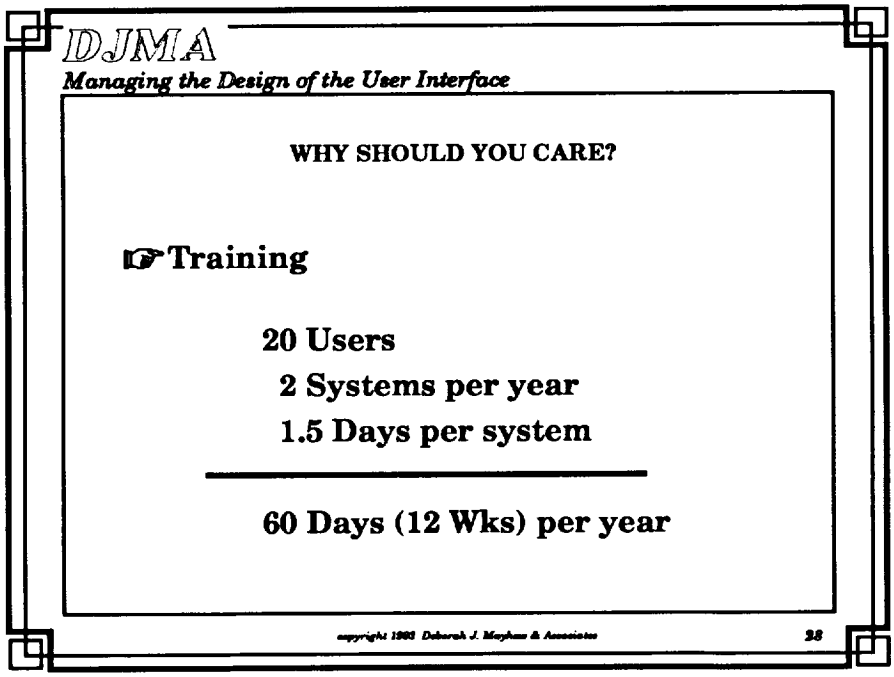
WHY SHOULD YOU CARE?
☞Productivity
20 Users
230 Days per year
80 Screens per day
10 Seconds per screen
1022 Hrs (25.5 Wks) per year
27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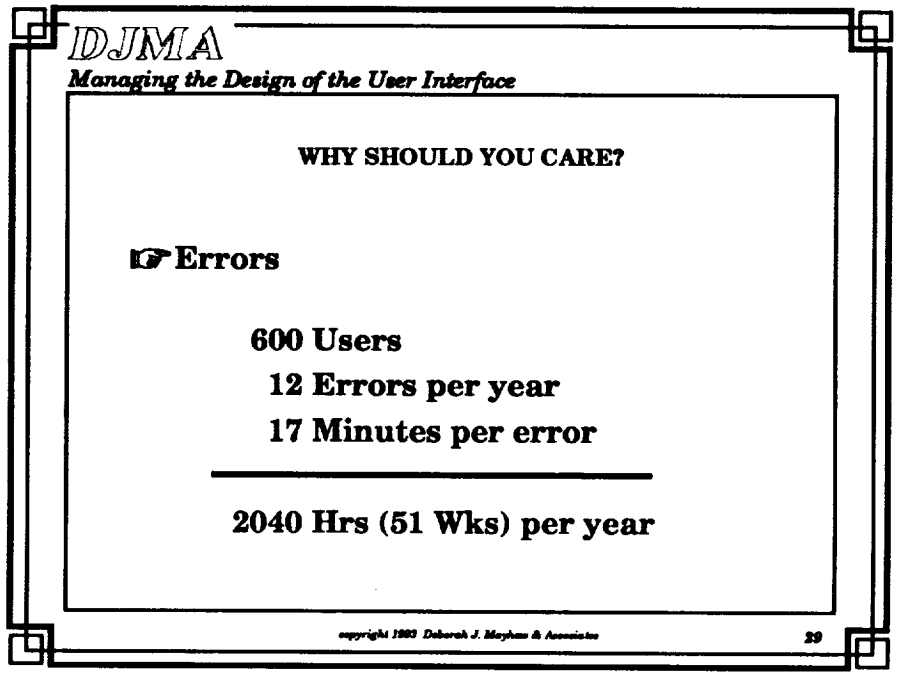
WHY SHOULD YOU CARE?
☞Training
20 Users
2 Systems per year
1.5 Days per system
60 Days (12 Wks) per year
28


DJMA
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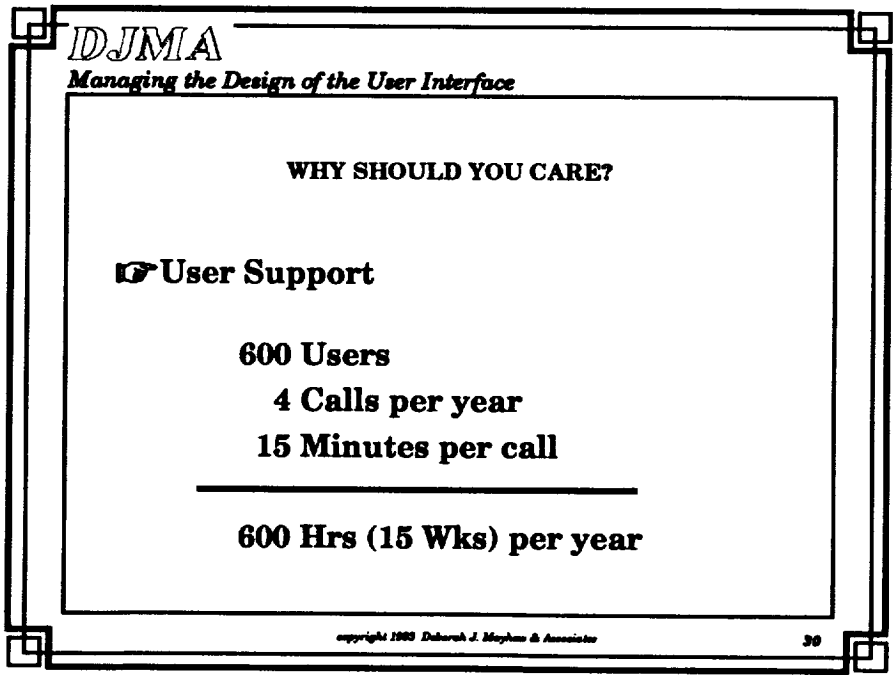
WHY SHOULD YOU CARE?
☞Errors
600 Users
12 Errors per year
17 Minutes per error
2040 Hrs (51 Wks) per year
29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WHY SHOULD YOU CARE?
☞User Support
600 Users
4 Calls per year
15 Minutes per call
600 Hrs (15 Wks) per year
30

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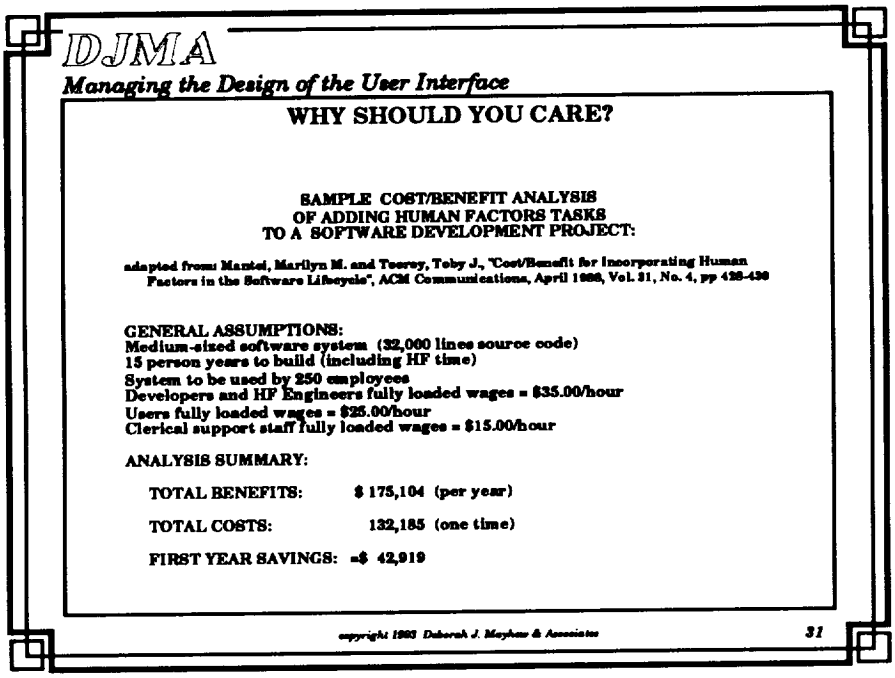

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WHY SHOULD YOU CARE?

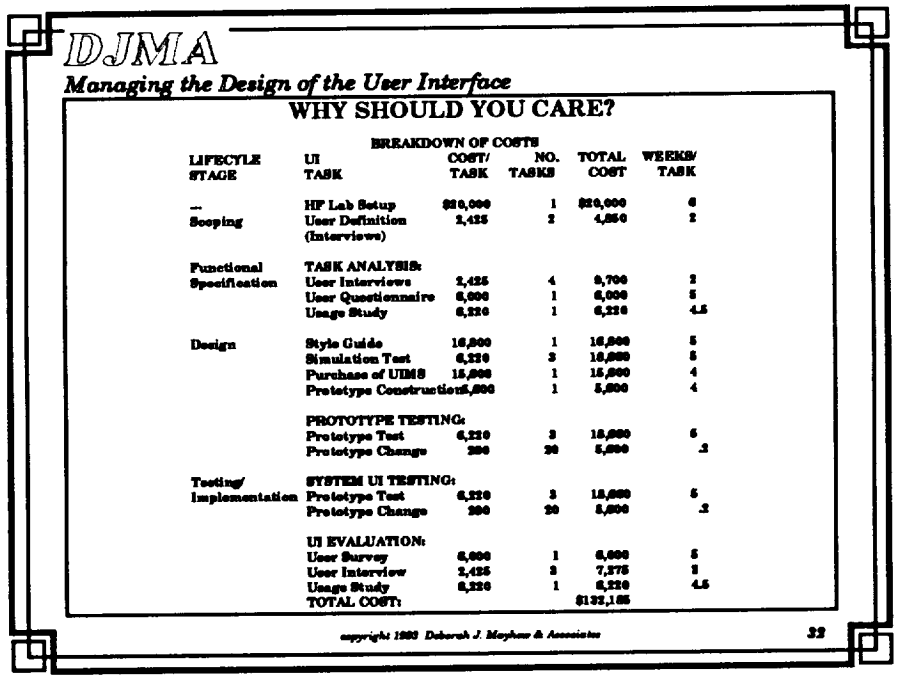
SAMPLE COST/BENEFIT ANALYSIS
OF ADDING HUMAN FACTORS TASKS
TO A SOFTWARE DEVELOPMENT PROJECT:

adapted from: Mantei, Marilyn M. and Teorey, Toby J., "Cost/Benefit for Incorporating Human Factors in the Software Lifecycle", ACM Communications, April 1988, Vol. 31, No. 4, pp 428-439

GENERAL ASSUMPTIONS:
Medium-sized software system (32,000 lines source code)
15 person years to build (including HF time)
System to be used by 250 employees
Developers and HF Engineers fully loaded wages = $35.00/hour
Users fully loaded wages = $25.00/hour
Clerical support staff fully loaded wages = $15.00/hour

ANALYSIS SUMMARY:

TOTAL BENEFITS:	$ 175,104 (per year)
TOTAL COSTS:	132,185 (one time)
FIRST YEAR SAVINGS:	=$ 42,919



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WHY SHOULD YOU CARE?

BREAKDOWN OF COSTS

LIFECYLE STAGE	UI TASK	COST/ TASK	NO. TASKS	TOTAL COST	WEEKS/ TASK
--	HF Lab Setup	$20,000	1	$20,000	8
Scoping	User Definition (Interviews)	2,425	2	4,850	2
Functional Specification	TASK ANALYSIS:				
	User Interviews	2,425	4	9,700	2
	User Questionnaire	6,000	1	6,000	5
	Usage Study	6,220	1	6,220	4.5
Design	Style Guide	16,000	1	16,000	5
	Simulation Tool	6,220	3	18,660	5
	Purchase of UIMS	15,000	1	15,000	4
	Prototype Construction	5,000	1	5,000	4
	PROTOTYPE TESTING:				
	Prototype Test	6,220	3	18,660	5
	Prototype Change	200	20	5,000	.5
Testing/ Implementation	SYSTEM UI TESTING:				
	Prototype Test	6,220	3	18,660	5
	Prototype Change	200	20	5,000	.5
	UI EVALUATION:				
	User Survey	6,000	1	6,000	5
	User Interview	2,425	3	7,275	3
	Usage Study	6,220	1	6,220	4.5
	TOTAL COST:			$132,185	

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WHY SHOULD YOU CARE?

BREAKDOWN OF BENEFITS

TYPE OF SAVING	AMOUNT
Decreased Training	$ 62,500
Decreased Errors	71,846
Increased Productivity	23,958
Decreased Late Design Changes	16,800
TOTAL BENEFITS:	$175,104

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Managing the Design of the User Interface

WHY SHOULD YOU CARE?

DERIVATION OF COSTS

1. HF LAB SET UP	
Lab design and equipment selection: 160 hrs @ $35/Hr	$5,600
Carpenters and electricians: 80 hrs @ $25/hr	2,000
Videocameras, VCRs, one-way mirror	12,400
TOTAL:	$20,000
2. USER INTERVIEWS	
10 Interviewees for 1 hour @ $25/hr	250
Interviewer @ $35/hr:	
16 hrs designing interview	
10 hrs conducting interviews	
28 hrs analyzing results	1,890
3 Support staff @ 5 hrs each @ $15/hr	225
Videotapes	60
TOTAL:	2,425

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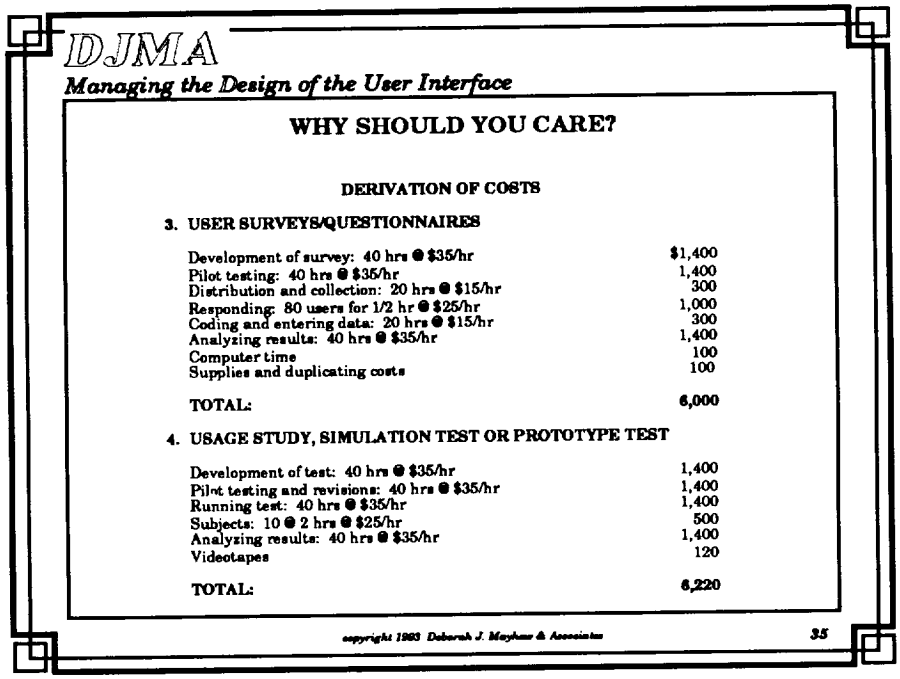
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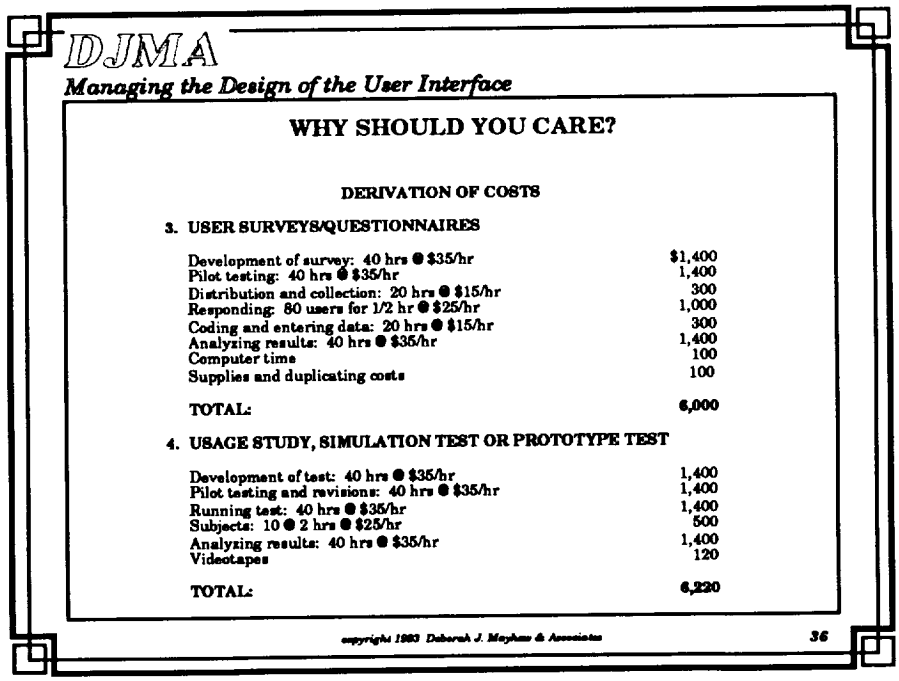
WHY SHOULD YOU CARE?
DERIVATION OF COSTS
3. USER SURVEYS/QUESTIONNAIRES
Development of survey: 40 hrs ● $35/hr $1,400
Pilot testing: 40 hrs ● $35/hr 1,400
Distribution and collection: 20 hrs ● $15/hr 300
Responding: 80 users for 1/2 hr ● $25/hr 1,000
Coding and entering data: 20 hrs ● $15/hr 300
Analyzing results: 40 hrs ● $35/hr 1,400
Computer time 100
Supplies and duplicating costs 100
TOTAL: 6,000
4. USAGE STUDY, SIMULATION TEST OR PROTOTYPE TEST
Development of test: 40 hrs ● $35/hr 1,400
Pilot testing and revisions: 40 hrs ● $35/hr 1,400
Running test: 40 hrs ● $35/hr 1,400
Subjects: 10 ● 2 hrs ● $25/hr 500
Analyzing results: 40 hrs ● $35/hr 1,400
Videotapes 120
TOTAL: 6,220
35


DJMA
Managing the Design of the User Interface
WHY SHOULD YOU CARE?
DERIVATION OF COSTS
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TOTAL: 6,000
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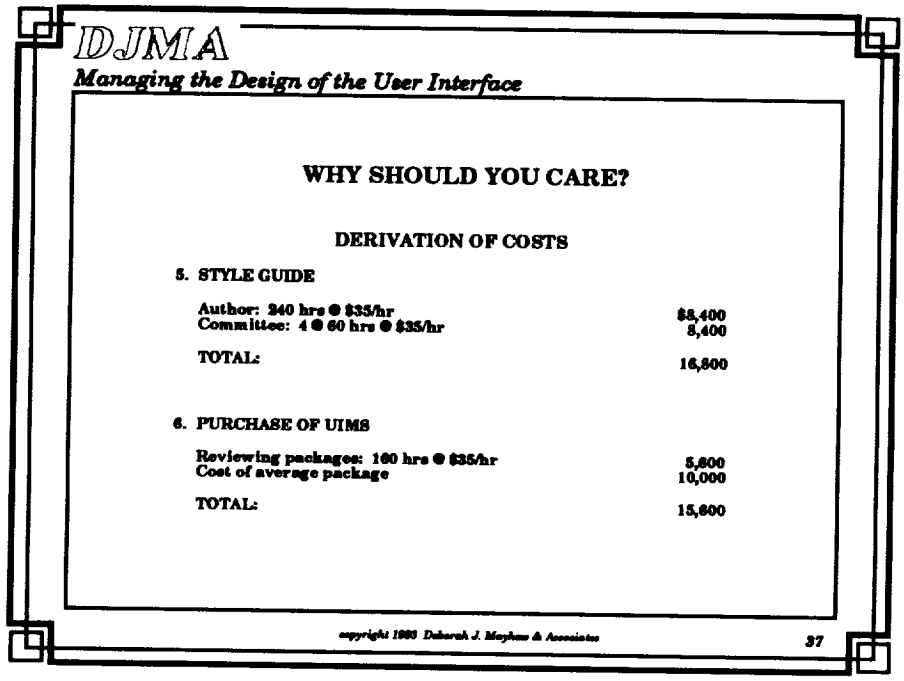
Videotapes 120
TOTAL: 6,220
36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WHY SHOULD YOU CARE?
DERIVATION OF COSTS
5. STYLE GUIDE
Author: 240 hrs @ $35/hr $8,400
Committee: 4 @ 60 hrs @ $35/hr 8,400
TOTAL: 16,800
6. PURCHASE OF UIMS
Reviewing packages: 160 hrs @ $35/hr 5,600
Cost of average package 10,000
TOTAL: 15,600
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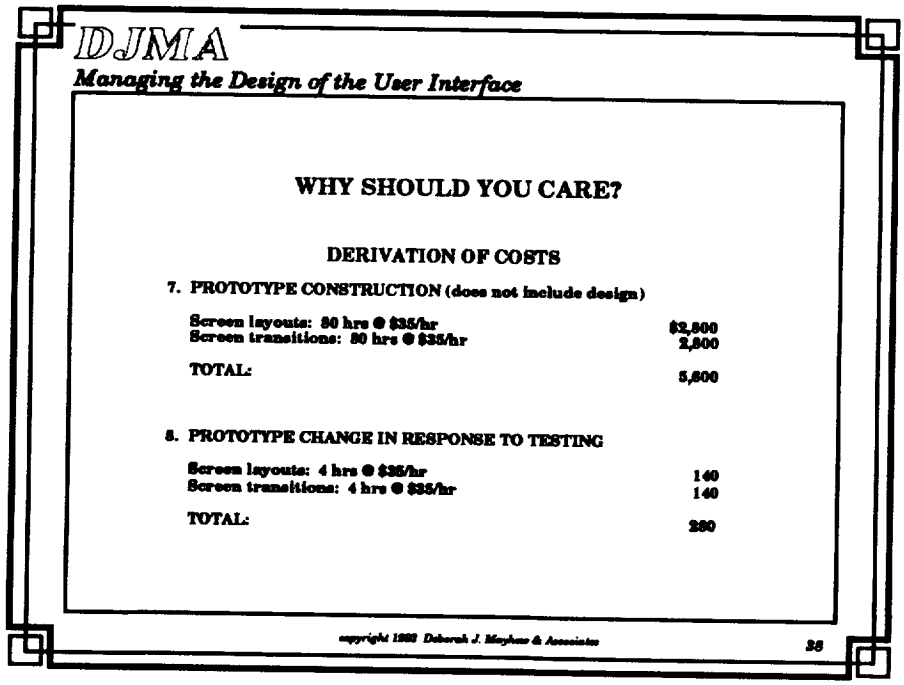
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WHY SHOULD YOU CARE?
DERIVATION OF COSTS
7. PROTOTYPE CONSTRUCTION (does not include design)
Screen layouts: 80 hrs @ $35/hr $2,800
Screen transitions: 80 hrs @ $35/hr 2,800
TOTAL: 5,600
8. PROTOTYPE CHANGE IN RESPONSE TO TESTING
Screen layouts: 4 hrs @ $35/hr 140
Screen transitions: 4 hrs @ $35/hr 140
TOTAL: 280
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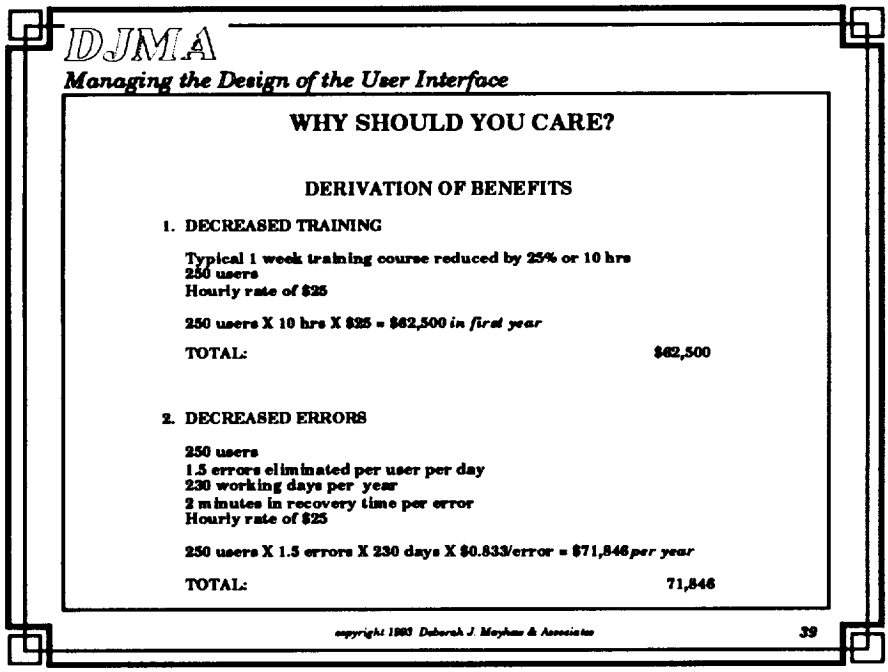
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WHY SHOULD YOU CARE?
DERIVATION OF BENEFITS
1. DECREASED TRAINING
Typical 1 week training course reduced by 25% or 10 hrs
250 users
Hourly rate of $25
250 users X 10 hrs X $25 = $62,500 in first year
TOTAL: $62,500
2. DECREASED ERRORS
250 users
1.5 errors eliminated per user per day
230 working days per year
2 minutes in recovery time per error
Hourly rate of $25
250 users X 1.5 errors X 230 days X $0.833/error = $71,846 per year
TOTAL: 71,846
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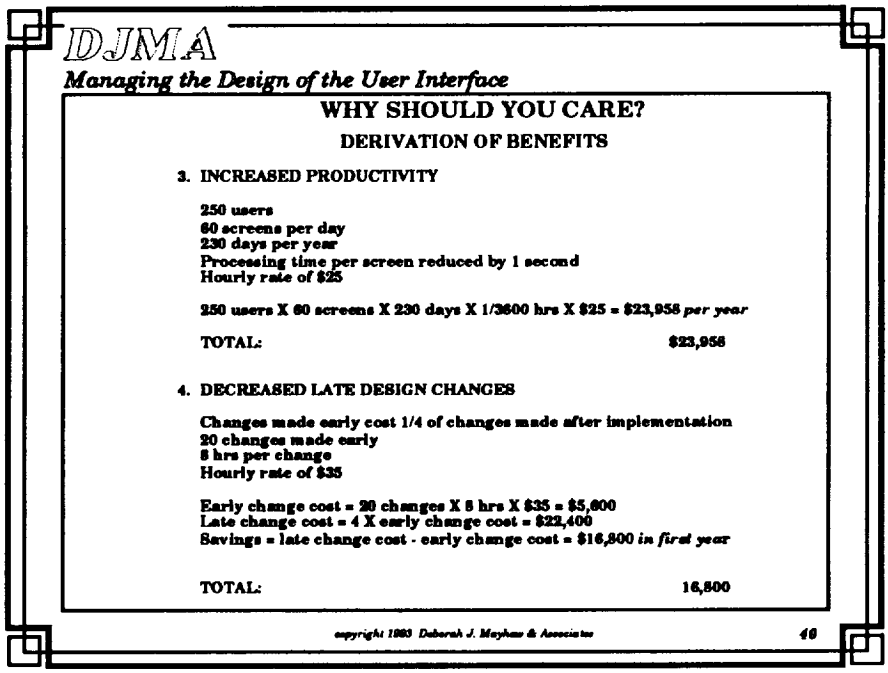
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Managing the Design of the User Interface
WHY SHOULD YOU CARE?
DERIVATION OF BENEFITS
3. INCREASED PRODUCTIVITY
250 users
60 screens per day
230 days per year
Processing time per screen reduced by 1 second
Hourly rate of $25
250 users X 60 screens X 230 days X 1/3600 hrs X $25 = $23,958 per year
TOTAL: $23,958
4. DECREASED LATE DESIGN CHANGES
Changes made early cost 1/4 of changes made after implementation
20 changes made early
8 hrs per change
Hourly rate of $35
Early change cost = 20 changes X 8 hrs X $35 = $5,600
Late change cost = 4 X early change cost = $22,400
Savings = late change cost - early change cost = $16,800 in first year
TOTAL: 16,800
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Managing the Design of the User Interface

WHY SHOULD YOU CARE?

☞Common questions about CBA of Human Factors function

Is time a legitimate benefit for a CBA?

Yes

Time is money.

User time can be expensive.

Companies often want to increase volume of sales/service without increasing personnel.

Will users actually take advantage of potential productivity gains?

Yes.

Studies show users realize bigger productivity gains on complex tasks than on simple ones.

Organizations provide incentives for productivity.

Personal and anecdotal experience suggest people make use of more powerful tools by being more productive.

Why should development incur the cost when users get the benefits?

To meet overall business goals.

Development should be driven by business goals.

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Managing the Design of the User Interface

WHO ELSE IS DOING IT?

SOFTWARE VENDORS	
Lotus	2
Apple Computer	15
Ashton-Tate	1
Microsoft	3

FINANCIAL SERVICES	
Citibank	20
Aetna	4
IDS Financial Services	3
The New England	1
ChemicalBank	1

OTHERS	
US West	4
Eastman Kodak	10
Nynex	2
CLDS Church	8

COMPUTER VENDORS	
IBM	150
DEC	20
Wang	12
Xerox	50
Unisys	8
Data General	3
Hewlett Packard	15
Bell Labs	250
Symbolics	2
Sun Microsystems	7
NCR	13

CONTRACTORS	
BBN	6
AIR	6
DRC	6
GTE Labs	5
GTE Data Services	5
Mitre Corp.	4
Boeing	5

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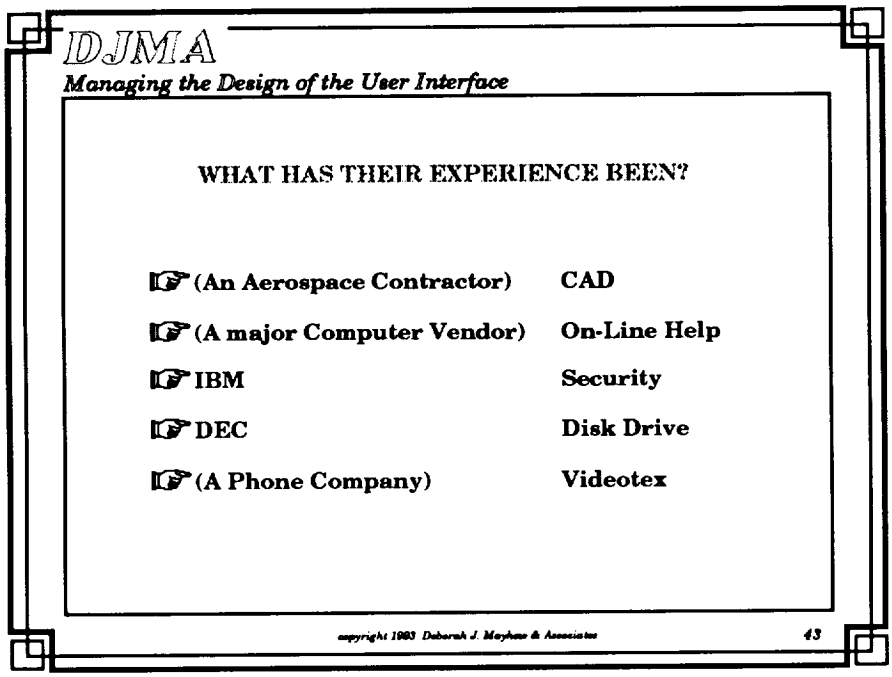
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Managing the Design of the User Interface
WHAT HAS THEIR EXPERIENCE BEEN?
☞ (An Aerospace Contractor) CAD
☞ (A major Computer Vendor) On-Line Help
☞ IBM Security
☞ DEC Disk Drive
☞ (A Phone Company) Videotex
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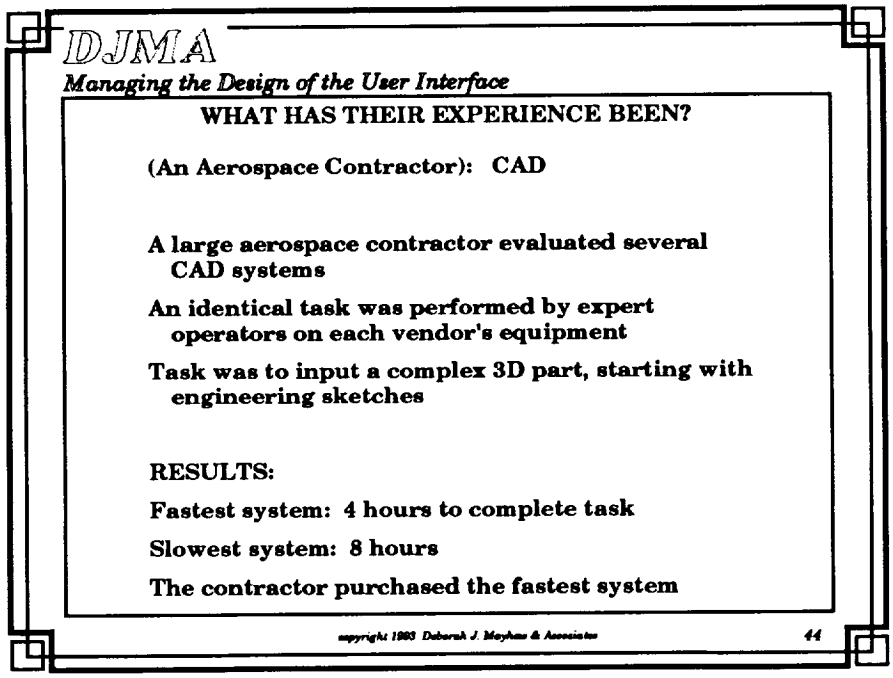
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Managing the Design of the User Interface
WHAT HAS THEIR EXPERIENCE BEEN?
(An Aerospace Contractor): CAD
A large aerospace contractor evaluated several CAD systems
An identical task was performed by expert operators on each vendor's equipment
Task was to input a complex 3D part, starting with engineering sketches
RESULTS:
Fastest system: 4 hours to complete task
Slowest system: 8 hours
The contractor purchased the fastest system
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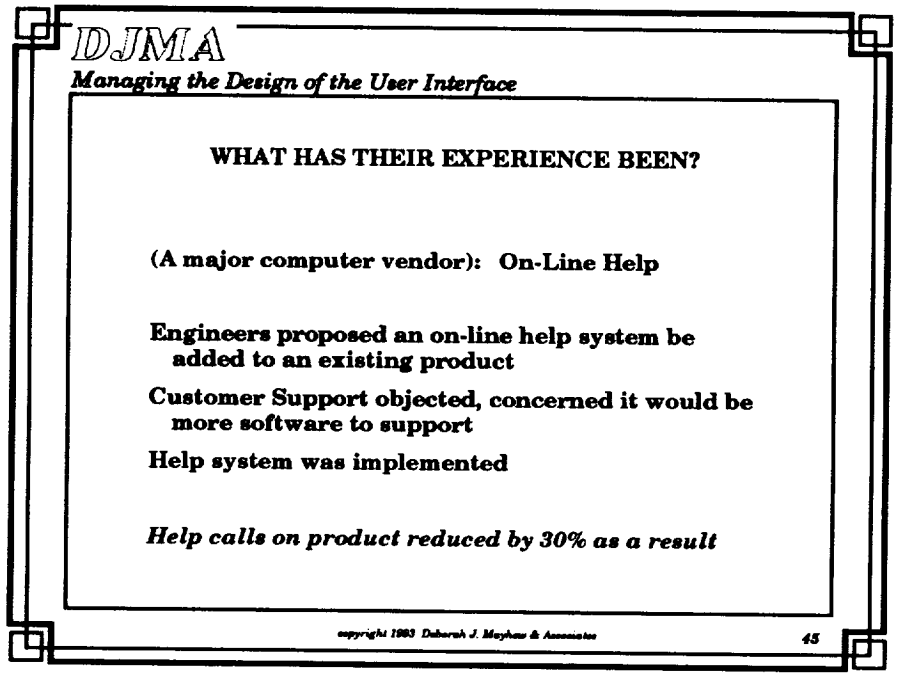
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Managing the Design of the User Interface
WHAT HAS THEIR EXPERIENCE BEEN?
(A major computer vendor): On-Line Help
Engineers proposed an on-line help system be added to an existing product
Customer Support objected, concerned it would be more software to support
Help system was implemented
Help calls on product reduced by 30% as a result
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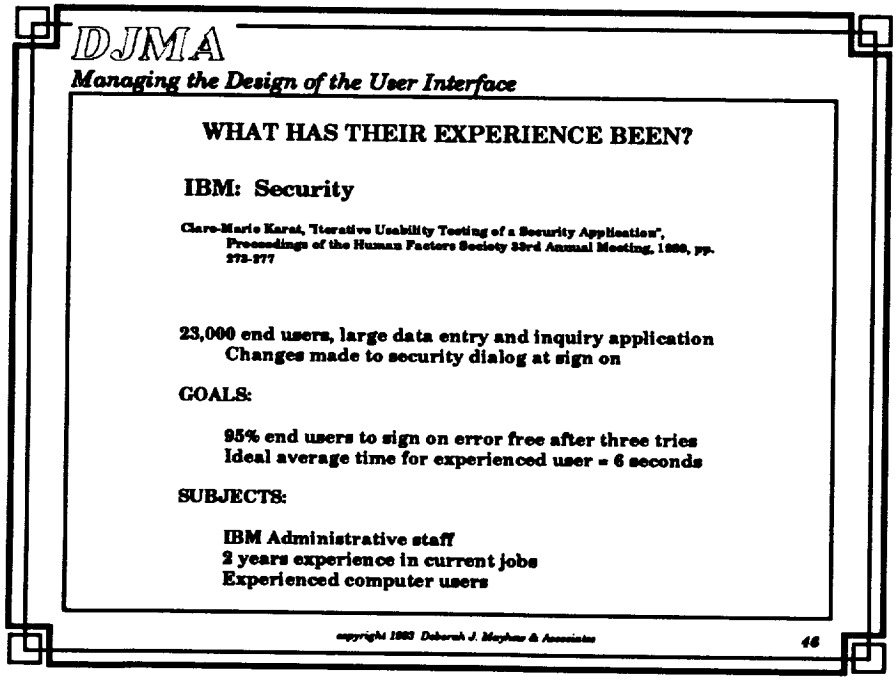
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Managing the Design of the User Interface
WHAT HAS THEIR EXPERIENCE BEEN?
IBM: Security
Clare-Marie Karat, "Iterative Usability Testing of a Security Application", Proceedings of the Human Factors Society 33rd Annual Meeting, 1989, pp. 273-277
23,000 end users, large data entry and inquiry application
Changes made to security dialog at sign on
GOALS:
95% end users to sign on error free after three tries
Ideal average time for experienced user = 6 seconds
SUBJECTS:
IBM Administrative staff
2 years experience in current jobs
Experienced computer users
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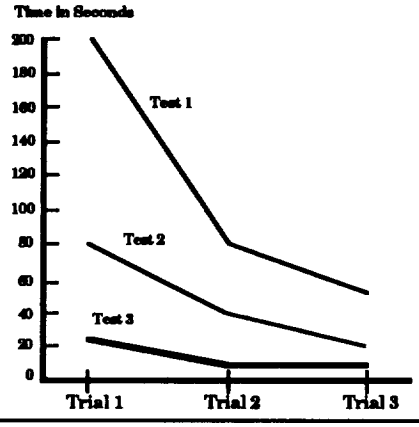
DJMA

Managing the Design of the User Interface

WHAT HAS THEIR EXPERIENCE BEEN?

IBM: Security



DJMA

Managing the Design of the User Interface

WHAT HAS THEIR EXPERIENCE BEEN?

IBM: Security

☞ **RESULTS:**

In Test 3, 100% signed on error free after third try

Median time on third trial in Test 3 = 7 seconds

☞ **COST/BENEFIT ANALYSIS:**

Calculated for first three sign on attempts only

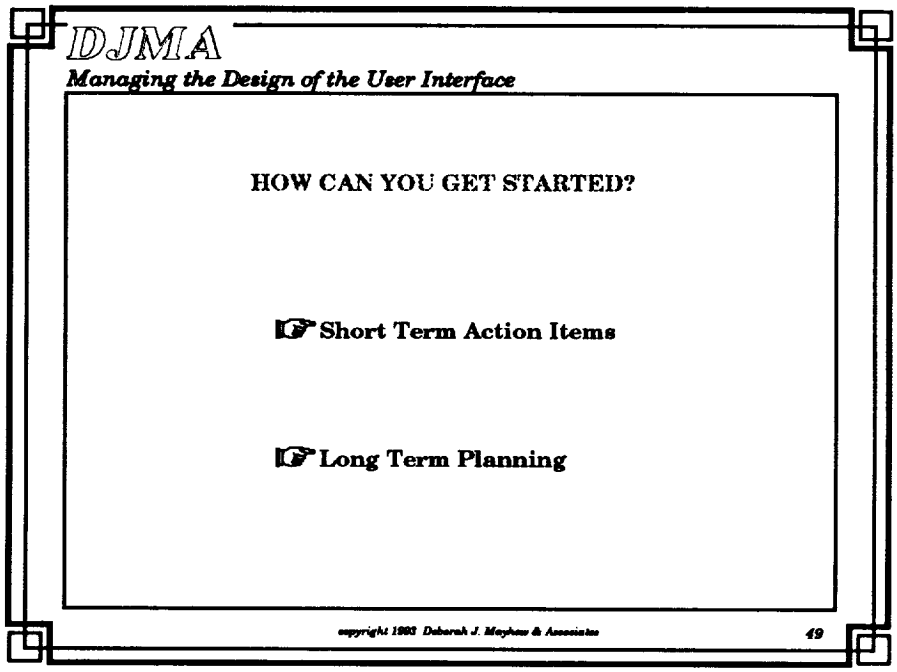
Total difference between Test 1 and Test 3 summed across three trials per user = 4.67 minutes

22,876 users X 4.67 minutes = 1,781 hours

Benefit = 1,781 hours X hourly rate = $41,700

Cost of three tests = $ 20,700

Net Benefit of $ 21,000


DJMA
Managing the Design of the User Interface
HOW CAN YOU GET STARTED?
☞ Short Term Action Items
☞ Long Term Planning
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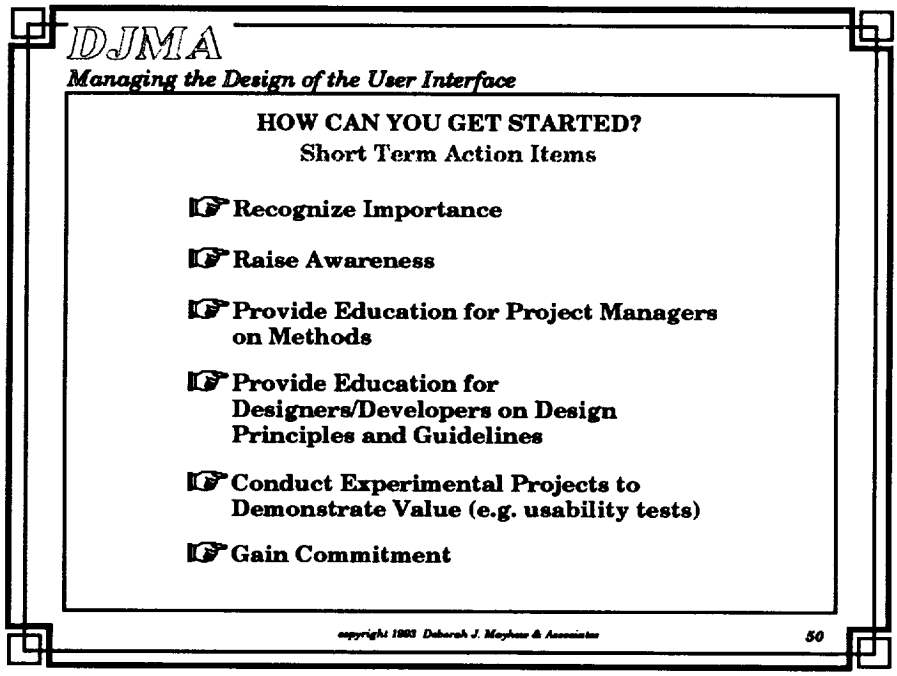
DJMA
Managing the Design of the User Interface
HOW CAN YOU GET STARTED?
Short Term Action Items
☞ Recognize Importance
☞ Raise Awareness
☞ Provide Education for Project Managers on Methods
☞ Provide Education for Designers/Developers on Design Principles and Guidelines
☞ Conduct Experimental Projects to Demonstrate Value (e.g. usability tests)
☞ Gain Commitment
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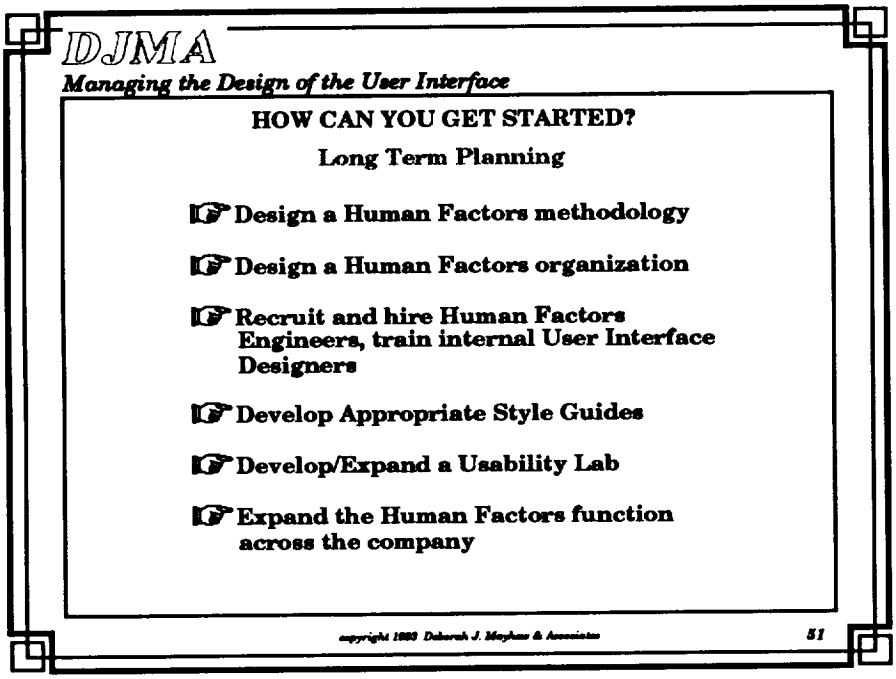
Managing the Design of the User Interface



Technology Transfer

Marti Szczur
Goddard Space Flight Center

TAE
Yesterday, Today & Tomorrow

Marti Szczur
NASA/Goddard Space Flight Center
Software and Automation Systems Branch

1

Under Discussion

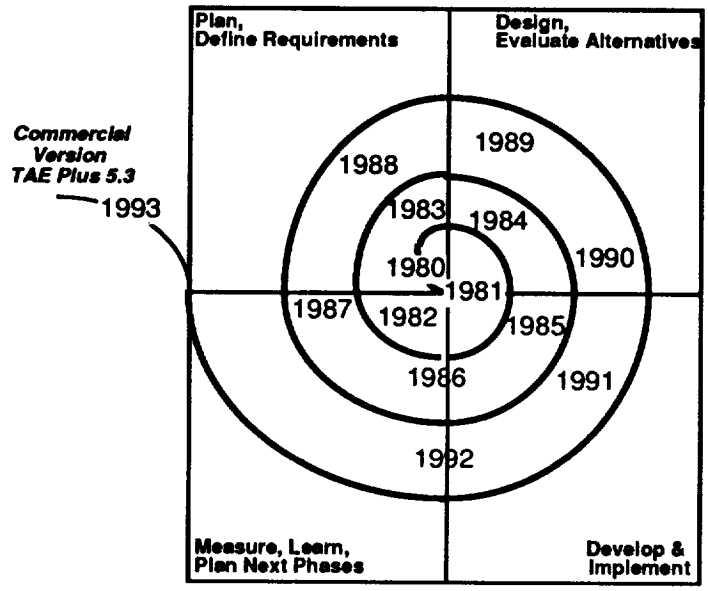
- TAE Classic, the Prewindow Period 1980 -1985
- TAE Plus, the New Beginning, 1985-1988
- TAE Plus Matures 1989-1992
- TAE Plus Commercialization 1993
- GSFC's Future Directions

2

Data Systems Technology Division 520

TAE
Incremental Life Cycle

TAE 10th Users Conference



3

Data Systems Technology Division 520

1980

TAE 10th Users Conference

REQUIREMENTS

- multiuser, portable applications control executive
- friendly environment for users
- extensive information management support
- standard set of executive services
- extensibility to allow installation of new programs with ease
- VICAR compatible

4

1981

- Develop Proof-of-Concept Prototype
- Implementation language Selection Issue
- Support 3 operational systems
- Future versions must be upward compatible
- TAE Support Office created
- 1st TAE External Review

1982 - 84

- Four prototype releases between August '81 and Oct '82
- C selected for implementation language
- By 1982, 13 different projects were using prototype versions
- November 1983, first operational system, V1.0
- New releases delivered in 1983 and 1984
- Operational on VAX/VMS, PDP 11/RSX-11M, Data General Eclipse
- TAE ports into UNIX environment
- TAE Support Office works with the user community
- By 1984, 30 different user sites are recorded

1985

- Introduction to the Macintosh and the arrival of GUIs with mice and windows
- Arrival of first "low-cost" graphic workstations with windows
- 5th TAE Users' Conference
- ... And the fun begins
  - experiments with VT220 and VAXStation 100
  - the TAE Facelift phase

1986- 89

- Conceptual Description of a WorkBench in '86
- Rapid Proof-of-Concept Prototype of TAE Plus in '87
  -- Smalltalk and X Windows 10
- 6th Users' Conference ('86) and 7thUsers' Conference ('88)
- Object-oriented language selected for implementation language
  -- C++ or Objective C?
  -- Compiler Woes
- Papers given at ACM Symposium '87, OOPSLA '88, NCGA '88, Xhibition '89
- Two Prototypes in '88 followed by two beta releases in '89

- TAE Plus papers given at USENIX '90, MIT X Conference '90
- Over 350 Beta Test Sites
- TAE Plus V4.1 (Ist Operational Release) goes to COSMIC in '90
- 8th Users Conference hosted by JSC

9

TAE 8th Users Conference

Future Directions

- Full Motif functionality support ?
  - -- WorkBench support for all Motif objects
  - -- WorkBench support for Motif conventions/style
  - -- UIL support
- *Architect/Builder* WorkBenchs
- Integrate/add object builder into TAE Plus
- Graph builder support
- Hypermedia support
- WorkBench improvements
- Support object direct manipulation and object dependencies

6/90

1990

- TAE Plus papers given at USENIX '90, MIT X Conference '90
- Over 350 Beta Test Sites
- TAE Plus V4.1 (Ist Operational Release) goes to COSMIC in '90
- 8th Users Conference hosted by JSC

1991

- Honorable Mentions for "Best in Open Systems Solutions" (FEDUNIX)
- NASA Group Achievement Award to TAE Plus team
- TAE Plus presented/demoed at several aerospace conferences and tutorial at MIT X Conference
- TAE Plus Submitted as a candidate API to IEEE 1201 Committee
- V5.1(with OSF/Motif™ toolkit) is delivered to COSMIC
- 9th TAE Users Conference in held in November '91

1992

TAE
10th Users
Conference

- TAE Plus article published in The X Resource Journal
- TAE Plus presented/demoed at CHI'92 and HCI '92
- Over 500 TAE Plus V5.1 User Sites
- TAE Plus V5.2 is delivered to COSMIC
- Decision to transfer the technology...Why Now?
- Planning the transition

11

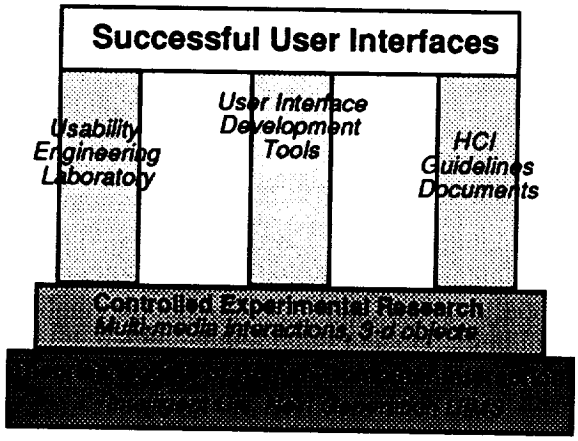
1993

TAE
10th Users
Conference

- GSFC's TAE Project Management changes hands
- TAE Plus article published in ACM's TOIS
- V5.2 goes to COSMIC
- Technology Transfer Agreement is finalized
- TAE 10th Users Conference
- Commercialization of TAE Plus

12

Future Directions

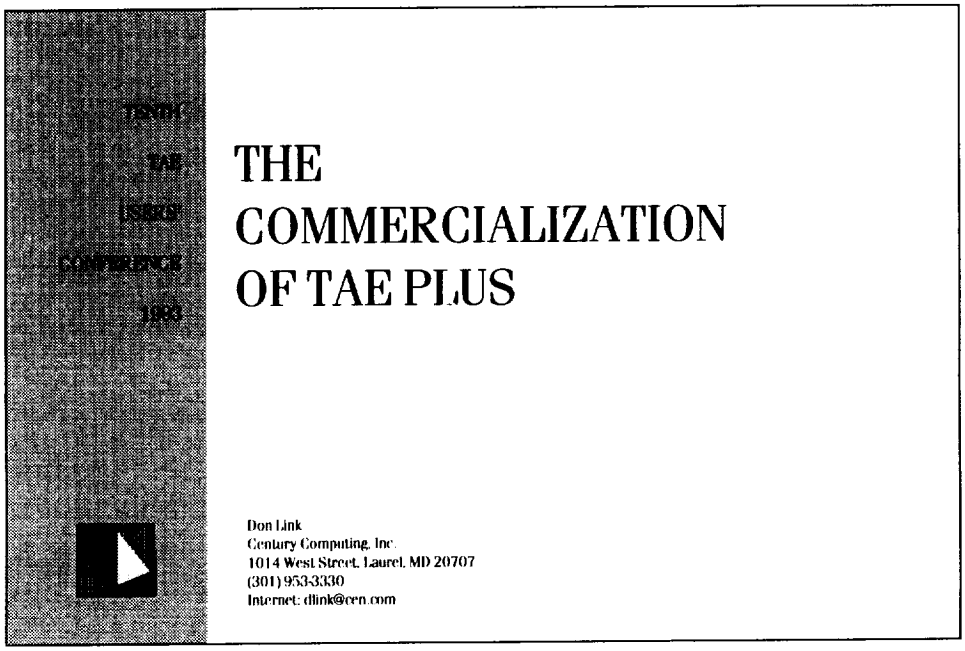


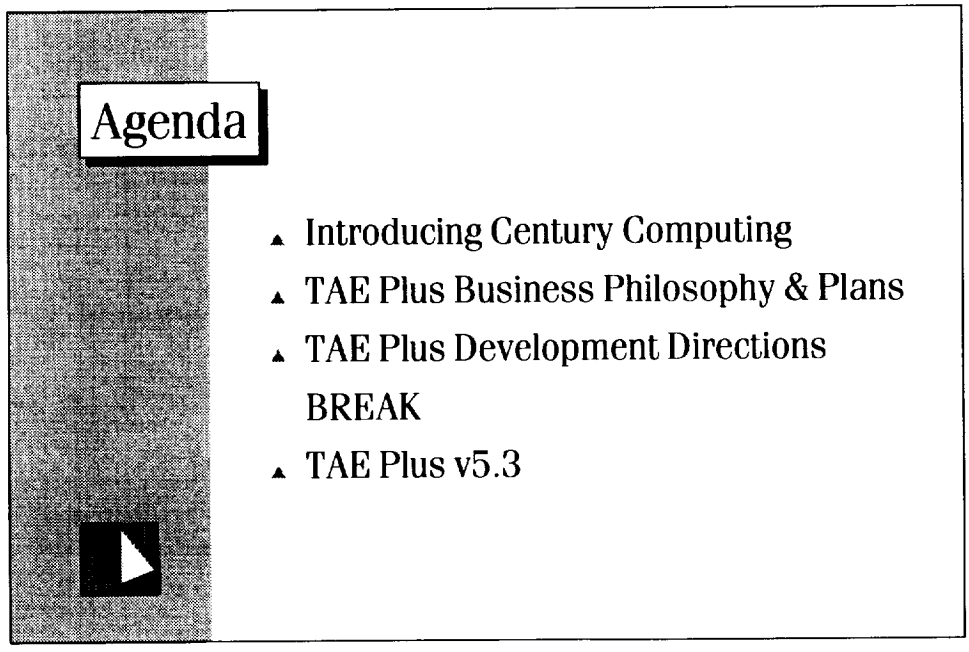
* diagram derived from Ben Shneiderman's "Three Pillars of Successful UI Design

In Conclusion

TAE V5.3 Summary

Don Link
Century Computing Inc.

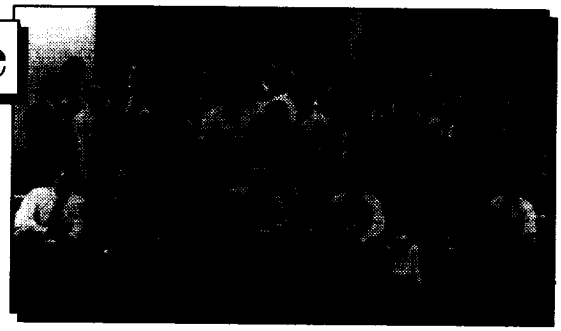




Introducing Century Computing

- Our People
- Our Company
- Our Business

Our People



- 47 Employees
- Average of 12 yrs Experience
- Expertise in C, C++, Ada
- Over 50% with Advanced Degrees

Our Company

- Founded in 1979
- Began TAE Development in 1981
- Employee Owned
- Financially Sound
- Committed to Customer Satisfaction

Our Business

Graphical User Interfaces

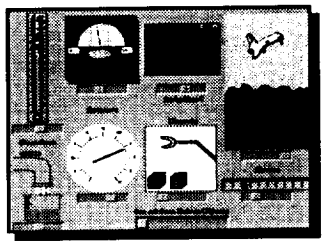
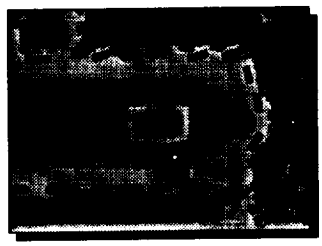


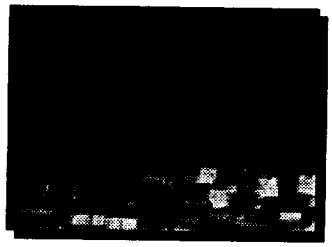
Image Processing



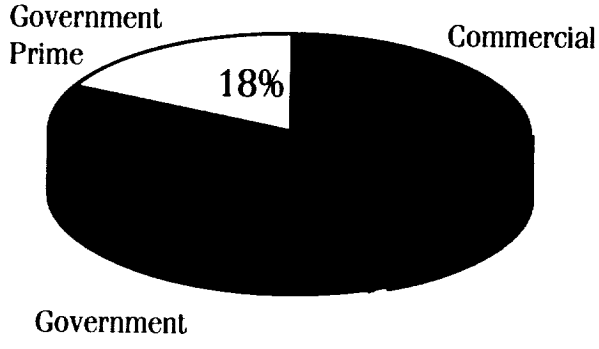
Our Business

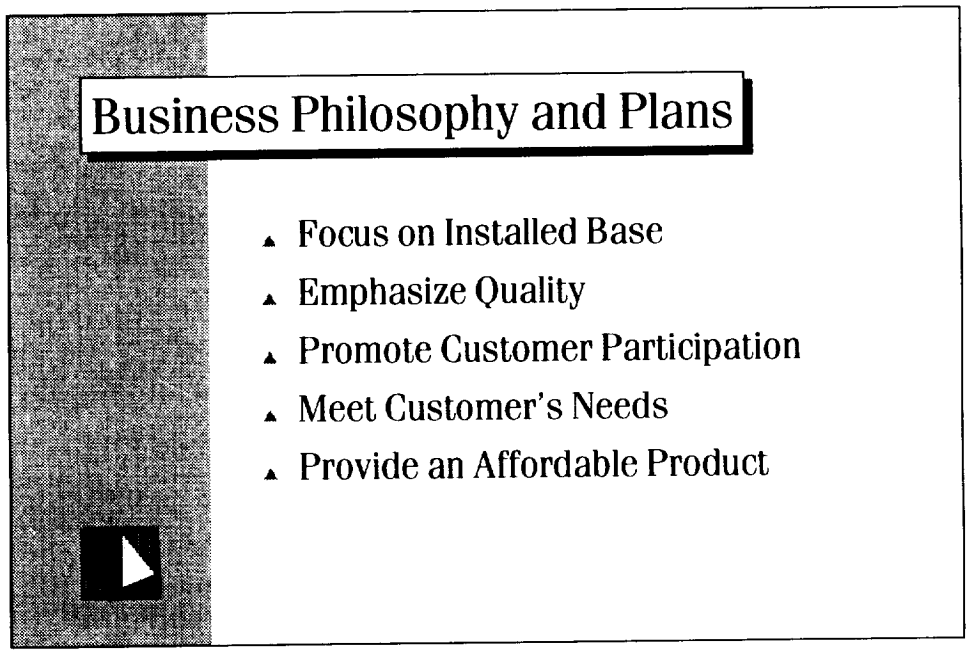
Simulation

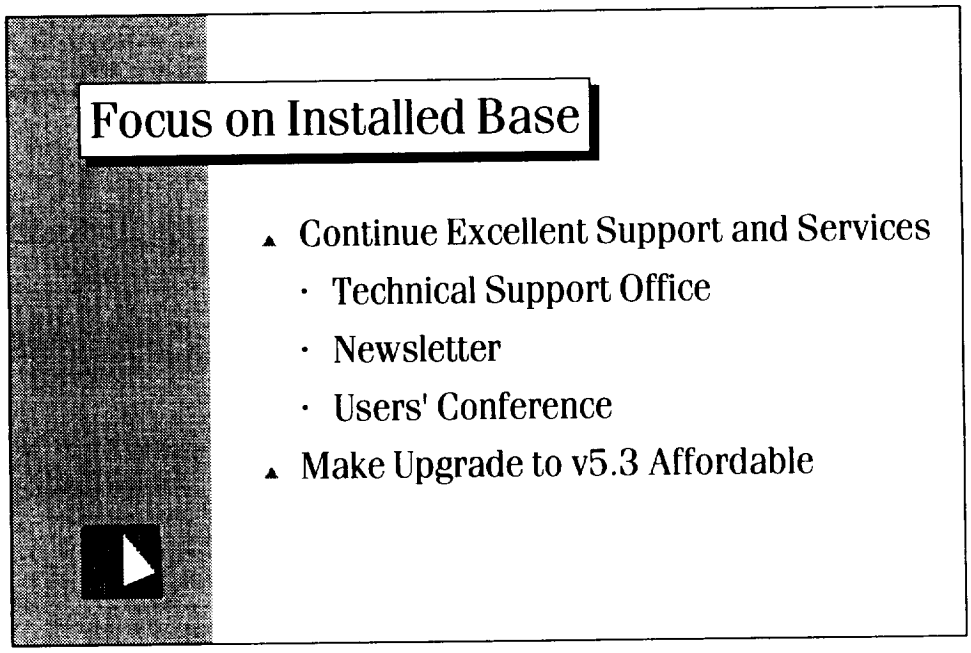
Spacecraft
Ground Systems

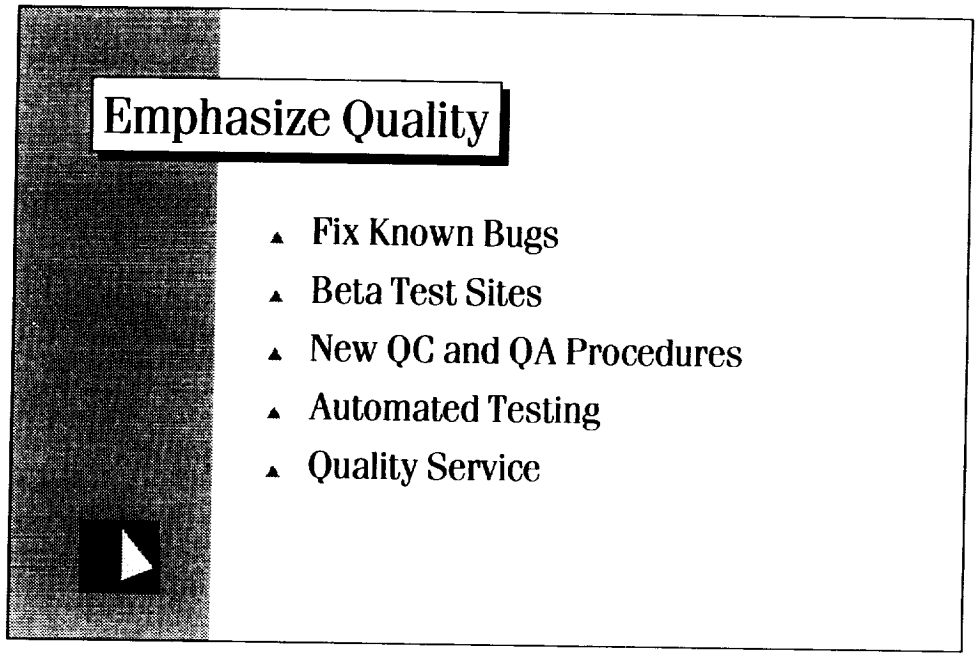


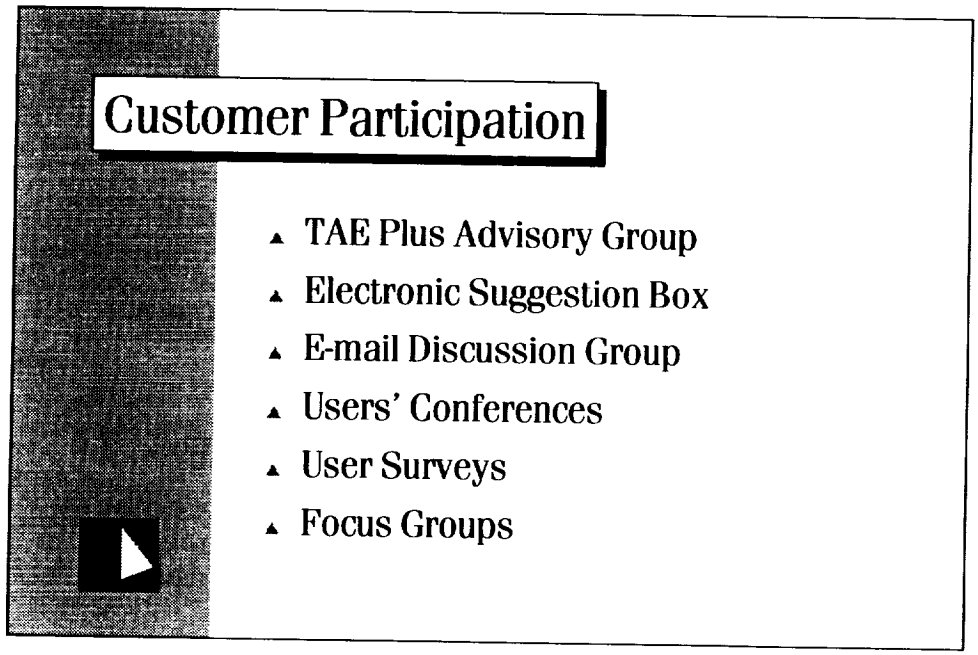
1992 Business Mix




Business Philosophy and Plans
▲ Focus on Installed Base
▲ Emphasize Quality
▲ Promote Customer Participation
▲ Meet Customer's Needs
▲ Provide an Affordable Product


Focus on Installed Base
▲ Continue Excellent Support and Services
· Technical Support Office
· Newsletter
· Users' Conference
▲ Make Upgrade to v5.3 Affordable


Emphasize Quality
Fix Known Bugs
Beta Test Sites
New QC and QA Procedures
Automated Testing
Quality Service


Customer Participation
TAE Plus Advisory Group
Electronic Suggestion Box
E-mail Discussion Group
Users' Conferences
User Surveys
Focus Groups

Meet Customer's Needs

- Customer Satisfaction Key to Success
- Market Forces at Work
- New Features
- Better Documentation
- Competent & Available Technical Support
- Technical Training Seminars
- Consulting Services

An Affordable Product

- Aggressive Pricing
- Creative Licensing
- Unbundle Ada and C++
- Government and Educational Discounts

Development Directions

- Truly Graphical Interfaces
- Direct Manipulation
- Rapid Prototyping and Iterative Refinement
- Non-Programmer Use
- Standards Compliance
- Integration with Other Tools
- Targeted Application Areas

Questions and Answers

Coming up:

TAE Plus v5.3

TAE PLUS v5.3

Don Link
Century Computing, Inc.
1014 West Street, Laurel, MD 20707
(301) 953-3330
Internet: dlink@ccm.com

Development Directions

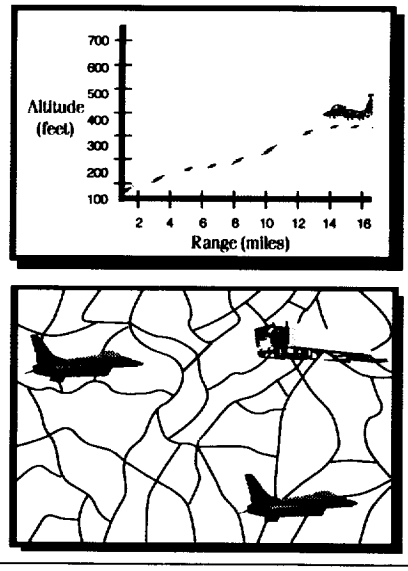
- Truly Graphical Interfaces
- Direct Manipulation
- Rapid Prototyping
- Non-Programmer Use
- Standards Compliance
- Integration with Other Tools
- Targeted Application Areas

Graphics + Direct Manipulation

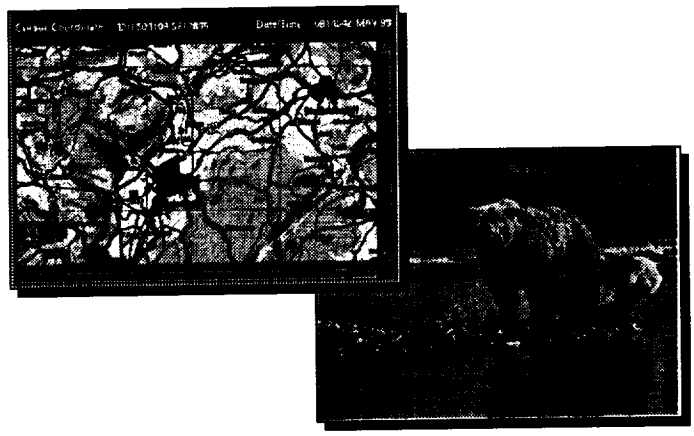
v5.3

- ☑ New Types of DDOs (e.g., 2-D mover)
- ☑ Import of Graphics (e.g., TIFF)
- ☑ DDO Input
- ☑ Composite DDOs
- ☑ Object Creation at Runtime
- ☐ Color Pixmaps
- ☐ Movable Items at Runtime
- ☐ Simple Graphic Decorations

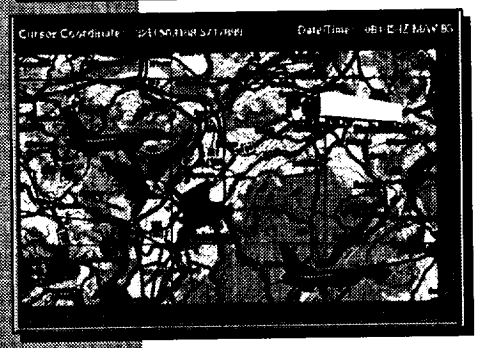
2-D Movers



Import of TIFF Pictures



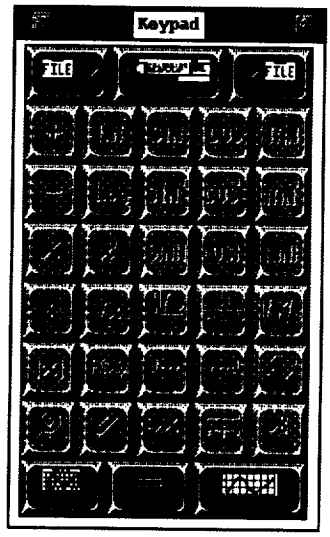
DDO Input



- Supports direct manipulation applications
- Increases flexibility of user input & control

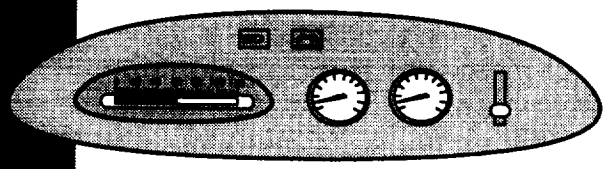
DDO Input (Selection)

- Keys are separate dynamics
- Mouse clicks on keys generate events for DDO



Composite DDOs

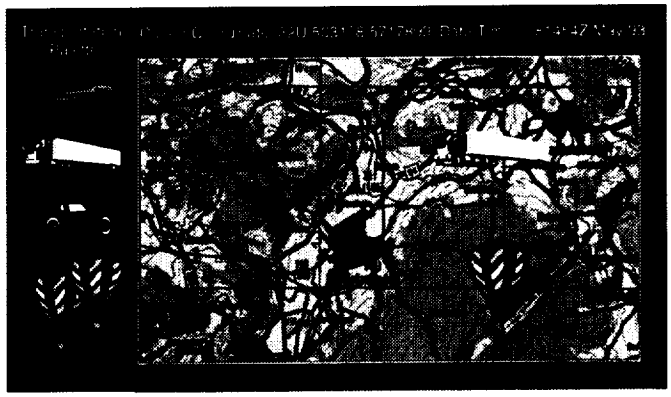
Thermostat



Auto Dashboard Under Design

- Allows collections of DDOs to be treated as one unit
- Allows different types of DDOs on a common background

Runtime Creation of Dynamics



Rapid Prototyping

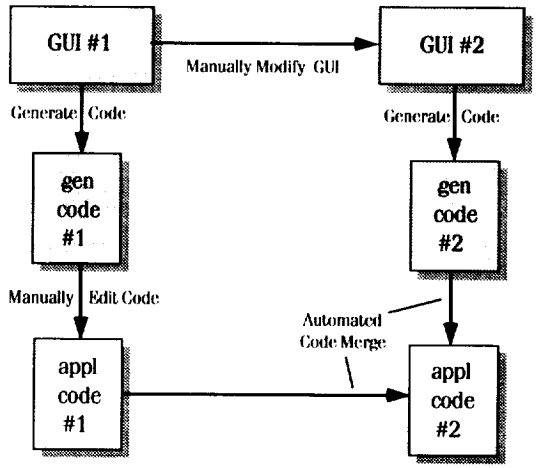
v5.3

- ☑ Automated Code Merge
- ☑ GUI Scripting
- ☐ Addition of New Widgets
- ☐ Tool Maker's Workbench
- ☐ Workbench Productivity Aids

Automated Code Merge

- Speeds up iterative development
- Reduces maintenance costs
- Reduces errors related to code regeneration
- Promotes iterative development

How It Works



GUI Scripting

- Automated and Repeatable Application Tests
- Application Demos
- Tutorials
- Record/Playback Facility
- Based on perl Language

Non-Programmer Use

v5.3

- Extended Connections
- Inter-Item Relationships
- Object Templates with Inheritance
- Composite Presentation Types

Standards Compliance

v5.3

- ☑ UIL Support
- ☑ ANSI C
- ☐ Full Motif Widget Set
- ☐ Geometry Management

UIL Support

- Code Generation of UIL and Mrm
- TAE Plus Applications without Runtime Libraries (Wpt, Vm, Co)
- New DDO Widget
- Increased Portability of Applications
- Easier Access to Widget Resources & Callbacks
- Easier Use of Non-TAE Widgets

ANSI C Support

- Increased Application Portability
- Improved Code Quality and Maintenance via Function Prototypes

Integration with Other Tools

v5.3

- Software Development Tools
  e.g., Energize, ObjectCenter
- U/I Design Tools
  e.g., style checkers/advisors
- Usability Testing Tools

Targeted Application Areas

- Image Processing
- Geographic Information Systems
- Command & Control

Summary of TAE Plus v5.3

v5.3

- ☑ 2-D Movers
- ☑ Interviews 3.1 with Graphics Import
- ☑ DDO Input
- ☑ Composite DDOs
- ☑ Runtime Creation of DDO Dynamics
- ☑ Automated Code Merge
- ☑ GUI Scripting
- ☑ UIL and DDO Widget
- ☑ ANSI C

Usability and Application Testing

Jianping Jiang
CTA Inc.

Jim Hicinbothom
CHI Systems Inc.

Sue Adams
Battelle

Phil Miller
Century Computing Inc.

COMPUTER-HUMAN INTERACTION MODELS (CHIMES)

PRESENTED AT

TENTH TAE USERS' CONFERENCE

JUNE,1993

PRESENTED BY

JIANPING (JIM) JIANG
GROUP ENGINEER

CTA INCORPORATED

SPONSORED BY
ADVANCED SYSTEMS PROGRAM NASA HEADQUARTERS (CODE 0)
THROUGH THE AUTOMATION TECHNOLOGY SECTION (CODE 522.3)
NASA-GODDARD SPACE FLIGHT CENTER
GREENBELT, MD 20771

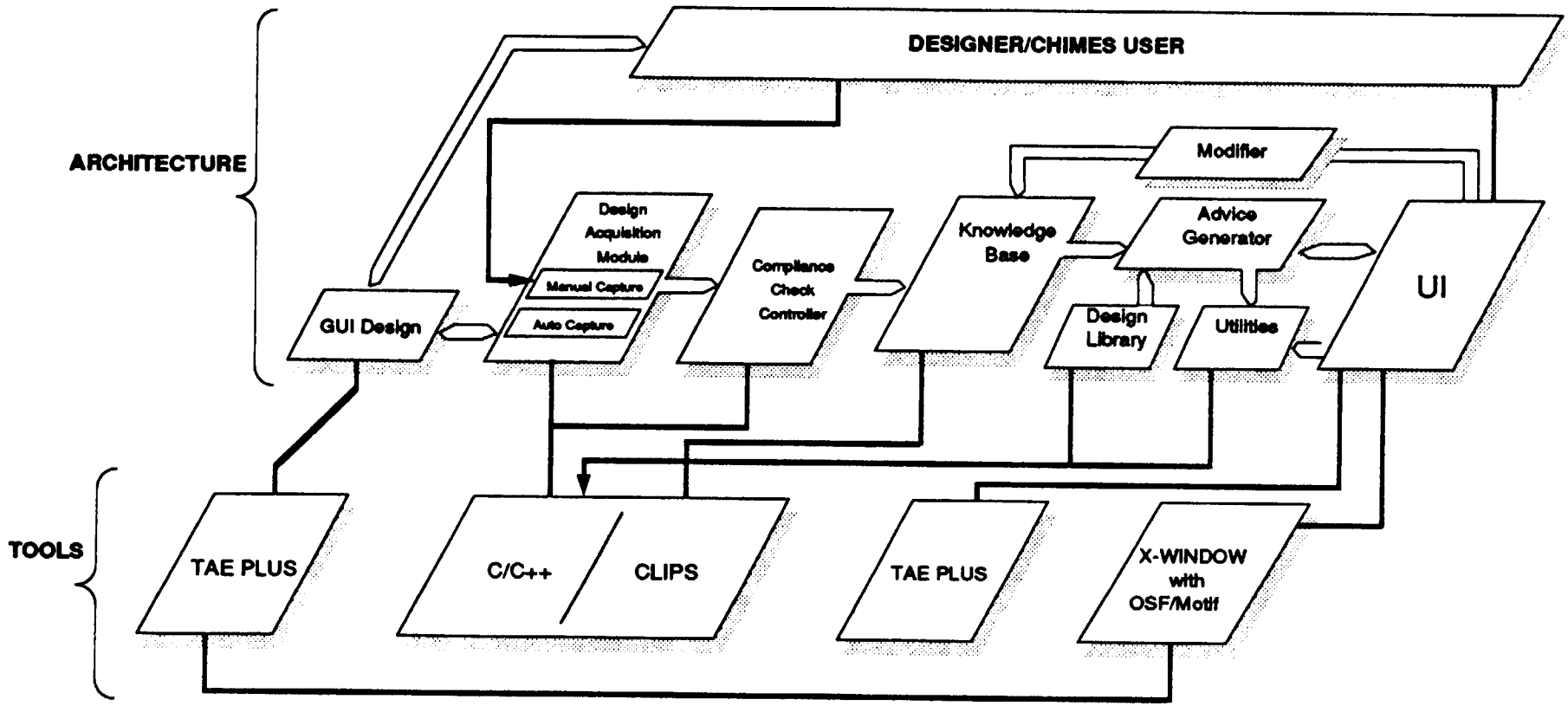
WHAT IS CHIMES?

- **User-Interface Designer's Associate**
- **Knowledge - Based Evaluation of UI Design's "Look and Feel"**
- **Modifier of UI Designs for Compliance with Human Factors Guidelines and Toolkit Style Guides**

INTRODUCTION TO CHIMES

- **PROBLEM:**
  How can we automate a human factors evaluation of user-interface design?
- **TECHNICAL APPROACH:**
  - **Model Demands on Users**
  - **Check for Compliance with Guidelines**
  - **Prototype Evaluation Concepts**
- **PRODUCT:**
  Computer-Human Interaction Models (CHIMES) Methodology and Toolset
- **BENEFITS:**
  Savings in Time and Expense
  Training in Human Factors for UI Designers

CHIMES ARCHITECTURE FOR COMPLIANCE CHECKING



CHIMES: CURRENT STATUS

- **Proof-of-Concept Prototype (CHIMES '93)**
  - **Demonstrates evaluation graphic features for single and multiple UI panels**
  - **Demonstrates Advice-in-Context, including recommended colors**
  - **Supports automatic modification and re-evaluation of UI design**
  - **Supports utilization of sample-design library**
- **Continuing R&D In Progress**

CHIMES: HIGHLIGHTS OF CURRENT AND PLANNED R&D

Current:

- Extension Of Chimes Knowledge Base
- Heuristics For Evaluation Of GUI Behavior

Planned:

- Preparation For Submission To COSMIC[1] For Distribution
- Implementation Of GUI Behavior Evaluation Heuristics
- Heuristics For Evaluation Of GUI Behavior
- Integration Of CHIMES With Other UIMSs

[1] COSMIC is a NASA-sponsored center for distribution of NASA software and is managed by the University of Georgia

Jiang, J., Murphy, E. D., & Bailin, S.C. (1993). *Computer -Human Interaction Models (CHIMES)*, DSTL-93-013. Greenbelt, MD: NASA-Goddard Space Flight Center

Copies Of This Document May Be Obtained From

Walt Truszkowski
Code 522.3
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

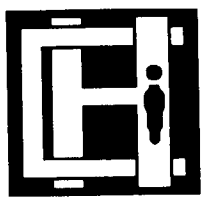
301-286-8821

User Interaction Testing of the User Interface

by

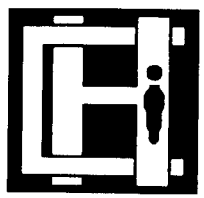
James H. Hicinbothom
Senior Scientist
CHI Systems, Inc.

Sponsored by
U. S. Army Research Laboratory
Human Research & Engineering Directorate
(Under Contract # DAAA15-92-C-0026)



Motivation

- Bad systems development starting with lines of code and no requirements or clear design
- Bad systems development that assumes the user is a peripheral with an I/O interface
- Slightly better systems development that incorporates evaluation, although put off until near the end of development
- Decreasing productivity after automation in some situations (e.g., when work flow obstructed by inappropriate design)
- Friends, relatives, and neighbors who are abused by bad tools at work, home, and play



Background

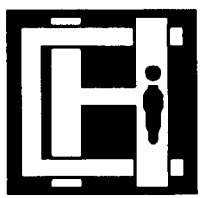
- Human-computer interaction dependent on situation
  = task domain(s) x tool(s) x user population(s)
  (task domain knowledge and tool knowledge are critical attributes of human subjects)

- Each situation different enough to constrain generalizability of interaction designs

- The only 'constant' is the human cognitive architecture, and thus, human cognitive limits

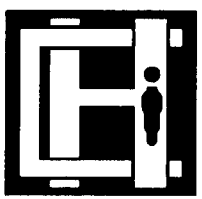
- **Therefore, evaluation must address both the specifics of the situation, and the more general human cognitive limits at work in the situation.**

  Additionally, this evaluation should be based on analyses of **both the static features** (e.g., layout, object semantics, vocabulary usage, and pre-defined 'connections') **and the dynamic features** (e.g., mappings of cognitive task structure to 'threads' of user action sequences, identified attention shifts, and undesirable navigation behaviour) **of the human-computer dialogue**.

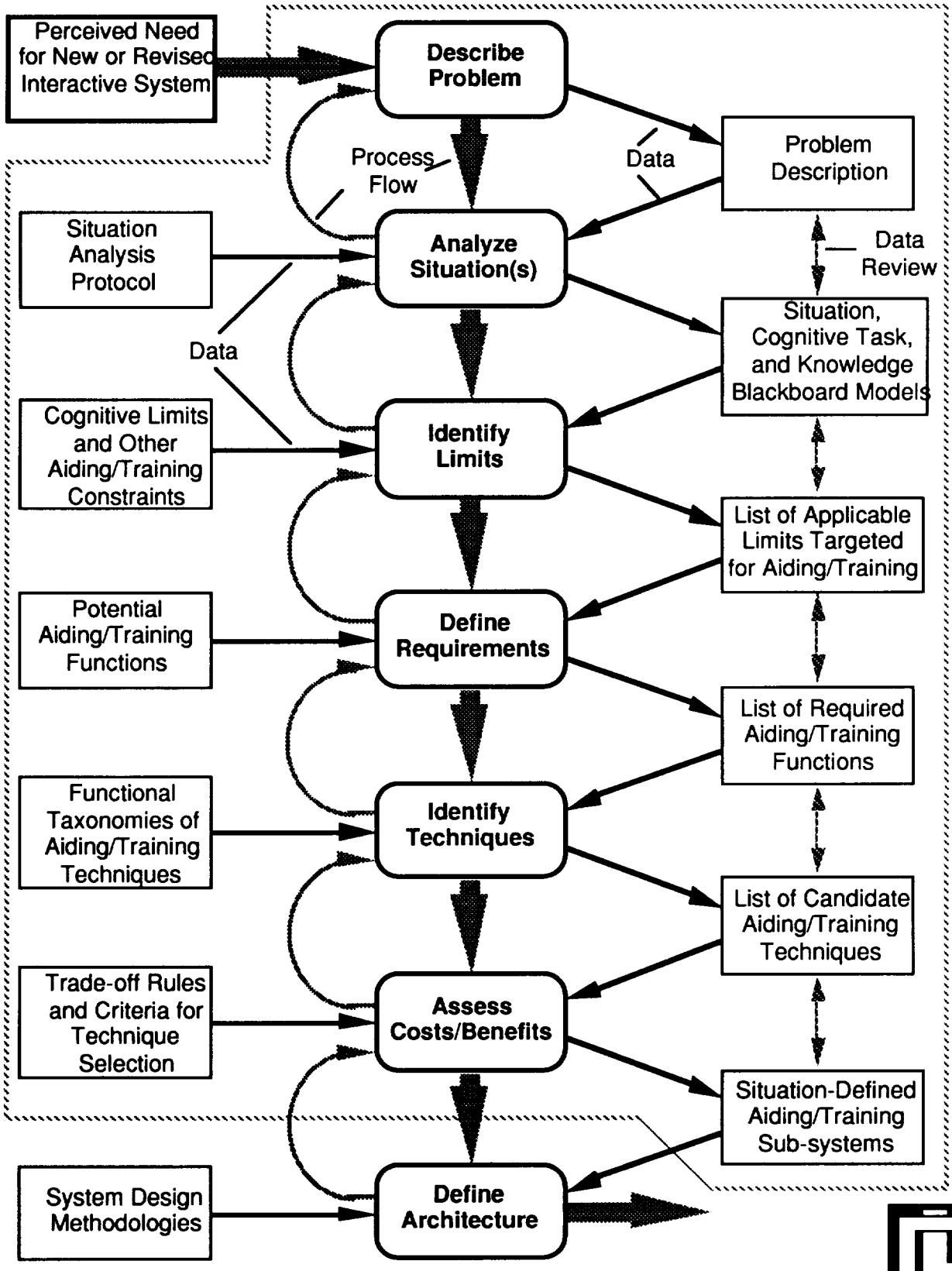


Human Cognitive Limits

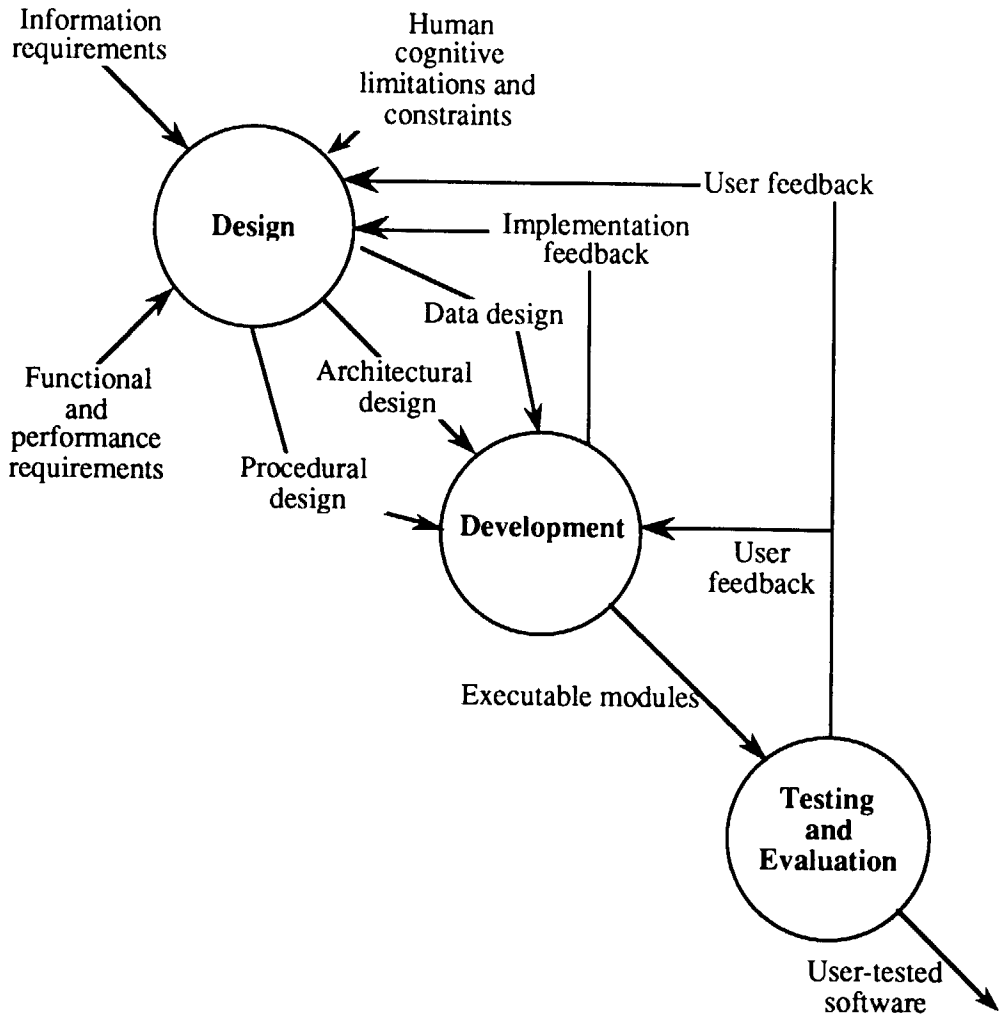
1. Predicting Processes
2. Combining Choice Attributes
3. Managing Information
4. Performing Intermediate Analysis/Reasoning Steps
5. Visualizing/Representing Problem and Solution Spaces
6. Making Required Judgments (e.g., Quantitative Judgment Biases, Maintaining Vigilance)



Cognitive Limits Extension Methodology

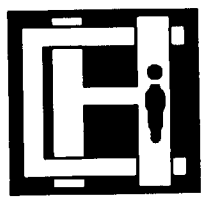


Overview of Mid-Section of Software Life-Cycle



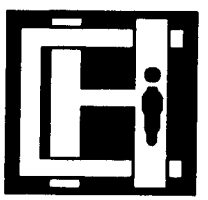
Integrating Evaluation into the Full Life-Cycle

1. Start with CLEM (Cognitive Limits Extension Methodology) for initial requirements analysis and aiding techniques selections
2. Follow up with initial architecture and design concepts, realized as Rapid Interface Prototypes using a Graphical User Interface (GUI) Builder
3. Evaluate overall architecture concept(s) and individual design concepts
4. Select or revise architecture concept (re-evaluating revisions as needed)
5. Revise initial individual design concepts (e.g., database navigator component, file selection component, etc.)
6. Define additional individual design concepts required for the chosen architecture
7. Evaluate new and revised design concepts
8. Iteratively revisit steps 5, 6, and 7, as needed
9. Integrate all available components of architecture
10. Evaluate integrated tool
11. Revise and re-integrate
12. Iteratively revisit steps 5 through 11, as needed



Tools to Aid Integrated Evaluation: The Intelligent Interface Construction (IICON) Evaluator

- Supports evaluation of advanced interactive systems using X Window System
- Aids Human Evaluator in preparing and managing evaluation sessions (e.g., test plan)
- Records sessions, producing both machine- and human-readable dialogue transcripts
- Records User's verbalizations, and annotations by Users and Human Evaluators
- Replays recorded sessions, including annotations, for further analyses
- Aids Human Evaluator in analyzing event sequences in dialogue
- Aids Human Evaluator in mapping semantics of dialogue
- Aids Human Evaluator in analyzing layout and organization of Graphical User Interface
- Provides a central repository for storing data, notes, and results of analyses for evaluation
- Supports distribution and re-integration of evaluation tasks, data, and results across sites
- Aids Human Evaluator in composing recommendations for design concept changes



AES

User Interface Design Guidelines

Susan M. Adams
Pacific Northwest Laboratory
Fort Lewis, WA

PNL

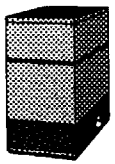
AES

Overview

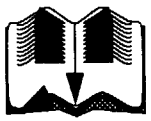
- ATCCS Guidelines --> DoD Style Guide
- Where they fit in design process
- Impact on design
- What's included
- Examples using TAE+
- Software demonstration

AES Methodology for User Interface Rapid Prototyping

Interactive Prototyping



Automated User Event Capture



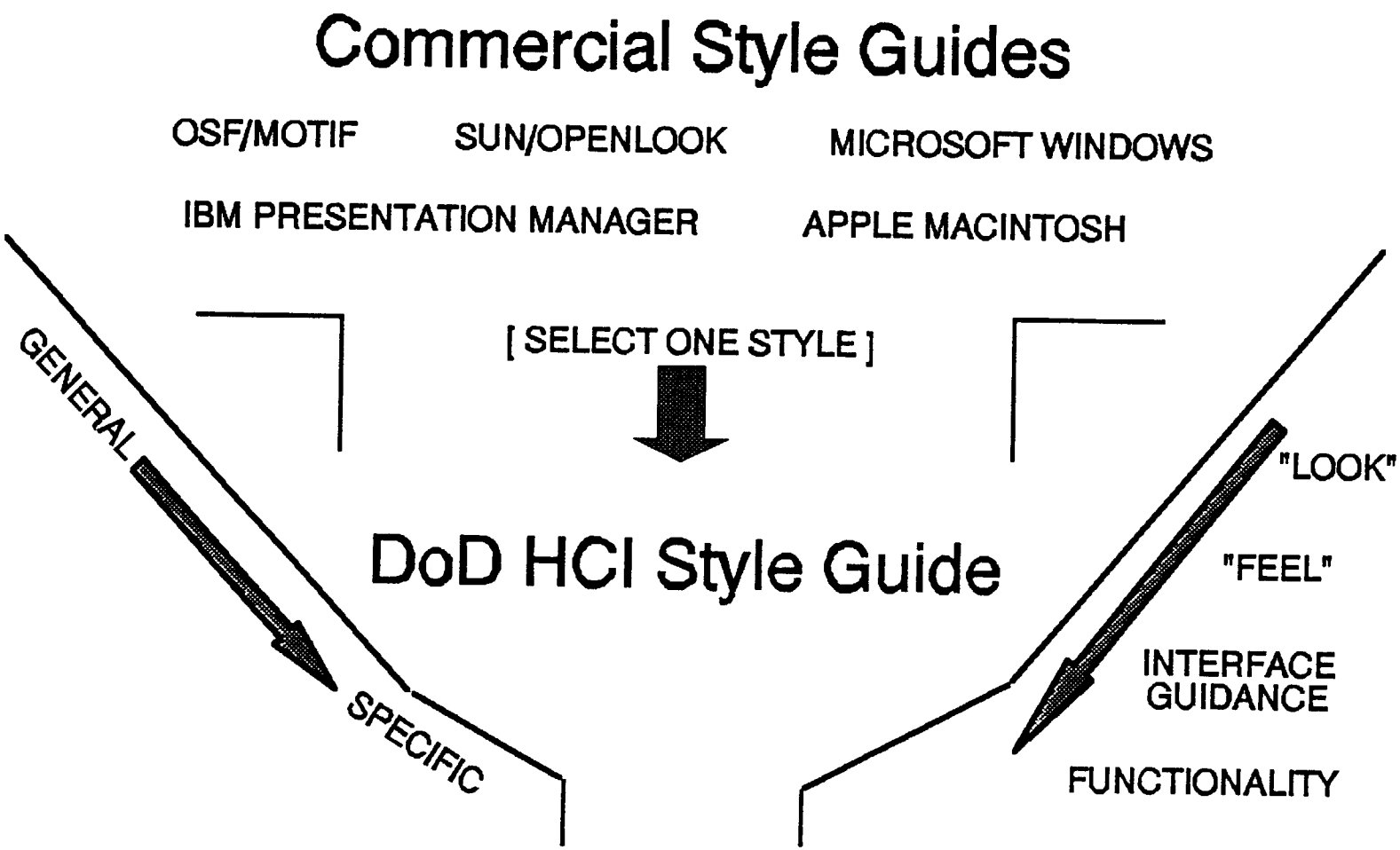
ATCCS User Interface Guidelines

AES-Enhanced
Rapid Prototyping Tools

AES Experimentation

Products for the Developer

Consistent & Usable ATCCS SMI


Commercial Style Guides
OSF/MOTIF
SUN/OPENLOOK
MICROSOFT WINDOWS
IBM PRESENTATION MANAGER
APPLE MACINTOSH
[SELECT ONE STYLE]
GENERAL
SPECIFIC
"LOOK"
"FEEL"
INTERFACE GUIDANCE
FUNCTIONALITY
DoD HCI Style Guide
Application Specific Style Guide

Impact on Industry and Government

- Provides positive influence on HCI design
  - Greater standardization
  - Reduced training requirements
  - Easier migration of personnel across applications and systems
  - Reduced Life-Cycle costs
- Conformance should be expected for future system design
- Need to plan for migration towards conformance

Style Guide Contents

- Discussion of differences in Motif and Open Look applications
- Hardware considerations including issues relating to Computer/Electronic Accommodation Program (CAP)
- Application Interface Design Guidelines
- Objective Security Interface Requirements
- References by Paragraph & Bibliography

AES

Style Guide Contents

- **HCI Guidelines**
  - Screen Design
  - Windows
  - Menu Design
  - Object Manipulation
  - Common Features
  - Text Graphics
  - Decision Aids
  - Query
  - Embedded Training
  - Emerging Technologies

PNL

Future Directions

- **Revision of StyleGuide**
  - Industry and Government comment
  - Style issue review
  - Uniform API (IEEE P1201.1)
  - Conformance checklist
  - "Look and Feel" (IEEE P1201.2)
  - Personal Layer
- **Publication of Style Guide Version 3.0**

Tenth TAE Users' Conference '93

TAE Plus v5.3 Testing Tools

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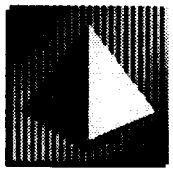
tae+

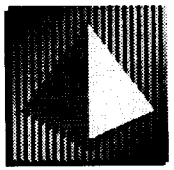


Outline

- Motivation
- Overview
- taeperl Language
- Scripting Example

Note: demos available

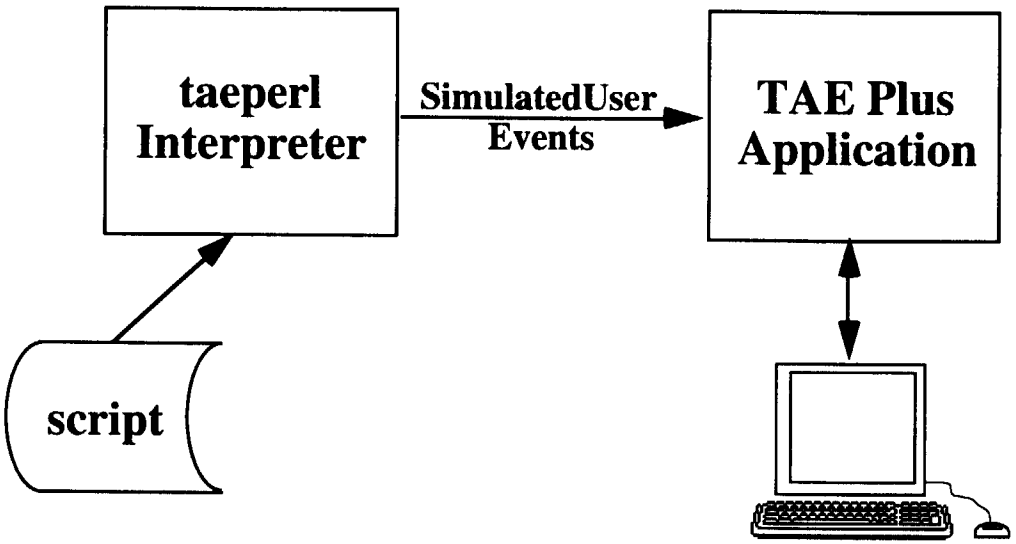
tae+



Motivation

- Repeatable tests of TAE Plus applications
- Minimal human involvement
- End-to-end tests with automatic verification
- Stress tests
- Easily maintainable test cases
- Generation of script via "record" mode

Overview



Notes:

- Script is sequential (as opposed to event-driven)
- Script language based on perl
- Application GUI interface remains alive
- Script is "interlocked" with event handlers
- Script may control multiple applications

taeperl

- Based on perl; see Larry Wall's "Programming perl", O'Reilly & Associates, 1992
- No perl changes; only new subroutines for application scripting
- Why perl as the base?
  - Public domain
  - Interpreted
  - C-like syntax
  - Many powerful features
  - Becoming very popular in the UNIX community

Note: taeperl may also be used as a GUI application language

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Example Script

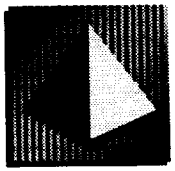
```
$appHandle = &Aut'Connect ("myApplication");
for ($i=1;  $i  <= 1000;  $i++)
    {
    print "processing file number $i. . .\n";
    &Aut'UserEvent  ($appHandle, "main", "fileName", "fileNumber$i");
    &Aut'UserEvent  ($appHandle, "main", "ok");
    sleep(4);
    }
&Aut'Close($appHandle);
```

Data Driven Objects

Karl Wolf
Century Computing Inc.

Terry Bleser
Century Computing Inc.

Patricia M. Jones
University of Illinois



Tenth TAE Users' Conference '93

TAE Plus v5.3 Extensions to DDOs

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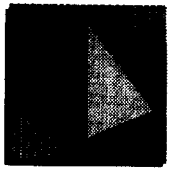
tae+

June 16, 1993



Extensions to DDOs

(aka TAE Plus v5.3 DDOs)

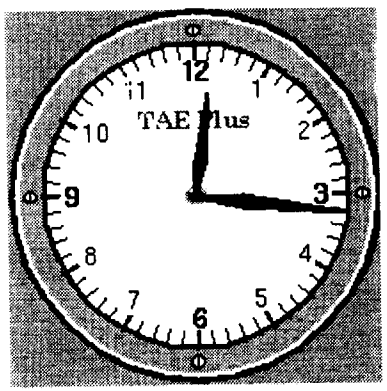
- Refresher on current DDOs
- Plans for TAE Plus v5.3
- Open Issues

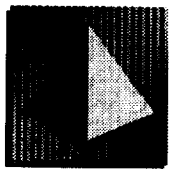
Current DDOs

- Map application data values to graphical objects.
- These objects change in response to changes in these data values in one of five ways:

  Mover, Rotator, Stretcher, Discrete, Stripchart

- Color thresholds can be applied to ranges of data values.
- In TAE Plus V5.2 we introduced multi-valued homogenous DDOs.
- Standard naming convention for idraw objects.
- Based on InterViews v2.6
- Entirely implemented within Wpt





Plans for TAE Plus v5.3

- New acronym DDO = Dynamic Data Object
  (was Data Driven Object)
- Implemented using InterViews v3.1
- Input Capabilities
- Extensions to DDOs
- Runtime Creation of Additional Dynamics
- Heterogeneous DDOs
- Introduction of a DDO widget

Advantages of InterViews v3.1

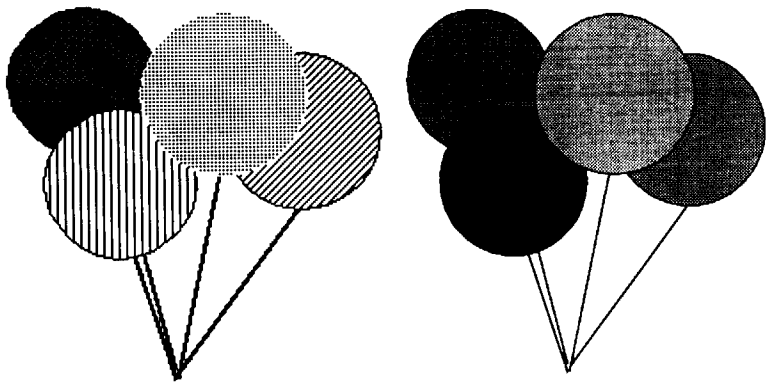
- InterViews v3.1 uses Glyphs. Glyphs are "light weight" objects.

- Improvements to taeidraw:

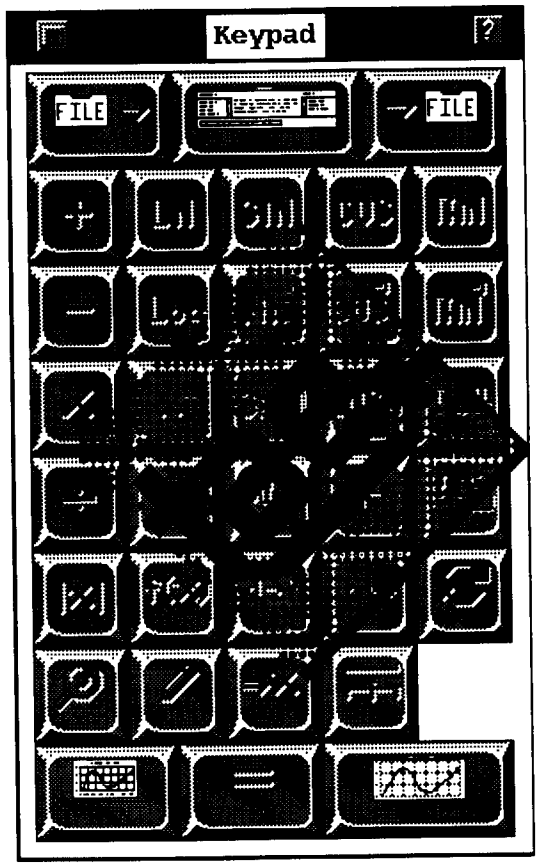
  Can import X bitmap files as stencils.

  Can import of color TIFF files as raster images.

- On color displays stippled fill patterns are rendered as smooth intermediate colors.



old new

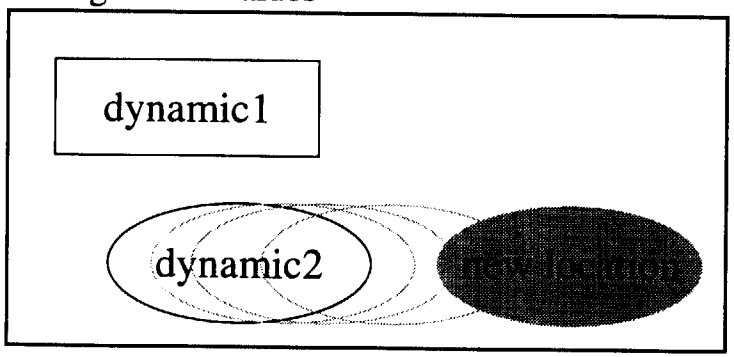


Input Capabilities

Allow user to click/drag dynamic objects

When a dynamic is changed, event handler is called

- Target value is updated (just like all other presentation types)
- Value array is filled with target Real values

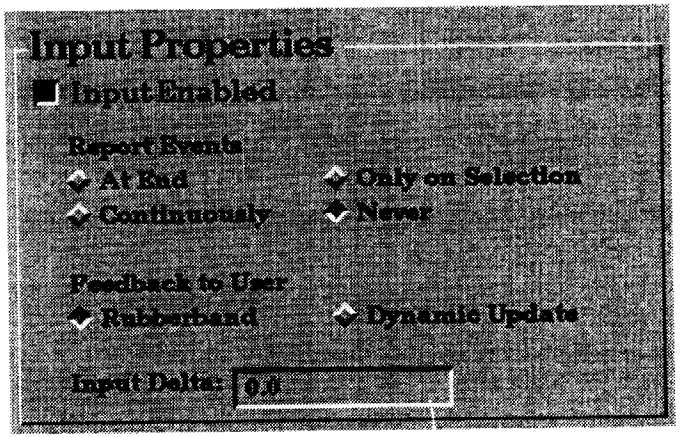


Allow for click/select on dynamic objects

- Target value won't change (like Push Button)
- Event handler is called

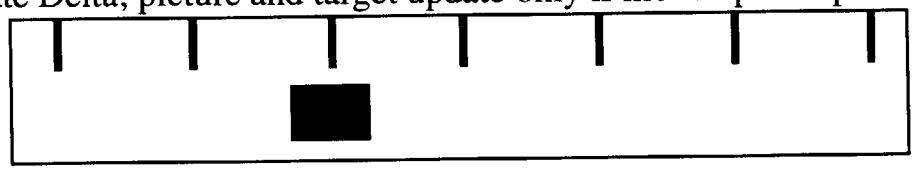
Input Capabilities (cont.)

Input Properties apply to each dynamic in a DDO



Input Delta

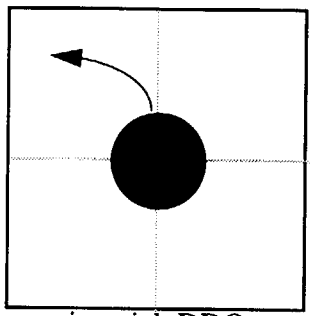
- Similar to Update Delta; picture and target update only if moved past input delta



Extend WptEvent structure to hold the additional information to support input (such as select vs. drag.)

Extensions to DDOs

(2-D Movers)

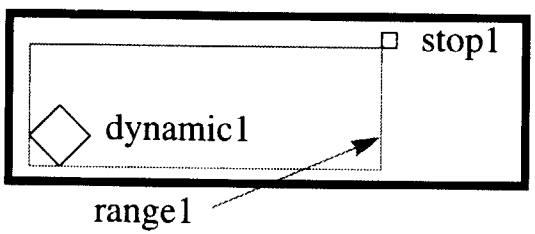

joystick DDO

Each Dynamic has 2 target indices in value array

- dynamic1 => value[0], value[1] => horizontal, vertical
- dynamic2 => value[2], value[3]

Start (Range Minimum) and Stop (Maximum) Positions

- Current 1-D Mover has an implicit start (from position in idraw file)
- Current 1-D Mover has a stop**n** picture (or defaults to edge of DDO)
- Use same for 2-D Mover
- new "rangen" picture

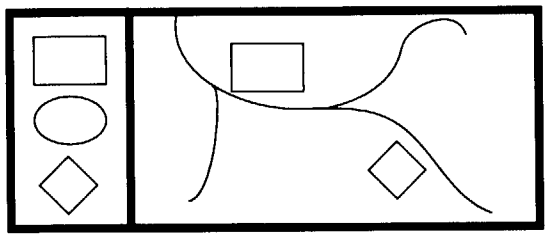


- For Multiple Dynamics wanting to use the same range (or stop)
  - New picture named "defaultrange" (and "defaultstop")

    If no associated range**n** (or stop**n**) for a dynamic**n**, then use defaultrange (or defaultstop)

Runtime Creation of Additional Dynamics

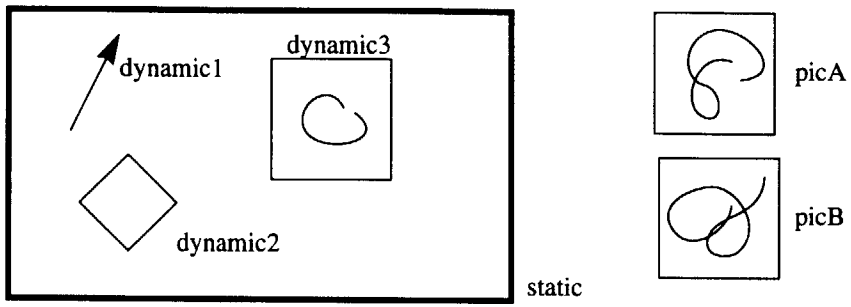
- With addition of 2-D Movers, naturally want to do map-type DDOs
  - Allow user to create new dynamic objects from a palette (e.g. place tanks, trucks, etc.)



- Additions to the Wpt_ API:
  - Wpt_CreateDynamic
  - Wpt_DeleteDynamic

Heterogeneous DDOs

- Different dynamic object types share the same static background



- In this example, dynamic3 is a discrete
- picA and picB are threshold pictures
- Still use a multi-valued Real target

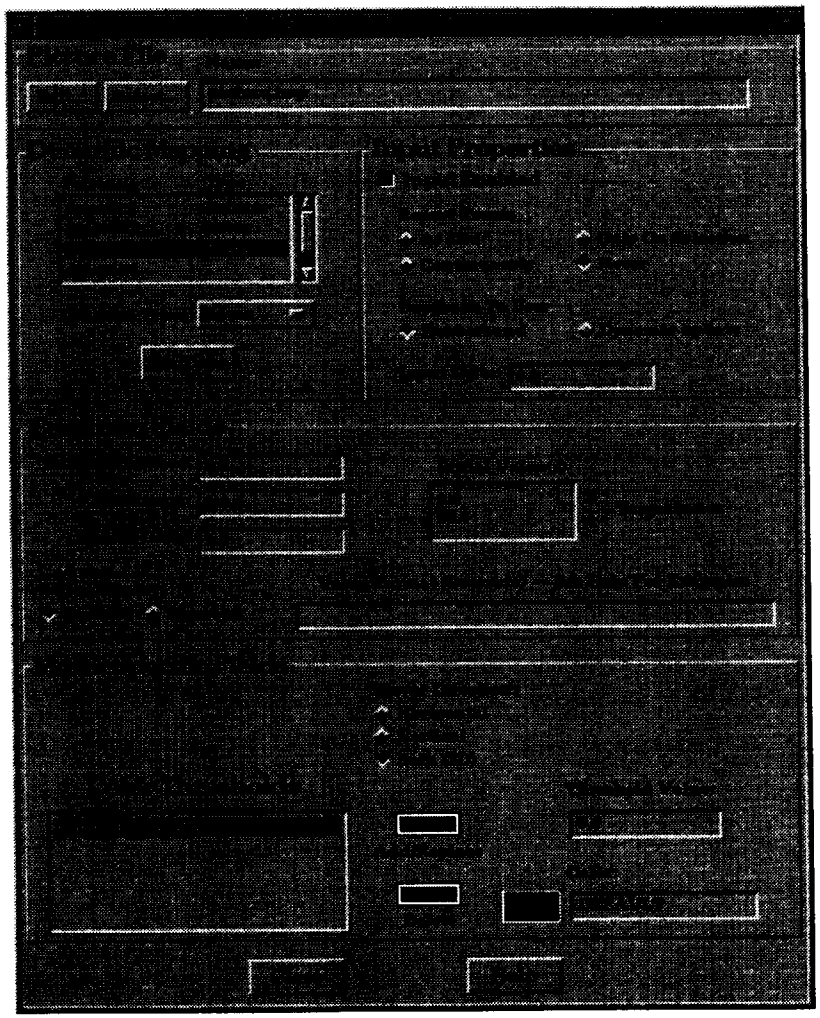
- Use our v5.2 standard naming conventions to keep the WorkBench side simpler

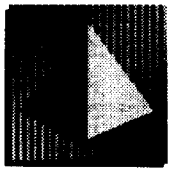
- Input Properties, Range Min & Max, Thresholds, etc. are per Dynamic (not per DDO)

Future enhancements are planned. Terry Bleser will discuss some.

Heterogeneous DDOs (cont.)

WorkBench Details Panel (tentative)





Introduction of a DDO Widget

- The previous discussion focused on the Wpt side of the DDOs. An effort is underway to "widgetize" them.

- The plan is to support only TAE Plus v5.2 DDO functionality with the addition of multiple thresholds. This implies:
  - Each dynamic may have its own set of thresholds.
  - No input support other than what is available for current DDOs.
  - No 2-D movers.

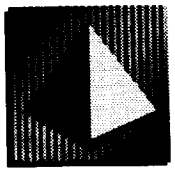
- UIL code generation will only support v5.2 style DDOs.

Open Issues

What does Input mean to a discrete?

What does it mean to have color thresholds for an dynamic with more than one degree of freedom (e.g. 2D-Mover)?

If a stretcher has shrunk to its minimum size (0 height or width), how do you select it to stretch it out again?



Tenth TAE Users' Conference '93

Data Driven Objects Potential Enhancements

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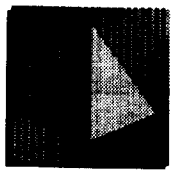
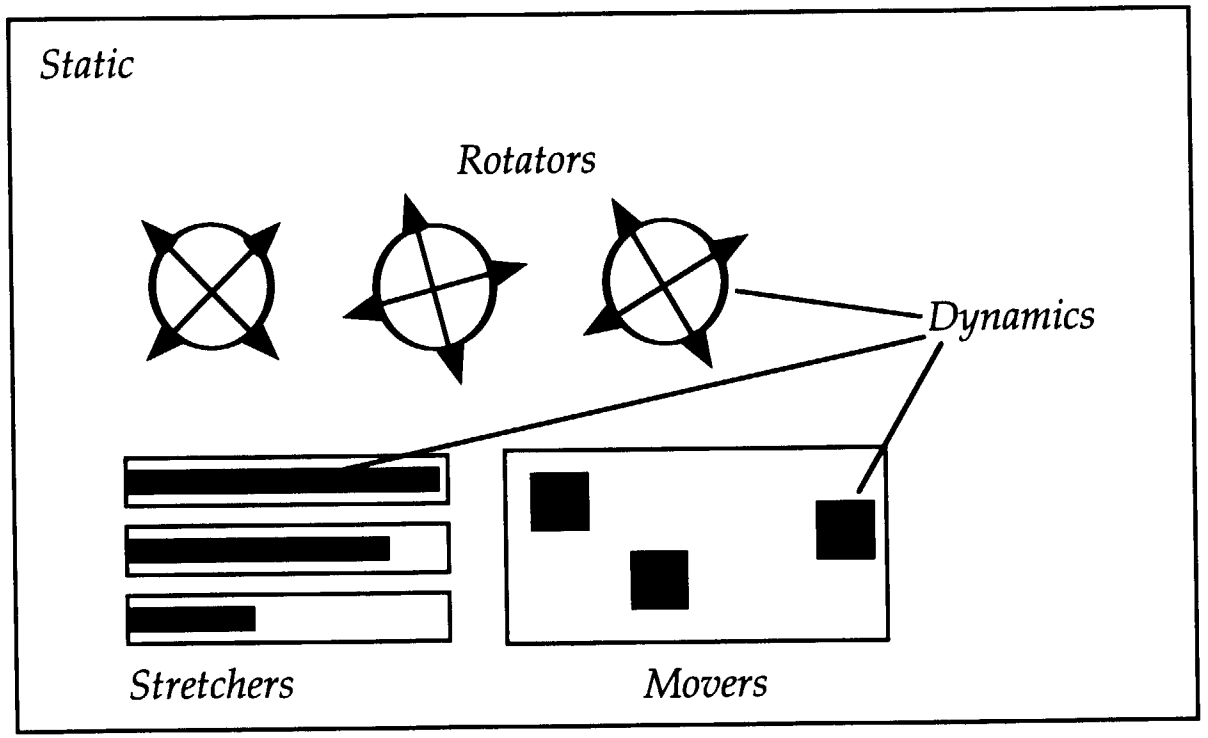
tae+



Future Directions for DDOs

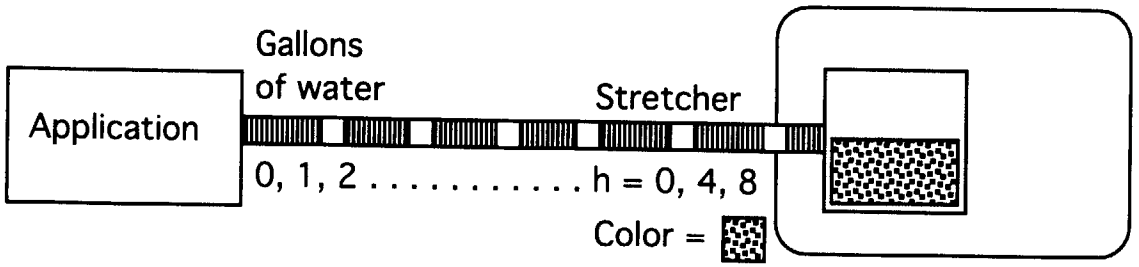
- Beyond Location, Size, and Angle
- Multi-dimensional DDOs
- Tailored Input
- Creating DDOs
- Other Media
- Escaping Flatland

DDO Structure

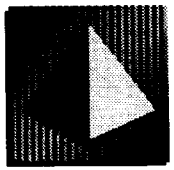


DDO

Beyond Location, Size, and Angle



- **Constrained location - along a specified path**
- **Area, volume**
- **Foreground and background**
- **Color hue, saturation**
- **Visibility**
- **Stacking order**
- **Line thickness, line pattern, fill pattern**
- **Text attributes**
- **Sensitivity of each attribute**



Multi-dimensional Dynamics

- Move and rotate - planes, tanks
- Move and stretch (scale)
- Rotate and stretch - angle and amount for direction and speed
- Move, stretch, and rotate
- Move (rotate, stretch) and discrete

- or any combination of other attributes

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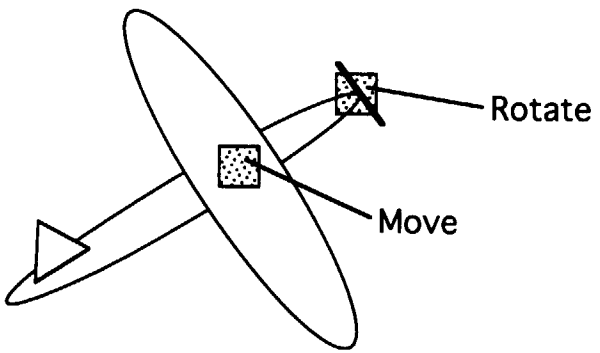
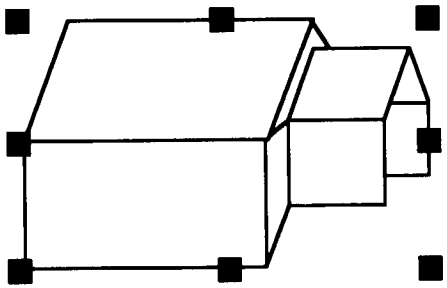
Tailored Input

- **Fine vs gross control**
- **Key/event mapping**
- **Hot spot definition**

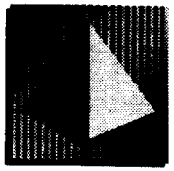


Tailored Input (cont'd)

- **Surrogates - graphical input object pops up on select**

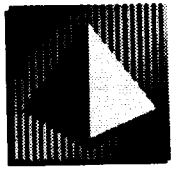


- **Gestural input**
- **Currently selected object**
- **Alternative selection methods - multi-select, cycling**
- **Object interactions - drag and drop, collisions**



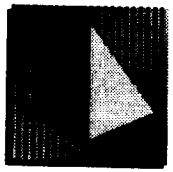
Creating DDOs

- Drawing facility
  - exact positioning and sizing
  - precise control over scaling
  - fine adjustment
  - color, font, line width assignment feedback
- Import drawings from other drawing tools
- Copy dynamics from an existing ddo - change the static only
- Arbitrary names
- Hierarchy of dynamics, groups of dynamics
- Group modify - thresholds, ranges
- Semantic attributes



Other Media

- **Sound output**
  - **data representation - scatter plot, size of mail message**
  - **symbolic "picture"**
  - **interaction of objects**
- **Voice input**



Escaping Flatland

- 2-d Stretcher
- 3-d Mover, stretcher, rotator
- 3-d Surrogates - shadows

User Experiences with Data-Driven Objects

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Urbana IL 61801

TAE Plus User's Conference, June 1993

- Part of "pilot" course on Interactive Systems Design

Application: Manufacturing

Students' favorite Presentation Item:
Discrete DDO

Very flexible

Utilized example in documentation on switching picture files dynamically

Easy to use

Fun!

Wish List

Generate code for thresholds set for DDO's

(e.g.,

#define ITEM1_PICTURE1_THRESHOLD 10

better yet:

#define ITEM1_RED 10)

Incorporate dynamic text into Movers (e.g., for AGV)

In general, **composite** DDOs

New DDO: "Tracker" object for vehicle applications.

User draws arbitrary path ("static"), "dynamic" vehicle follows it.

Object Dependencies

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Margi Klemp
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Tenth TAE Users' Conference '93

Object Dependencies

Item-to-Item Connections

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tae+

June 16, 1993

Overview

Goals

Static Layout vs. Dynamic Behavior

Current Connection Capability

Separate User Interface from Application

Miscellaneous Connection Enhancements

Item-to-Item Connections

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Goals

Enhancements to Connections

Allow non-programmer / UI designer to specify more dynamic behavior

Improve separation of UI and application (potentially)

Interested in input from the user community

These enhancements are only in the idea phase. They are *not* slated for a particular release

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Static Layout vs. Dynamic Behavior

Non-programmer uses the WorkBench to define the User Interface

User Interface is composed of *static layout* and *dynamic behavior*

Static Layout

- Visual Attributes, Position, Size, Color, Font, Label

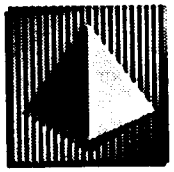
Dynamic Behavior

- DDO Thresholds, Connections

Problem: Most UI dynamic behavior must be specified by the programmer. Programmer should only be concerned about the application, not the UI.

Solution: Extend connections to allow non-programmer to specify more dynamic behavior

tae+



Current Connection Capability

Item-to-Panel

Connections allow non-programmer to specify simple dialog control, e.g.

- When the user presses buttonA on panel1, panel2 appears and panel1 disappears
- Display a different panel for each choice in a menu

No Separation of User Interface from Application

- Connection is implemented via code generated into the event handler
- If connection is changed (in the WorkBench), code must be regenerated and recompiled

Separate User Interface and Application

To Generate into Code -- Or Handle in Wpt

Generate connections into code

- Generated code can be modified (by programmer) to integrate dynamic behavior with application knowledge
- E.g. if database is empty, display panel1, else display panel2

Handle connections in Wpt

- Change connection in WorkBench doesn't require application change
- Should be able to change connection at run-time

Which would most fit people's needs

- Applies to current and future connections
- An option would be most desirable, but we need to focus our development efforts

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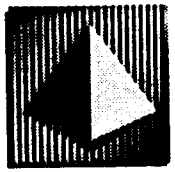


Miscellaneous Connection Enhancements

Item-to-Multiple Panels

Create, delete, or change state of many panels from a single event

Handle Multiple Selection - Selection List

Loop through all indices of value array (must be done for all event handlers)

Default Connection

A single connection for all choices of a multiple connection item

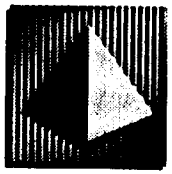
E.g. Show panel 2 when any choice is made from a radio button

MACRO facility - developed by University of Colorado

Allows non-programmers to insert code using customizable macros

Request input from user community

tae+



Item-to-Item Connections

Potential types of item-to-item connections (all driven by user-events)

- Update Properties (e.g. Sensitivity, Visibility)
  Select a mode from a Radio Button — certain control buttons dim
- Update Target values
  Manipulate a Scale — set the target value of a DDO
- Update Constraints or Menubar entries
  Press a button — change the choices of a menu
- Update View attributes
  Check a checkbox — Change the title and foreground color of a label

Request input from user community

- Consider your applications — How often would this be useful?
- Even without application knowledge?

USING THE SPREADSHEET MODEL OF COMPUTATION FOR DEFINING OBJECT DEPENDENCIES

PRESENTED BY

MARGI KLEMP
UNIVERSITY OF COLORADA

Using the Spreadsheet Model of Computation for Defining Object Dependencies

Why the Spreadsheet?

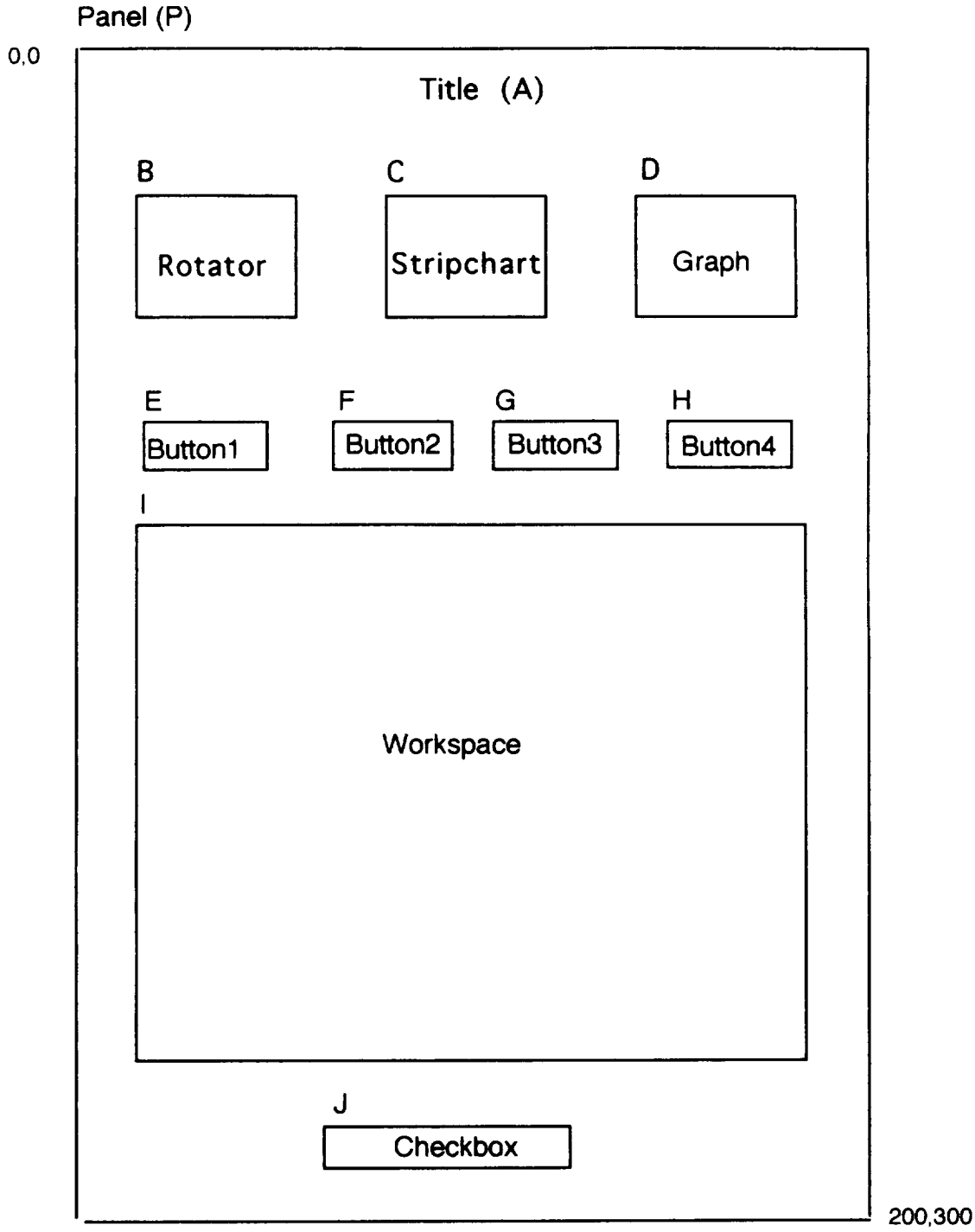
- Programming languages are difficult for non-specialists

- The spreadsheet model has done more to make computing accessible than any development since Fortran (Clayton Lewis - New Approaches to Programming, 1989)

- The spreadsheet model fits well with graphical user interfaces which can be viewed as intercommunicating objects

- NoPumpG extends the spreadsheet model to control graphical interactions and animation (Lewis, 1987)

- Software development projects at the University of Colorado are building on this model to define interactions of objects used for scientific visualization


Panel (P)
0,0
Title (A)
B
Rotator
C
Stripchart
D
Graph
E
Button1
F
Button2
G
Button3
H
Button4
I
Workspace
J
Checkbox
200,300

Spreadsheet View of TAE objects:

	A	B	C	D	E	F	G	H	I	P
Object Type	Text	Rotator	Stripchart	Graph	Button	Button	Button	Button	Workspace	Panel
Bg Color										
Fg Color										
Font										
Xsize										
Ysize										
Visible										
Xorigin										
Yorigin										

Geometry Management Examples

Assume the user resizes the panel:

- Item B (rotator) changes size in proportion to the new window size

  B.Xsize = .2 * P.Xsize
  B.Ysize = .1 * P.Ysize

- The position of B remains the same relative to the new panel size

  B.Xorigin = .1 * P.Xsize
  B.Yorigin = .05 * P.Ysize

- Item E (button) remains the same size regardless of panel size. There are no formulas for the size cells

  E.Xsize = 50
  E.Ysize = 20

Geometry Management Examples (continued)

- Items E - H (buttons) are always displayed in the same order but will be placed in separate rows if not fully visible on the panel

  E.Xorigin = .1 * P.Xsize

  F - H are positioned relative to the previous button
  We create an ordinary cell for the previous X distance.

  previous-diste = E.Xorigin + E.Xsize + spacex

  The formula for the X origin of button F is an if construct:

  F.Xorigin = if(F.Xsize + previous-diste > P.Xsize,
  E.Xorigin, previous-diste)

- Object visibility could be controlled by a formula. Assume that item D (graph) should be invisible if the panel X size is less that 180

  D.visible = if(P.Xsize < 180, 0, 1)

- If an item on a panel were resized, the origin and size of surrounding items could be defined in terms of the new size of adjacent items

Other Examples

- Attributes can be propagated via formulas. To maintain the same background color for buttons E - H define an ordinary cell for the color

  Button-color = "red"

  Then use formulas to set the color for each button

  E.Bgcolor = Button-color
  F.Bgcolor = Button-color
  . . .

  Note that the color could be set from a menu item, a text list, etc.

- A checkbox (J) could control the visibility of workspace I

  I.visible = J

A Simpler Interface for the TAE WorkBench

Panel resize options:

- Resize an item (or all items on panel) in proportion to the new panel size
- Leave an item (or all items on panel) the same size clipping where necessary
- Group selected items maintaining sequential positioning within the group (create extra rows or columns as needed)

Specify the options above via standard TAE interaction objects

Automatically generate the spreadsheet including formulas to define the selected option

Summary

- The spreadsheet model of computation appears to handle many of the problems encountered by user interface designers in regard to object dependencies which would traditionally require a programming solution.

- Formulas may become quite complex. A simpler interface could be used to define the behavior for the most commonly used scenarios.

Integration with Other Software

Chris Barclay, Joseph Molnar
Naval Research Lab.

Ken Sall
Century Computing Inc.

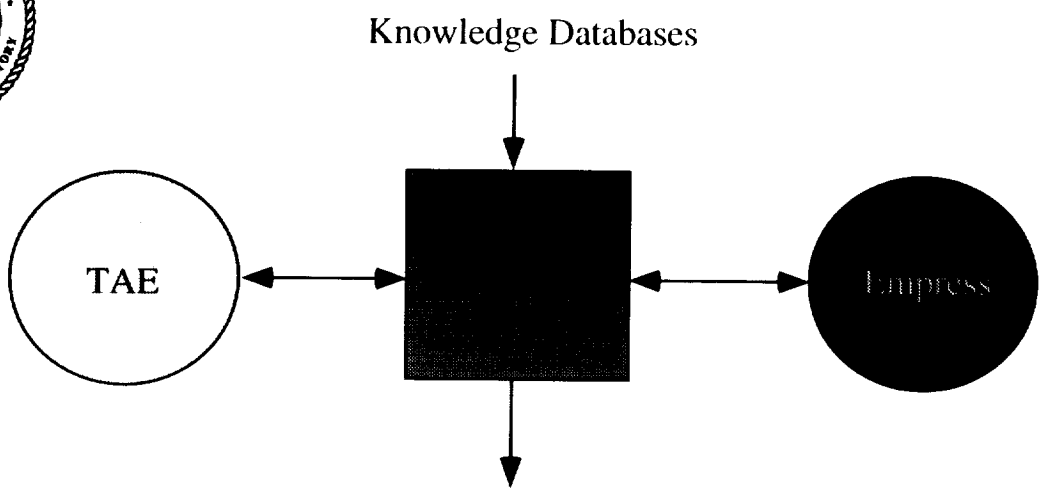
Greg Shirah
Goddard Space Flight Center

The Development of a Graphical User Interface to the Fault Isolation System Database Manager

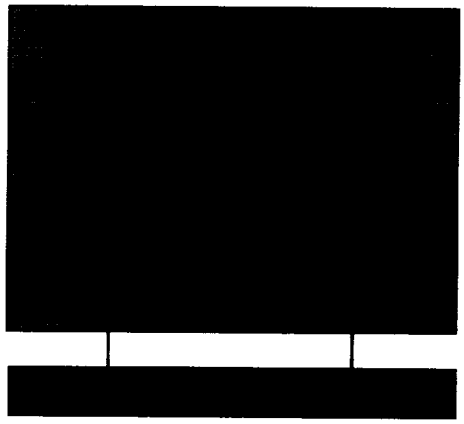
Delivered to the Tenth TAE User's Conference
June 14-17, 1993

Christopher Barclay
Joseph Molnar

Information Technology Division
Naval Research Laboratory



Enhanced knowledge database development and management

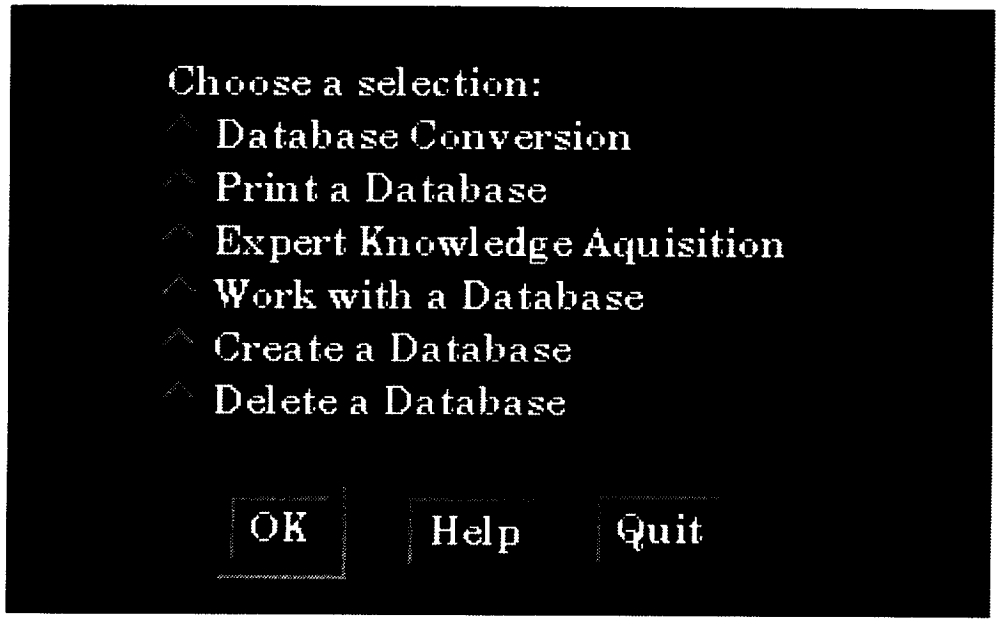


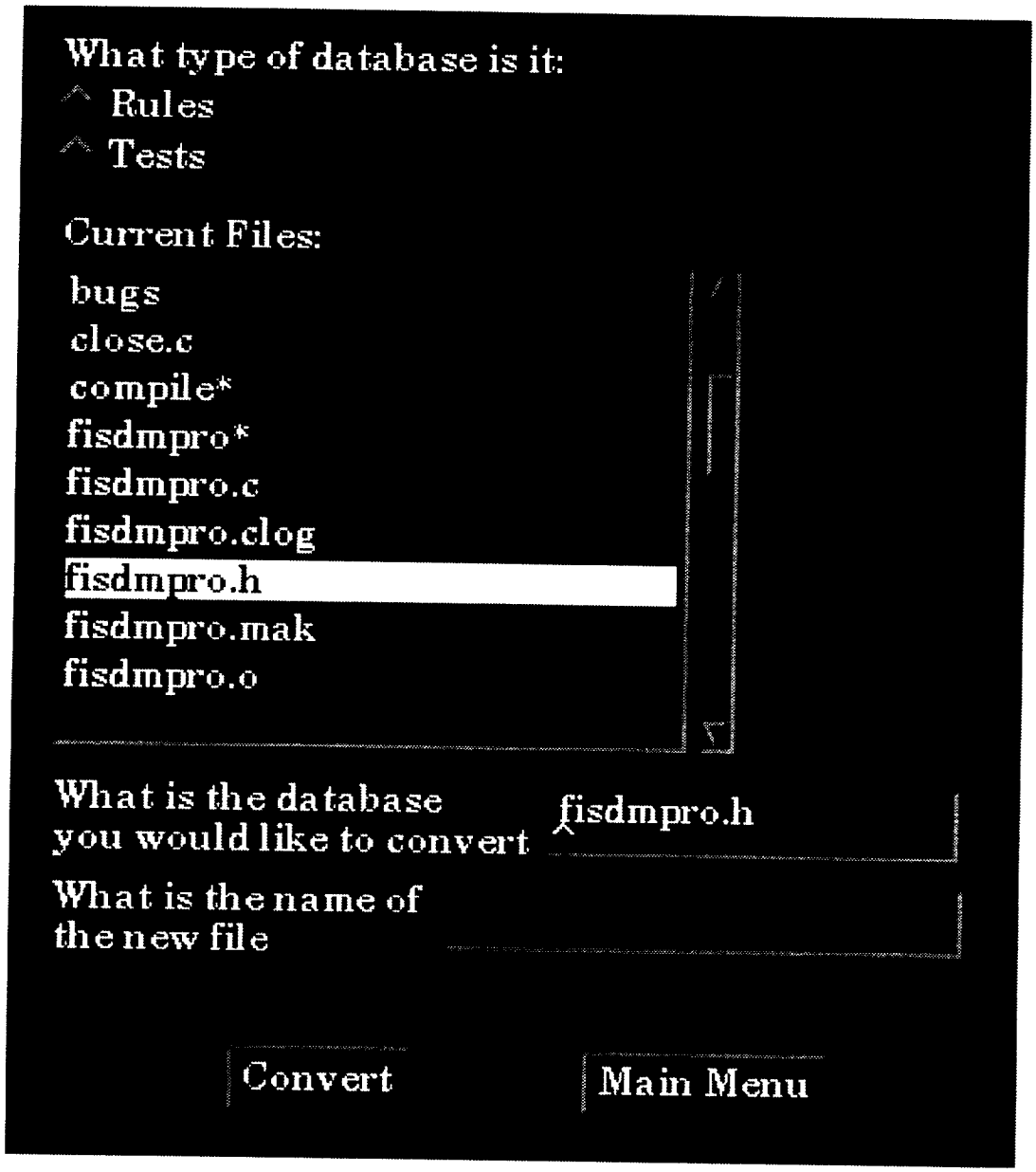
Goal: Working Expert System

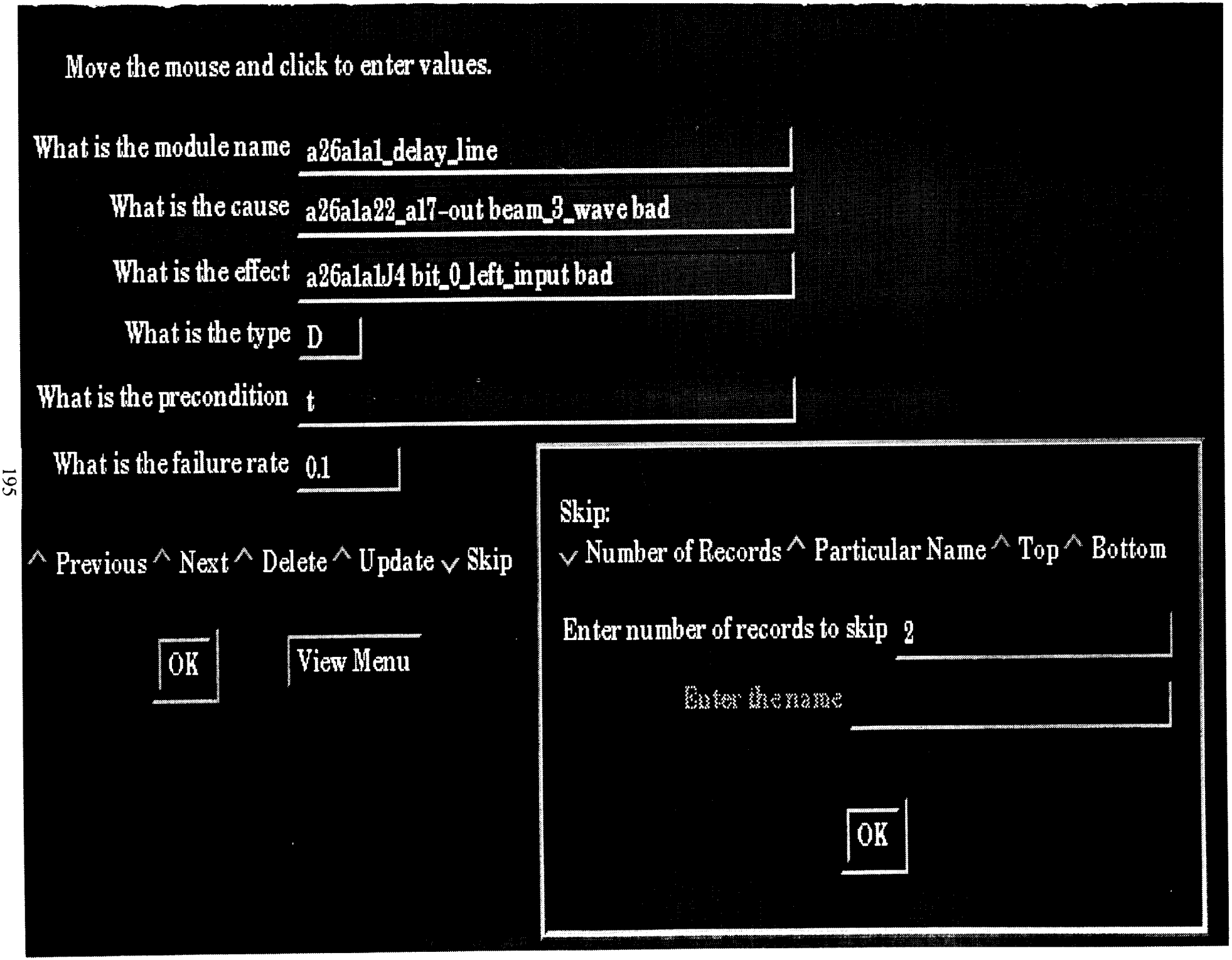
- Reliability
- Ease of Use
- Robust
- Data Management

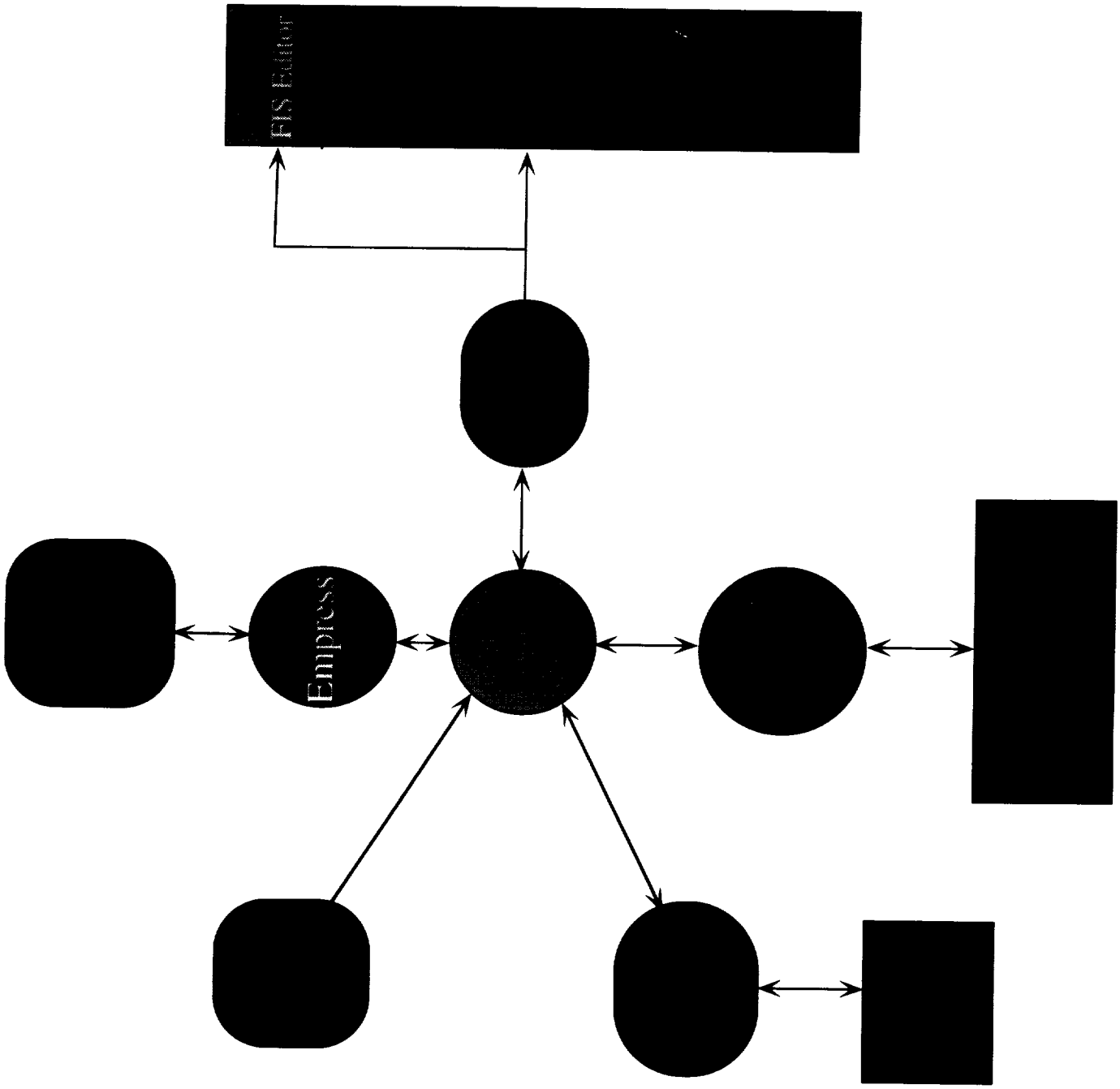
Method:

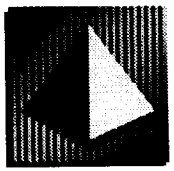
- Empress
  - Reliable Database
  - Data Management Functionality
- TAE
  - Ease of Use
  - Rapid Prototyping
  - Intuitive Interface


Choose a selection:
Database Conversion
Print a Database
Expert Knowledge Aquisition
Work with a Database
Create a Database
Delete a Database
OK
Help
Quit


What type of database is it:
Rules
Tests
Current Files:
bugs
close.c
compile*
fisdmpro*
fisdmpro.c
fisdmpro.clog
fisdmpro.h
fisdmpro.mak
fisdmpro.o
What is the database you would like to convert
fisdmpro.h
What is the name of the new file
Convert
Main Menu


Move the mouse and click to enter values.
What is the module name
a26a1a1_delay_line
What is the cause
a26a1a22_a17-out beam_3_wave bad
What is the effect
a26a1a1J4 bit_0_left_input bad
What is the type
D
What is the precondition
t
What is the failure rate
0.1
^ Previous ^ Next ^ Delete ^ Update v Skip
OK
View Menu
Skip:
v Number of Records ^ Particular Name ^ Top ^ Bottom
Enter number of records to skip
2
Enter the name
OK





Tenth TAE Users' Conference '93

UIL Support and Mrm Code Generation

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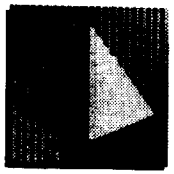
tae+



UIL Support and Mrm Code Generation

Overview

- What are UIL and Mrm?
- Advantages of UIL/Mrm Applications
- Advantages of Wpt Applications
- UIL Generation
- Sample Mrm Code (prototype)
- Sample UIL File (prototype)

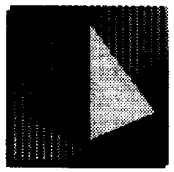
What are UIL and Mrm?

UIL is Motif's *User Interface Language*

- Permits separation of user interface specification from application code.
- Textual description of the UI which is compiled into binary form called **UID** (*User Interface Definition)* using the Motif compiler, named *uil.*
- Static description (e.g., no item-to-panel connections)

MRM is the *Motif Resource Manager*

- Set of functions in libMrm.a which retrieve the widget hierarchy from the UID file and create the widgets.
- Application code defines callbacks in the normal X Toolkit manner, but doesn't call XtCreate[Managed]Widget.



Advantages of UIL/Mrm Applications

- A more standard representation for interfaces developed with TAE Plus.
- No proprietary libraries (DDOs, however, require new DDO widget library, libXtae.a).[1]
- Eliminates the requirements for applications to use the Wpt, Vm, and Co runtime packages, thereby significantly reducing the size of executables.[2]
- Eases the porting of applications to platforms not supporting TAE Plus.
- New interfaces developed in TAE Plus will be more easily migrated to other UIDTs (user interface development tools).

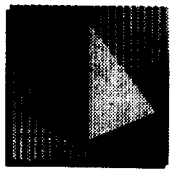
1. Link libs are simply "[-lddo -lXtae -lInterViewsX11] -lMrm -lXm -lXt -lX11" instead of "-lwpt -lxterm -lddo -lwmw -lInterViewsX11 -lXm -lXt [-lXmu] -lX11 -ltaec -ltae -ltermlib -lm -lc"
2. Test case: single panel with 29 items [all presentation types except DDOs, color logger, and dynamic text]; static layout only; comparison of Sun stripped binary size. *UIL application was approximately one-half the size of the Wpt version.* (Size of interface description files was approximately the same.)

Advantages of UIL/Mrm App. (cont.)

- Improved application performance using compiled UIL file (app.uid).
- Permits access to all widget resources and callbacks for finer control than is allowed in the WorkBench.[3]
- Enables addition of widgets not supported by TAE Plus. Knowledgeable Motif programmers can directly add Motif widgets (e.g., XmArrowButton, XmScrollbar, XmCommandBox) to app.uil.[4]
- All 23 Presentation Types supported including DDOs.[5]

  ➥ **Note**: To use UIL, your Motif vendor must supply the Mrm library (default location: /usr/lib/libMrm.a) and the *uil* compiler (default: /usr/bin/X11/uil). Most vendors do provide these.

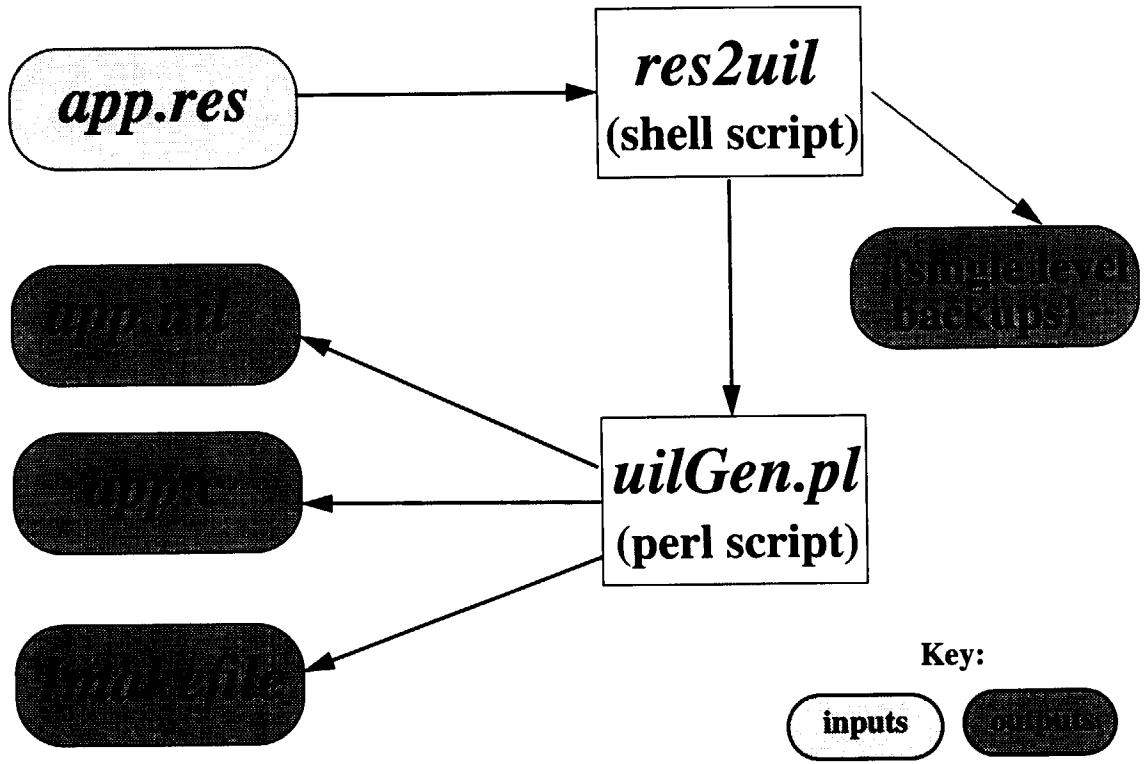
3. At this time, automatic merging of hand-edits to generated UIL when regenerating is still TBD.
4. Can also add your own widgets by registering them with UIL, which is what we've done with DDOs. This will be covered in the v5.3 *Guidelines for Adding a New Presentation Type*.
5. Dynamic Text is generated as simply an XmLabel widget in v5.3.



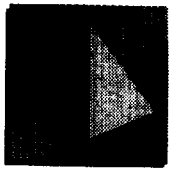
Advantages of Wpt Applications

- Wpt library provides greater functionality, usually with less application code than Xt, whereas UIL apps. have to simulate Wpt_PanelMessage, Wpt_HideItem, Wpt_ParmReject, etc.
- Designer and programmer need not be as familiar with Motif, Xt, and Xlib details, especially Motif resources and callbacks.
- Automatic error checking, such as for constraints (e.g., keyin, multi-line edit)
- Customized error messages (keyin, multi-line edit, textlist)
- TAE Plus Help mechanism
- Scripting (a v5.3 feature) - recording and playing back
- Code merging (a v5.3 feature; TBD whether in v5.3 UIL)
- Item-to-panel connections may only be available to Wpt applications. (TBD whether supported for UIL in v5.3.)

UIL Generation

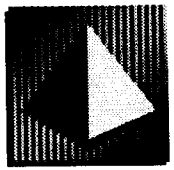


- Generated code is Mrm, Xt, and some Xlib (no Wpt or IV).
- Type "make" to build; type "make app.uid" to compile app.uil (into app.uid) using the *uil* compiler.

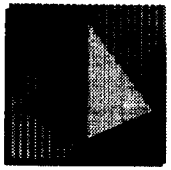


Sample Mrm Code (prototype)

```
/* *** TAE Plus Mrm Code Generator version 5.3 *** */
/* *** Generated: Wed Jun 2 19:14:27 1993 *** */
#include <stdio.h>
#include <Mrm/MrmPublic.h>
#include <Xm/Xm.h>
#include <X11/Intrinsic.h>
#include <X11/StringDefs.h>
#include <Xm/MwmUtil.h> /* for MWM_DECOR_* and MWM_FUNC_* */
#define MAX_ARGLIST 12

int SetTopLevelResources ( );

Display *TheDisplay;
XtAppContext AppContext;
Widget TopLevelWidget;
MrmHierarchy S_MrmHierarchy;

int main (argc, argv)
int argc;
char **argv;
{
        int n;
        Arg arglist[MAX_ARGLIST];
        MrmType dummy_class;
        Widget main_window_widget = NULL;
        static char *db_filename_vec[] = {"app.uid"};
        static int db_filename_num =
                (sizeof db_filename_vec / sizeof db_filename_vec [0]);
```

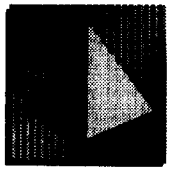


```
MrmInitialize ();
XtToolkitInitialize ();
AppContext = XtCreateApplicationContext ();
TheDisplay = XtOpenDisplay (AppContext, NULL, argv[0], "theApplication",
                NULL, 0, &argc, argv);
if (TheDisplay == NULL) {
        fprintf (stderr, "%s: Can't open display\n", argv[0]);
        exit (1);
        }

 n = SetTopLevelResources ( arglist, "Presentation Types Demo",
                617, 871, 511, 39, 5,"presdemo", "$TAE/inc/bitmaps/tae.icon",
                (MWM_DECOR_MENU|MWM_DECOR_TITLE|MWM_DECOR_BORDER|
                MWM_DECOR_TITLE|MWM_DECOR_MINIMIZE),
                 (MWM_FUNC_MOVE | MWM_FUNC_MINIMIZE ) );

 TopLevelWidget = XtAppCreateShell ("ToppresdemoPanel", NULL,
                        applicationShellWidgetClass,
                        TheDisplay, arglist, n);

 if (MrmOpenHierarchy (db_filename_num, /* Number of files. */
        db_filename_vec, /* Array of file names. */
        NULL, /* Default OS extenstion. */
        &S_MrmHierarchy) /* Pointer to returned MRM ID */
        !=MrmSUCCESS)
        {
        fprintf (stderr, "can't open hierarchy\n");
```

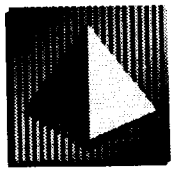


```
            exit (1);
            }
        RegisterCallbacks ();

        if (MrmFetchWidget (S_MrmHierarchy,
            "presdemoPanel", /* uil name of panel */
            TopLevelWidget, /* TBD */
            &main_window_widget, /* TBD */
            &dummy_class) /* TBD */
            != MrmSUCCESS)
            {
            fprintf (stderr, "can't fetch main window\n");
            exit (1);
            }

        XtManageChild (main_window_widget);
        XtRealizeWidget (TopLevelWidget);
        XtAppMainLoop (AppContext);
    } /* main */

void presdemo_textlist_cb (widget, client_data, call_data)
    Widget widget;
    XtPointer client_data;
    XtPointer call_data;
    {
    printf ("event handler: presdemo/textlist\n");
    }
```

```
void presdemo_checkbox_cb (widget, client_data, call_data)
        Widget widget;
        XtPointer client_data;
        XtPointer call_data;
        {
        printf ("event handler: presdemo/checkbox\n");
        }

/* list of functions to register */

static MrmRegisterArg RegList[] =
        {
        {"presdemo_textlist_cb", (XtPointer)presdemo_textlist_cb},
        {"presdemo_checkbox_cb", (XtPointer)presdemo_checkbox_cb},
        {"", 0} /* dummy last entry */
        };
#define NRegList (sizeof(RegList)/sizeof(RegList[0]) - 1)

int RegisterCallbacks ()
{
        int code;
        code = MrmRegisterNames (RegList, NRegList);
        if (code != MrmSUCCESS)
                {
                printf ("cannot register callbacks\n");
                return;
                }
} /* RegisterCallbacks */
```

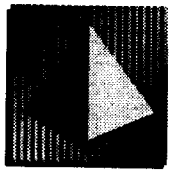


```
int SetTopLevelResources ( arglist, title,
                           width, height, x, y, border,
                           iconName, iconFilename,
                           decorMask, funcMask )
        Arg arglist[];
        char *title;
        Dimension width, height;
        Position x, y;
        Dimension border;
        char *iconName, *iconFilename;
        unsigned long decorMask, funcMask;
{
        int n = 0;
        XtSetArg (arglist[n], XmNtitle, title ); n++;
        XtSetArg (arglist[n], XmNmwmDecorations, decorMask ); n++;
        XtSetArg (arglist[n], XmNmwmFunctions, funcMask ); n++;
        XtSetArg (arglist[n], XmNwidth, width ); n++;
        XtSetArg (arglist[n], XmNheight, height ); n++;
        XtSetArg (arglist[n], XmNx, x ); n++;
        XtSetArg (arglist[n], XmNy, y ); n++;
        XtSetArg (arglist[n], XmNiconName, iconName ); n++;
        XtSetArg (arglist[n], XmNborderWidth, border ); n++;
        return ( n ); /* number of resources set in arglist */
} /* SetTopLevelResources */
```

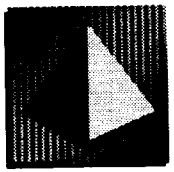


Sample UIL File (prototype)

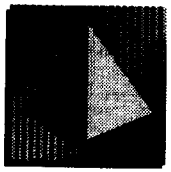
```
! UIL generated by TAE Plus 5.3: Wed Jun 2 19:14:27 1993
module main
version = 'v1.1'
names = case_sensitive

        pixmap_icon: xbitmapfile('/net/bat/home/tae/v53/inc/bitmaps/tae.icon');
        color_black: color('black');
        color_gold: color('gold');
        font_alias_courB18: font('courB18');
procedure
        presdemo_textlist_cb();
        presdemo_checkbox_cb();

object presdemo_checkbox : XmToggleButton
        {
        arguments
                {
                ! Item Specification Panel resources
                XmNlabelString = "Checkbox";
                XmNfontList = font_alias_courB18;
                XmNx = 15;
                XmNy = 26;
                XmNwidth = 129;
                XmNheight = 53;
                XmNforeground = color_black;
                XmNbackground = color_gold;
                XmNborderColor = color_black;
                XmNborderWidth = 2;
```



```
                XmNshadowThickness = 2;
                XmNtraversalOn = true;
                XmNnavigationType = XmTAB_GROUP;
                XmNhighlightThickness = 0;
                ! Presentation Panel resources
                XmNspacing = 5;
                XmNset = true;
                XmNalignment = XmALIGNMENT_BEGINNING;
                XmNselectColor = color_black;
                };
        callbacks
                {
                XmNvalueChangedCallback = procedure presdemo_checkbox_cb();
                };
        };

object presdemo_textlist : XmBulletinBoard
        {
        arguments
                {
                ! Item Specification Panel resources
                XmNx = 446;
                XmNy = 94;
                XmNwidth = 117;
                XmNheight = 112;
                XmNforeground = color_blue;
                XmNbackground = color_beige;
                XmNborderColor = color_blue;
```

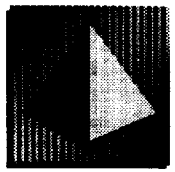


```
        XmNborderWidth = 1;
        XmNshadowThickness = 2;
        XmNtraversalOn = true;
        XmNnavigationType = XmTAB_GROUP;
        XmNhighlightThickness = 2;
        ! Presentation Panel resources
        XmNmarginHeight = 0;
        XmNmarginWidth = 0;
        };
controls
        {
        XmScrolledList
                {
                arguments
                        {
                        XmNx = 1;
                        XmNy = 22;
                        XmNwidth = 117;
                        XmNheight = 89;
                        XmNfontList = font_alias_variable;
                        XmNforeground = color_blue;
                        XmNbackground = color_beige;
                        XmNborderColor = color_blue;
                        XmNitemCount = 5;
                        XmNitems = string_table( "choice 1",
                                "choice 2",
                                "choice 3",
                                "choice 4",
                                "choice 5" );
```

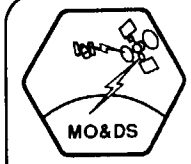


```
                        XmNvisibleItemCount = 3;
                        XmNselectedItemCount = 3;
                        XmNselectedItems = string_table( "choice 2",
                                "choice 3",
                                "choice 4" );
                        XmNselectionPolicy = XmMULTIPLE_SELECT;
                        XmNlistSizePolicy = XmVARIABLE ;
                        XmNscrollBarDisplayPolicy = XmSTATIC ;
                        XmNhighlightThickness = 0;
                        XmNlistMarginHeight = 3;
                        XmNlistMarginWidth = 3;
                        XmNlistSpacing = 3;
                        };
                callbacks
                {
                XmNmultipleSelectionCallback = procedure presdemo_textlist_cb();
                };
        };
XmLabel
        {
        arguments
                {
                XmNx = 2;
                XmNy = 4;
                XmNheight = 14;
                XmNwidth = 117;
                XmNfontList = font_alias_variable;
                XmNforeground = color_blue;
```

```
                    XmNbackground = color_beige;
                    XmNborderColor = color_blue;
                    XmNlabelString = 'Selection List';
                    XmNalignment = XmALIGNMENT_BEGINNING;
                    };
                };
        };
};

object presdemoPanel : XmBulletinBoard
        {
        arguments
                {
                XmNx = 511;
                XmNy = 39;
                XmNwidth = 617;
                XmNheight = 871;
                XmNforeground = color_black ;
                XmNbackground = color_beige ;
                XmNborderColor = color_black ;
                XmNborderWidth = 5;
                XmNresizePolicy = XmRESIZE_GROW;
                XmNtraversalOn = false;
                XmNnavigationType = XmNONE;

                ! TBD: Font default for objects without font resources
                XmNlabelFontList = font_alias_variable;
                XmNbuttonFontList = font_alias_ncenl14;
```



```
                ! TBD panel mwm resources and other panel resources; See SetTopLevelResources
                };
        controls
                {
                XmBulletinBoard presdemo_textlist;
                XmToggleButton presdemo_checkbox;
                };
    };
end module;
```



Data Systems
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520

Centerline's Object Center C++ Compiler

CenterLine's
Object Center C++
Compiler with TAE

Greg Shirah

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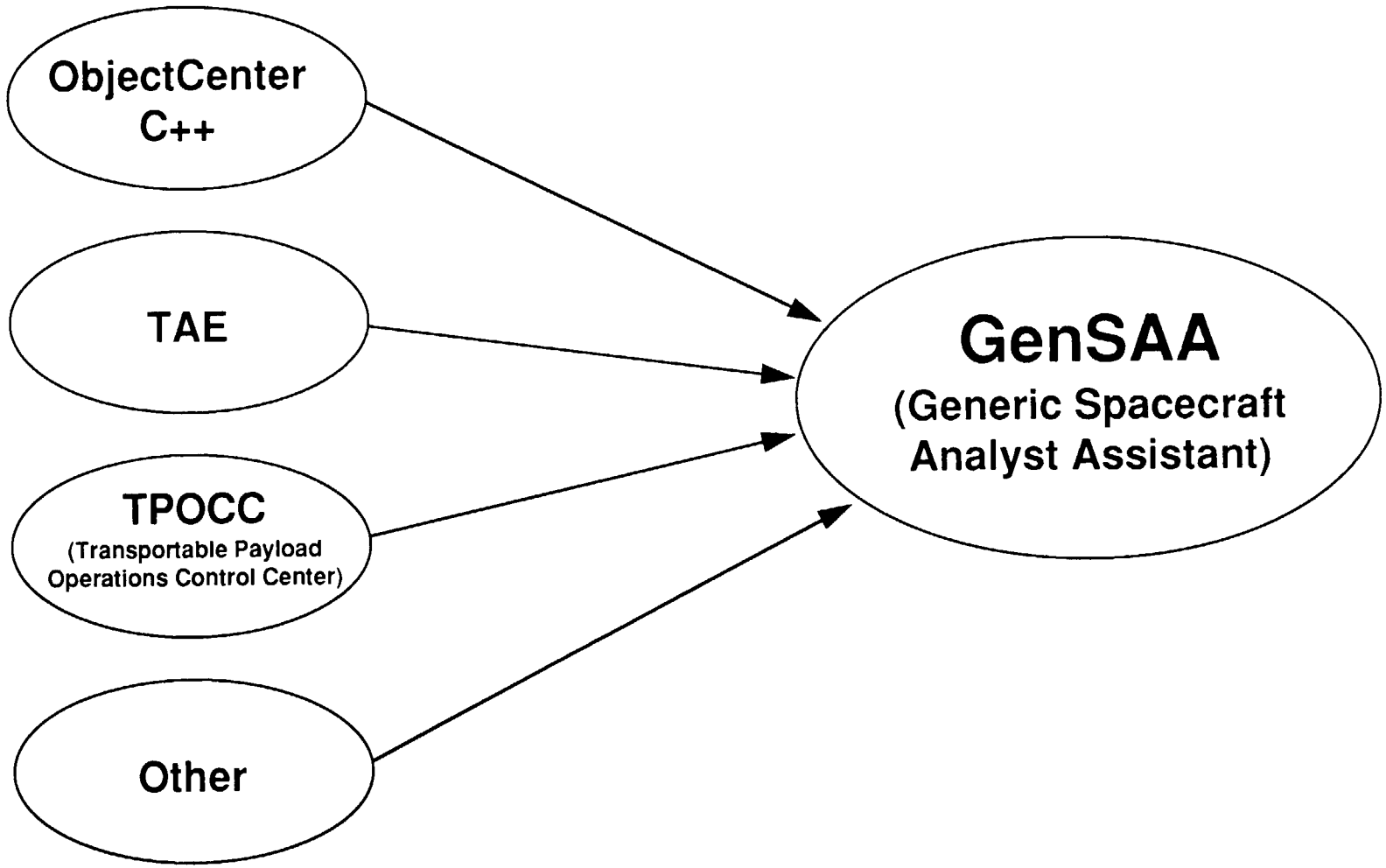
NASA - Goddard Space Flight Center

Experience

- C++ 2 years
- TAE+ 1 year (no TAE C experience)
- X/Motif 3+ years

GenSAA


ObjectCenter
C++
TAE
TPOCC
(Transportable Payload
Operations Control Center)
Other
GenSAA
(Generic Spacecraft
Analyst Assistant)

What is GenSAA?

- Generic Spacecraft Analyst Assistant
- Graphical expert system builder for spacecraft monitoring & fault isolation
- Written in Centerline's C++
- Used TAE 5.2 for GenSAA Workbench
- Integrated with TPOCC
- GenSAA Workbench - graphical specification of:
  - Data to be monitored/generated
  - Expert System Rules
  - User Interface
- GenSAA Runtime - execution environment

Object Center C++ With TAE

- Object Center interprets source *or* loads object code
- Used graphical debugger initially
- Found bug in Object Center related to displaying TAE widgets - Object Center / TAE responded with a fix
- Our system grew to be too large to load into Object Center's debugger

Using TPOCC with TAE and ObjectCenter C++

- TAE & TPOCC redefine several common macros
  - LONG
  - DOUBLE
- TPOCC used a C++ keyword "class"
- TPOCC & TAE work together smoothly, otherwise

Lessons Learned

- Object Center is very good at:
  - Enabling quick access to source files
  - Identifying compile time errors
  - Identifying runtime errors
  - Unit testing
- Object Center is not so good at:
  - Debugging large systems

TAE Tenth Users' Conference
June 14-17, 1993

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13. ABSTRACT *(Maximum 200 words)*

Goddard Space Flight Center sponsored the Tenth TAE Users' Conference on June 14–17, 1993. This document represents the proceedings; the papers included are published as received from the authors. This was the first TAE conference that followed an informal workshop format with panel discussions, demonstrations, tutorials and working sessions. With the TAE software being transferred into the private sector, all future user conferences will be managed by Century Computing, Inc., the commercial developers/distributors of TAE Plus.

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