HUMAN FACTORS ISSUES IN THE DESIGN OF USER INTERFACES FOR PLANNING AND SCHEDULING

PRESENTED AT THE SPACE NETWORK CONTROL CONFERENCE ON RESOURCE ALLOCATION CONCEPTS AND APPROACHES

NASA/GODDARD SPACE FLIGHT CENTER

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PREFACE

THE SYSTEM MUST BE BASED UPON A SIMPLE, CONCEPTUALLY USEFUL MODEL OF THE SCHEDULING PROCESS, THE USER INTERFACE MUST BE NATURAL AND INTUITIVE, AND THE COMMANDS MUST PROVIDE A DIRECT MAPPING OF THE INTENTION INTO ACTION.

--FOX, 1989

. . . THE FIRST STEP FOR THE DESIGNER IS TO DETERMINE THE FUNCTIONALITY OF THE SYSTEM BY ASSESSING THE USER TASK DOMAIN.

--SHNEIDERMAN, 1987

AGENDA

- INTRODUCTION
- ISSUES
- GUIDELINES
- DISPLAY CONCEPTS
- GENERAL RECOMMENDATIONS

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INTRODUCTION

- PURPOSE — PROVIDE AN OVERVIEW OF HUMAN FACTORS ISSUES THAT IMPACT THE EFFECTIVENESS OF USER INTERFACES TO AUTOMATED SCHEDULING TOOLS
- SCOPE — SELECTED ISSUES ADDRESSED IN RECENT WORK FOR NASA-GODDARD CODE 522.1

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INTRODUCTION (2)

- METHOD
  - SURVEY OF PLANNING AND SCHEDULING TOOLS
  - IDENTIFICATION AND ANALYSIS OF HUMAN FACTORS ISSUES
  - DEVELOPMENT OF DESIGN GUIDELINES BASED ON HUMAN FACTORS LITERATURE
  - GENERATION OF DISPLAY CONCEPTS TO ILLUSTRATE GUIDELINES

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HF-4

ISSUE: VISUAL REPRESENTATION OF THE SCHEDULE

- OBJECTIVE: REDUCE MENTAL MANIPULATION AND TRANSFORMATION OF DATA
- OPERATIONAL NEED:
  - ALTERNATIVE LEVELS OF ABSTRACTION
  - SUPPORT FOR VISUALIZING RELATIONSHIPS BETWEEN EVENTS
  - SUPPORT FOR REORDERING EVENTS
  - REDUCED DEMAND ON MEMORY

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ISSUE: VISUAL REPRESENTATION OF THE SCHEDULE (2)

- GUIDELINE: CONSIDER ALLOWING A SPECIFIC TEMPORAL ORDERING OF EVENTS TO EVOLVE OVER THE SCHEDULE'S LIFE CYCLE.
- DISPLAY CONCEPT: PRECEDENCE SCHEDULING
  - FOCUS ON RELATIONSHIPS BETWEEN EVENTS AND POINTS IN TIME
  - USE EVENT "CLONES" TO REPRESENT ALTERNATIVE SATISFACTION OF CONSTRAINTS ON AN EVENT

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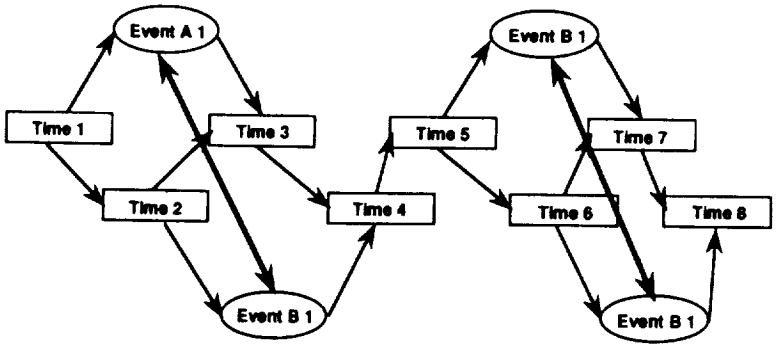
DISPLAY CONCEPT: PRECEDENCE SCHEDULING



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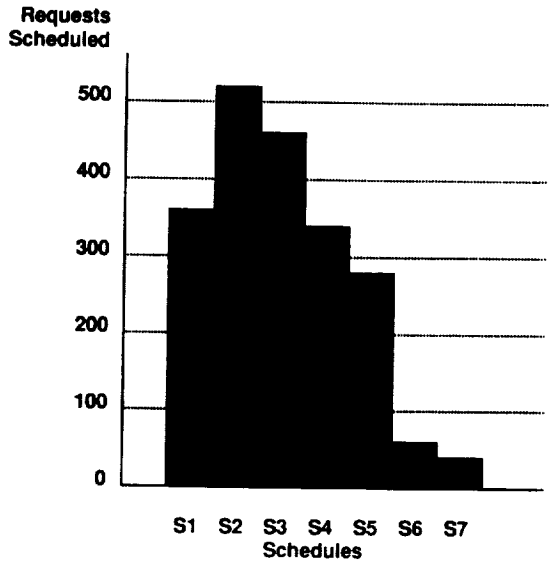
ISSUE: EVALUATION OF SCHEDULES

- OBJECTIVE: INCREASE THE EASE AND EFFECTIVENESS OF SCHEDULE COMPARISON AND SELECTION
- INFORMATION REQUIREMENTS/CRITERIA:
  - NUMBER OF REQUESTS SATISFIED
  - LEVEL OF RESOURCE FRAGMENTATION
  - AVERAGE PERCENTAGE OF SERVICE PROVIDED
  - PERCENTAGE OF SERVICE PER USER

ISSUE: EVALUATION OF SCHEDULES (2)

- GUIDELINE: PROVIDE A CAPABILITY THAT SUPPORTS QUICK VISUAL COMPARISON OF SCHEDULES
- DISPLAY CONCEPT: HISTOGRAM
  - CONVEYS RELATIVE EFFECTIVENESS OF ALTERNATIVES
  - REDUCES MENTAL COMPARISON OF DISCRETE QUANTITIES

DISPLAY CONCEPT: HISTOGRAM



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ISSUE: IDENTIFICATION OF AVAILABLE RESOURCES

- OBJECTIVE: SUPPORT OPERATOR HEURISTICS FOR MAXIMIZING USE OF RESOURCES (E.G., NEGOTIATION WITH USER, RESOURCE SUBSTITUTION)
- OPERATIONAL NEED/INFORMATION REQUIREMENTS:
  - DISCRETE RESOURCE AVAILABILITIES (AMOUNT BY TIME)
  - REQUESTED RESOURCES
  - FUNCTIONALITY FOR COMPARISON OF REQUESTED AND AVAILABLE RESOURCES

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ISSUE: IDENTIFICATION OF AVAILABLE RESOURCES (2)

- GUIDELINE: PROVIDE ACCESS TO RESOURCE AVAILABILITIES; SUPPORT COMPARISON OF AVAILABLE AND REQUESTED RESOURCES; SUPPORT RESOURCE SUBSTITUTION.
- DISPLAY CONCEPT: GRAPHICAL REPRESENTATION OF AVAILABLE RESOURCES
  - FEATURES DIRECT-MANIPULATION APPROACH TO COMPARISON OF REQUESTED AND AVAILABLE RESOURCES

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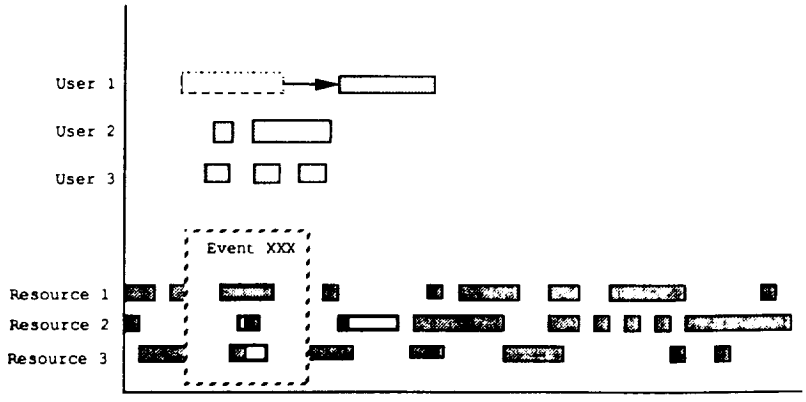
DISPLAY CONCEPT: GRAPHICAL REPRESENTATION OF AVAILABLE RESOURCES



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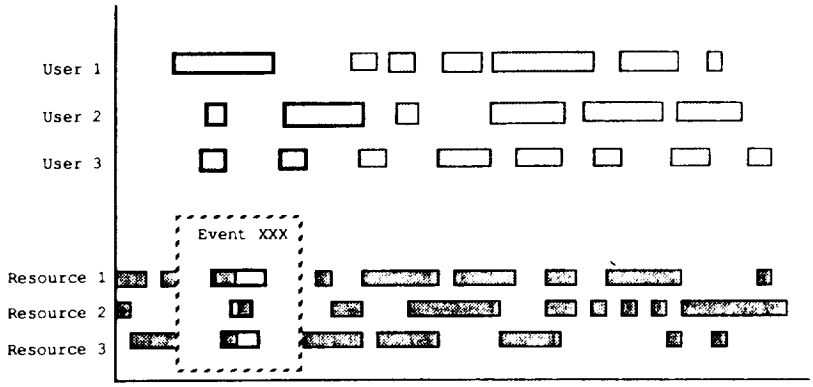
ISSUE: SUPPORT FOR CONFLICT RESOLUTION

- OBJECTIVE: PROVIDE SUPPORT FOR OPERATOR'S MENTAL PROCESS OF CONFLICT RESOLUTION
- OPERATIONAL NEEDS/INFORMATION REQUIREMENTS
  - RESOURCE AVAILABILITIES
  - REQUEST CONTENTS AND FLEXIBILITIES
  - CHANGES IN PRIORITIES
  - USERS AND EVENTS IN CONFLICT
  - EXTENT OF EXISTING CONFLICTS
  - RESOURCE USAGE PER USER
  - REQUEST-EDIT CAPABILITY

ISSUE: SUPPORT FOR CONFLICT RESOLUTION (2)

- GUIDELINE: PROVIDE SUPPORT FOR CONFLICT RESOLUTION BASED ON ANALYSIS OF OPERATOR'S GOALS AND MENTAL OPERATIONS; INVOLVE OPERATORS FULLY IN THE DEVELOPMENT PROCESS
- DISPLAY CONCEPTS: DISPLAY OF CONFLICTING EVENTS
  - OPTION 1: HIGHLIGHTING CONFLICTS
  - OPTION 2: SUPPRESSING NON-CONFLICTING EVENTS

DISPLAY CONCEPT: DISPLAY OF CONFLICTING EVENTS (OPTION 1 - HIGHLIGHTING CONFLICTS)



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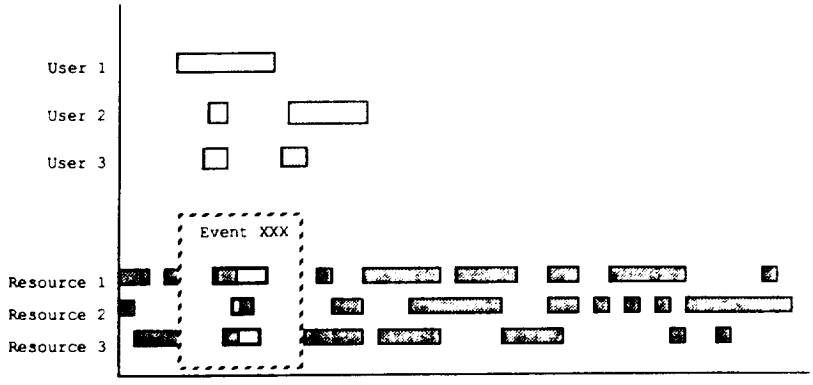
DISPLAY CONCEPT: DISPLAY OF CONFLICTING EVENTS (OPTION 2 - SUPPRESSING NON-CONFLICTING EVENTS)



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GENERAL RECOMMENDATIONS

- BASE DISPLAY DESIGN ON OPERATIONAL TASK ANALYSIS (FOCUS ON COGNITIVE TASK ANALYSIS
- SUPPORT VISUALIZATION, DIRECT MANIPULATION OF DATA
- KEEP OPERATORS IN THE DEVELOPMENT LOOP

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REFERENCES

FOX, B.R. (1989). MIXED INITIATIVE SCHEDULING. PAPER PRESENTED AT THE AAAI-STANFORD SPRING SYMPOSIUM ON AI IN SCHEDULING, STANFORD, CA.

SHNEIDERMAN, B. (1987). DESIGNING THE USER INTERFACE. READING, MA: ADDISON-WESLEY.

WEILAND, W. J., BAHDER, S. A., & MURPHY, E. D. (1990). DESIGN OF PLANNING AND SCHEDULING INTERFACES: GUIDELINES AND DISPLAY CONCEPTS (DSTL-90-027). GREENBELT, MD: NASA/GODDARD SPACE FLIGHT CENTER.

COPIES OF THE GUIDELINES DOCUMENT (WEILAND, BAHDER, & MURPHY, 1990) MAY BE OBTAINED BY WRITING TO:

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