

**N92-11049**

**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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**Presented by:**

**Elizabeth D. Murphy**

**CTA INCORPORATED  
6116 Executive Boulevard, Suite 800  
Rockville, MD 20852  
(301) 816-1262**

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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**

## 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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### 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**

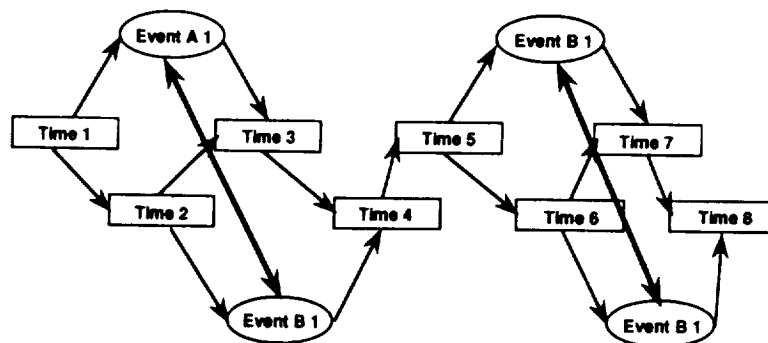
## ISSUE: VISUAL REPRESENTATION OF THE SCHEDULE (2)

- **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



## **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**

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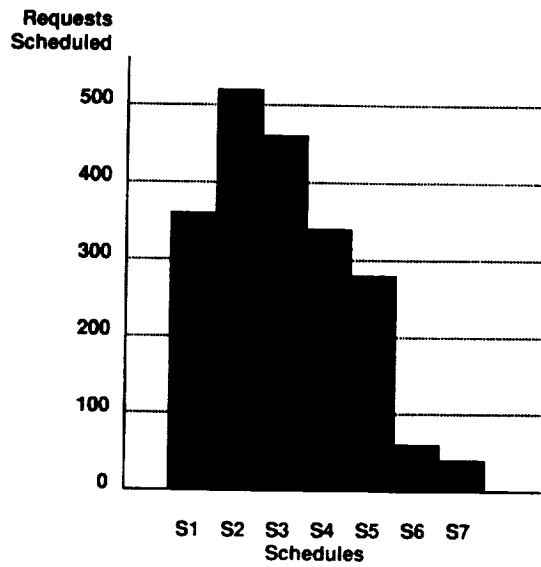
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## **ISSUE: EVALUATION OF SCHEDULES (2)**

- **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**

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## 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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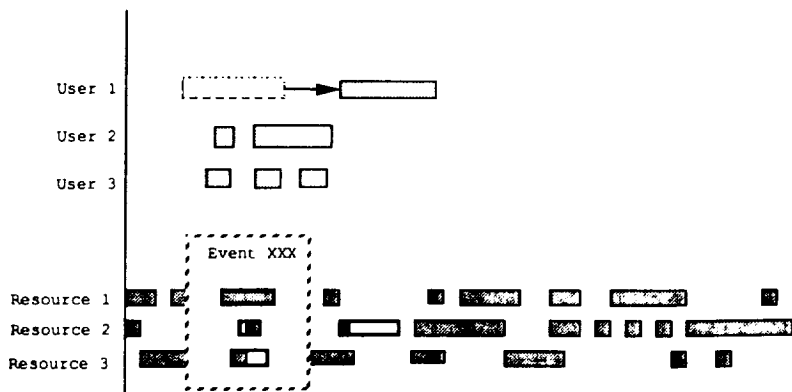
## ISSUE: IDENTIFICATION OF AVAILABLE RESOURCES (2)

- **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**

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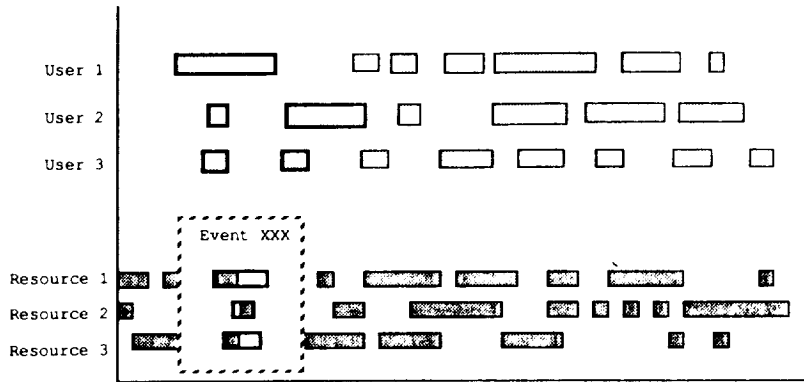
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## **ISSUE: SUPPORT FOR CONFLICT RESOLUTION (2)**

- **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**



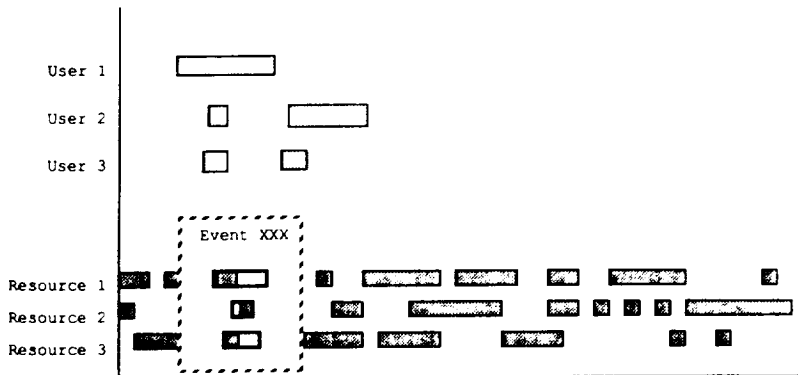
**DISPLAY CONCEPT: DISPLAY OF CONFLICTING EVENTS  
(OPTION 1 - HIGHLIGHTING CONFLICTS)**



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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

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**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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