Usability and HCI issues in Planning and Scheduling Systems

William P. Staderman

Naval Surface Warfare Center, Carderock Division
wstaderman@vzavenue.net

Abstract

Accomplishments of planning and scheduling tasks (of variable success) are performed routinely in all sorts of domains of human activity. Detailed models and analyses of this task can further the efforts of AI developers working in this domain. There are a few general issues involved in schedule management that need to be considered in an interface with a scheduling system, for example: dynamic priorities/values, information overload, display of information, and means of information input.

Introduction

Regardless of the complexity or capability of a technology, its usefulness is determined by its use. While the exact applications of a technology may not be known, it is fair to say that if a technology can't be used, its worth is questionable. The usability aspects of schedule management should be considered from the beginnings of the development of technology intended to assist in solving related problems. Failure to consider things such as users' fluctuating priorities, dynamic environments, uncertainty, and users' capacities in the design of a system can lead to the development of an unusable system that intended users will dismiss. For example, consider the usability of vehicle navigation systems. System issues such as proposing routes that correspond to users' priorities (What routes are more important?), dynamic environments (What routes are temporarily unavailable?), uncertainty (With what certainty is route A better than route B?), and user capacity (an individual can make sense of a few alternatives at a time) need to be considered. A system that does not consider such issues might not allow the user to order routes, propose unavailable routes, decide among routes, and it might overwhelm users with alternatives and demand too much attention. A human is generally more adept at handling these issues than an AI. Therefore, to be successful and useful, a technology should be designed so as to augment the human's ability to perform the functions at which he or she excels.

Task analyses and models

Task analyses are detailed descriptions of a task performance. Detailed descriptions of how schedule management tasks are traditionally accomplished are necessary. Describing tasks and modeling planners can inspire and inform the development of an automated system. Yet, detailed descriptions are not available. Details often end when a task is deemed "subjective." For example, the tasks involved in planning a military mission are incredibly detailed, while decisions made by individual units or soldiers in the "fog of war" after a mission begins are not described. The complexity and human cognitive biases involved in these subjective decision-making processes may have prevented the process from being described in detail. Presently, detailed descriptions and models can and should be generated. Managing complexity and human cognitive biases suggest areas where AI can augment scheduling functions.

Detailed models of scheduling in several domains should be done as well as those for specific domains. Models based on a specific domain are likely to be brittle and not generalizable. Comparing models from several domains can identify common task elements. For example, when designing the PalmPilot™, it was clear that functions like viewing the calendar and viewing the address book were common to all users from all domains. The identification of common and frequently used functions is helpful to interface designers, who can make common functions prominent features of the interface. Common elements of scheduling probably include some type of reference to supporting information. The means to access supporting information, then, should be a prominent feature of an interface to a scheduling system.

General Issues

Deciding among alternative courses of action (CoAs) is a particularly human feat that involves assessing the effectiveness of a CoA in accomplishing a goal among other goals of variable priority, the cost/risk of alternative CoAs, and the implications of a change in plan on other elements of the plan. Quality decisions require considering each of these sets of information. An interface that supports the human decision maker will provide the appropriate amount of the appropriate information at the appropriate time. Again, "appropriate" is undefined. The appropriate information may be information about the current situation (such as importance of choosing an alternative CoA), possible CoAs (including their costs and implications for the overall plan as well as other elements of the plan). By considering this information, in light of current values, the

human decision maker is prepared to make quality decisions.

Values/Priorities
Users' values/priorities have strong influence on planning and scheduling tasks. In order to support human users, a good interface should take into account user values/priorities. The weights users' assign to different elements of a plan will always vary from other users and often over the course of a plan. This means goal prioritization is dynamic. An interface must, therefore, present appropriate CoAs to accomplish goals. Since "appropriate" is undefined, this may involve determining approximately optimal CoAs or feasible CoAs. In either case, establishing some sort of boundary conditions based on a user's values is necessary.

Information display
How do users and information systems share information? Traditionally, information is displayed visually. Human vision allows a wide bandwidth of input and the highest resolution of human sense modalities; it is clearly the modality of choice for most kinds of information. However, the field of view is limited and can become cluttered. Often there are too many things in an individual's field of view, so that he or she is confused and cannot see things or carry out a task that needs to be done while interacting with a schedule management information system. An individual's attention is critical to efficiently receiving visual input. Displays using haptics or audio can provide cues and alarms to direct a user's attention. For some kinds of information, haptic or auditory displays do not require a visual display. For example, haptic display can provide orientation and directional information; auditory displays can provide most kinds of textual information (in small bites).

Information input
How a user inputs information to a scheduling system is a corollary concern. Traditional input via a keyboard is often too cumbersome, time-consuming, and distracting to be efficient in many situations. For example, consider a soldier in the field. He or she is likely unable to manipulate and carry a keyboard (even a small keyboard), take time away from the task he or she is supposed to do in order to use a keyboard, and sacrifice situation awareness in order to focus on a keyboard. Among alternative input means are speech, gesture, and the use of clickwheels (like the iPod™ interface).

Information overload
Overloading a user with information is an obvious risk. A user can effectively handle only a fraction of the information relevant to each CoA at a given time. An

information system is capable of retaining huge amounts of information, while human users can utilize only a fraction of this information. An obvious issue, then, is designing an interface that allows a user to exploit the capacities of an information system without being overwhelmed. An interface can use several methods for displaying "appropriate" information in usable amounts including linking information, annotating displays, and limiting displays and options.

In order to accept a change in plans, the warfighter must *identify and discriminate alternative courses of action*. What alternatives are feasible? What are *costs and risks* associated with each alternative? A good interface should allow the warfighter to be *aware of all alternatives*. It should also allow the warfighter to *consider the possible outcomes* of each alternative. Perhaps the alternatives can be listed in order of predicted success or failure. Success and failure can be considered in terms of proximity to goals. Since goals and priorities lead to the selection of alternative CoAs, the order of alternatives proposed should be filtered by *current goals and priorities* which may be indicated by the warfighter using relative weights of goals such as minimize time, safety, accomplish X, etc.. For example, an interface with graphic slide-levels related to each goal can allow the user to note and prioritize his or her current values before considering alternatives. Particularly salient features of alternatives should be highlighted.

Summary
Planning and schedule management are complex tasks that people routinely perform. Detailed analyses of people performing this task will provide necessary input for AI developers. Functions that are common among domains of schedule management can be identified through task analyses and models. There are several tasks involved in schedule management that are routinely handled by human managers and need to be accurately modeled in order to develop an automated system.