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The Next Generation User Support Tools

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Abstract. Technological advances such as widespread use of the Internet, multi-platform visual development tools such as Java and CORBA, and overall increases in the power of desktop hardware are allowing for significant improvements in user support tools. Consequently, many of us are expending considerable effort developing or rewriting observing tools to take advantage of these advances. We will present what we think are the key challenges and issues facing the developers of the Next Generation Support Tools, and describe how some groups are approaching these challenges.

1. The Need for User Support Tools

Observing, be it ground-based or space-based, classical or service mode, is a pipeline from start to finish. It starts with the submission of a proposal and ends with properly documented data sets in the archive. In the present era, it is often the case that observing instruments are developed by one group, and commonly used by another group of people. Further, the instrumentation can be very complex with large capital investment both in instrumentation and observatory infrastructure. In such an environment, for any type of observing to maximize scientific returns, information has to be passed back and forth between instrument developer, observatory staff and the user community. Observational conditions, instrument capabilities, and scheduling complexities must be thoroughly understood, and this information has to be provided to the user community in a concise, timely, effective and efficient manner. Thus, to disseminate information effectively to the user community observatory staff depend on:

- documentation
- software tools
- human user support

The overriding goal of maximizing the scientific returns becomes challenging when it has to be achieved with limited resources for user support. In such an environment, user support provided by a person has to be minimized without losing the human aspect of support. This implies that the support provided via documentation and tools has to be friendly, up to date, and easily accessible to users of varying levels of expertise. Therefore, we need to move towards electronic documentation that is well indexed and is well suited for frequent and dynamic updating. An important implication of electronic documentation is that software tools can effectively access information to provide context sensitive help. This integration of documentation and tools must be exploited to reduce manual effort.

2. The Proposal Preparation Process

The proposal preparation process is normally divided into two phases:

- *Phase I:* In this phase the proposer describes a project, its scientific goals and objectives and defends the science. A proposal in this stage is the basis for the initial planning and scheduling by the observatory staff.
- *Phase II:* In this phase the successful proposer provides the observatory staff with a precise executable observing.

From the user's perspective during the the proposal preparation process he/she needs to understand:

- what is the instrumentation available at the observatory,
- what are the characteristics of the observatory/instrumentation,
- how much observing time will be required for a given science project, and finally
- how the observatory plans and schedules observing programs.

From the observatory staff perspective all the above information has to be provided to the users, so that at the end of the proposal preparation process the observatory has obtained a pool of well-defined, accurate, unambiguous, flexible, feasible and schedulable programs. This pool of "good" observing programs then has to be organized into an efficient observing time line. It is essential that the observing pool have good programs, since every problem in the beginning of the pipeline has a tendency to propagate down the observing pipeline and make the whole system inefficient. Thus, it is crucial to have an effective proposal preparation process.

Various steps in the proposal preparation and scheduling processes are governed by a set of rules, may be complex rules, conducive to some form of automation. In this paper we will concentrate on the proposal preparation process, i.e., the Phase I and Phase II process from the users perspective. Note that we will not be differentiating between the Phase I and Phase II, since many of the software tools can be used in both phases.

3. What are Good User Support Tools?

"Good" proposal preparation software tools are essential not only because they help decrease the amount of human user support, but because of the complexity of both instruments and observing programs. Also, the increase in competition for observing time implies that users want to explore their parameter space to justify their scientific objectives properly. Further, with the rise in service mode observing information must be passed precisely and correctly from the user to the observatory staff. Thus, let us define what we consider a "good" software tool. A good software tool has the following properties:

- easy to use for users of varying degrees of expertise.
- provides reduction in manual support from observatory staff. This implies that the tool decreases complexity of instruments/process, provides easy access up-to-date reference information, is flexible and helps guide user towards completion of that tool's process.
- allows exploration of observing parameter space.
- allows visualization and is as interactive as possible.
- is aesthetically pleasing.
- is common for both observatory staff and observer.

4. New Technologies

It is an understatement to say that there has been an explosion of new technologies in the past decade. Major advances continue to occur in software, hardware, and telecommunications. The Internet revolution has fostered the development of distributed tools and languages. Java, while still maturing and developing, shows promise at succeeding in becoming a truly platform independent language. CORBA (Common Object Request Broker Architecture) is emerging as a single standard to allow objects on different systems to truly become distributed and to interact with each other, regardless of the host system and language.

On the hardware side, the exponential growth in computing speed, memory, and storage shows no sign of slowing. What was impossible on personal machines just a few years ago is now virtually instantaneous. And with the growth in computing power comes new possibilities in the capabilities of visual and interactive tools and interfaces.

Similarly, expert systems tools are no longer relegated to mainframe systems and unfriendly interfaces. The new generation tools are visual, fast, and much cheaper that their predecessors.

Finally, a whole new technology arena is emerging: data mining. Data mining is a combination of all of the above technologies to provide new ways of organizing, studying, analyzing, and managing the vast sources of information now at astronomer's fingertips.

5. Emerging Strategies for User Support Tools

There are two efforts that are aggressively using these new technologies. The tools generated by both these efforts are globally attempting to reduce complexity in the proposal preparation process. They use interactive and dynamic visualization to help prepare an observing program. Java is the preferred language for both these efforts.

5.1. The Gemini Effort

The Gemini Observatory has proposal preparation tools both for Phase I and Phase II. In the Phase I tool there is a Navigator that guides the user through the process and leads them to completion. The check list is a very useful visual aid (see Fig. 1). Although the administrative information is gathered through a form based tool, this tool is effective because of two features. (1) the tool simultaneously shows a concise form of the information; and (2) if previewing or printing the formatted Phase I proposal information, the tool launches an HTML browser window in which the current proposal information is displayed. The user can use the HTML window in the manual mode or the automatic mode to update the proposal information.

The Phase II tool allows the observer to completely define an observation or observing program. The definition of an observation includes components such as target position, scheduling constraints, instrument configuration, guide star selection, sequencing, calibration and configuration of the data processing pipeline. The visualization and interactive capabilities of the tool allow the user a lot of freedom to explore the parameter space. This effort is now entering the final phases of development. For further information see the Gemini web site at `http://www.gemini.edu`.

5.2. The Next Generation Space Telescope's Scientist's Expert Assistant (SEA)

The SEA is a research and development effort, investigating new approaches for proposal development with the goal of significantly reducing the costs of supporting the general observer program. It is a joint effort between Space Telescope Science Institute (ST ScI) and the Advanced Architectures and Automation Branch of Goddard Space Flight Center's (GSFC) Information Systems Center. SEA's prototyping effort priorities are visualization and expert systems. Because of its prototyping nature, we are able to explore riskier and more radical approaches than is possible conventionally.

The SEA has an interactive exposure time calculator (ETC) that allows exploration of the instrument, target and observatory parameter space. It can access reference material dynamically to immediately see the effects of changes in the exposure's parameters (see Fig. 2). It can also handle multiple instruments and even multiple observatories. The Visual Target Tuner (VTT) is another main feature of SEA. The VTT is an interactive field-of-view visualization tool that allows the user to import images from several sources (including the NASA Extraterrestrial Database—NED, HST's Guide Star Catalogs, and the Digitized Sky Survey). Once imported the user can overlay an instrument's field-of-view positioning and orienting the target exposure visually. Overlays of multiple exposures can also be done visually.

The various SEA tools are designed to have a common "look and feel". We anticipate that most of the tools will be valuable during all phases of proposal preparation: exploratory, Phase I, and Phase II. And information will pass between tools and phases seamlessly with no manual transfer of information. This alone will avoid many unnecessary mistakes. Although the SEA tools are integrated they can be used individually.

SEA is about halfway through the development cycle. Currently, the expert system capabilities are limited and have not yet been fully explored. Additional features expected over the next year include spectroscopic support for the (ETC), substantial expansion of expert systems capabilities especially in the areas of visit planning, and context sensitive help. SEA has also not yet undergone significant testing for its effectiveness. For further information see the SEA web site at `http://aaaprod.gsfc.nasa.gov/SEA/`.

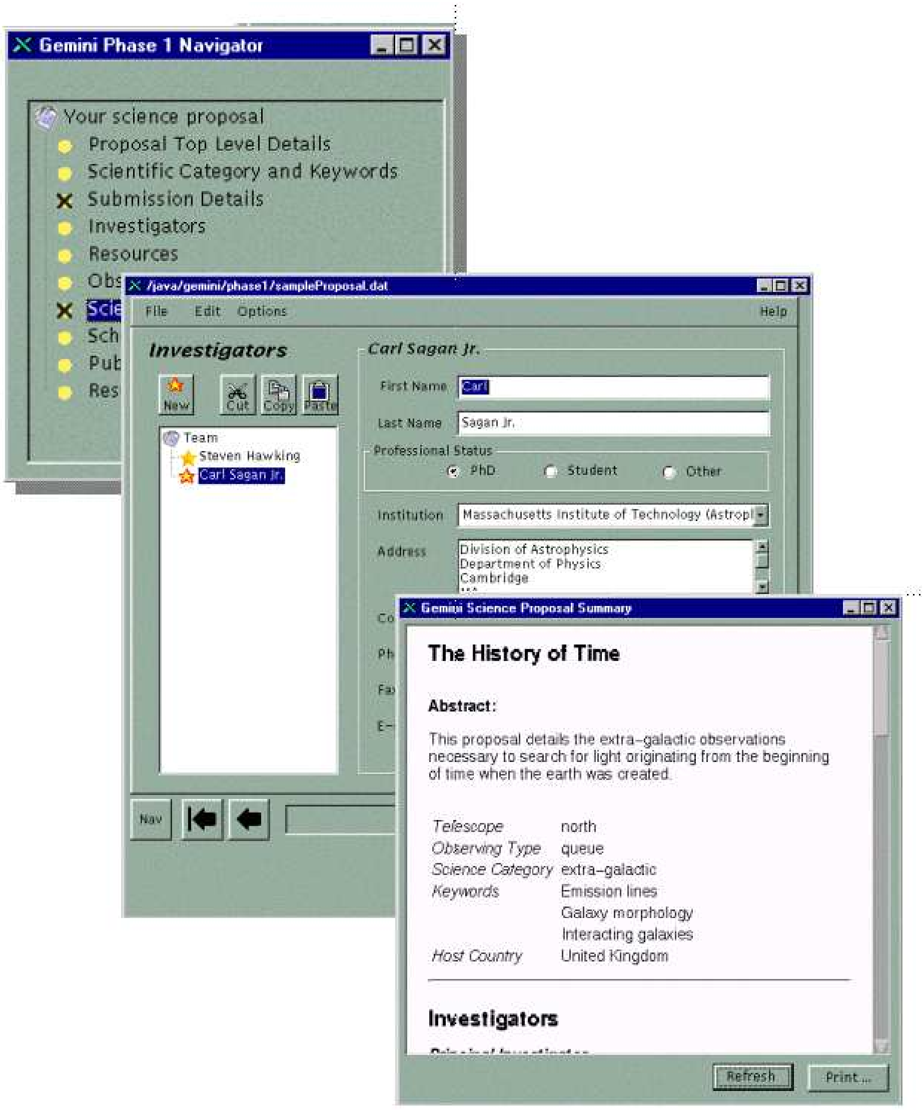

Figure 1. Gemini Phase I Tool highlights.

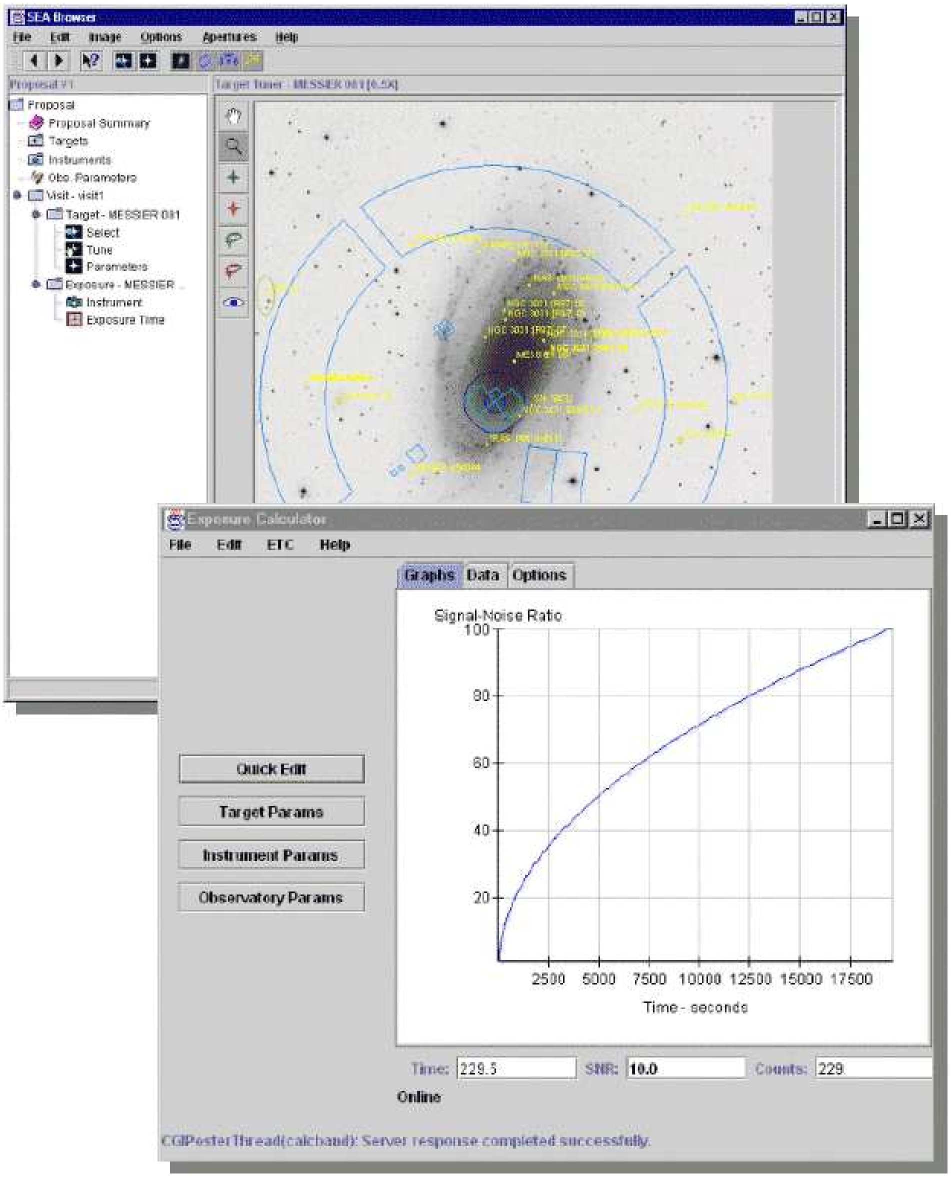

Figure 2. The SEA Exposure Time Calculator and Visual Target Tuner.

6. Workshop on Observing Tools

At the SPIE meeting on "Observatory Operations to Optimize Scientific Returns," there was consensus that we explore the mutual concerns and constraints of the various observatories, so that we can understand where joint, shared, or collaborative effort might be beneficial. Such a collaborative effort across observatories can be considered because:

- the fundamental details of preparing a proposal are common to most observatories whether they be ground-based or space-based.
- from the users' perspective it would be extremely useful if one did not have to be intimately familiar with a given observatory to be able to use it effectively. Common proposal preparation and user support tools that are similar across observatories reduce the learning curve and help in achieving familiarity.
- also from the users' perspective, there should be ways to effectively compare the various observatory/instrument setups within an observatory and across observatories.
- finally, many of us are developing or rewriting our proposal preparation tools using the latest software technologies, which is a unique opportunity for an effective and efficient collaboration.

We therefore organized the "Workshop on Observing Tools" on the 28th and 29th of October 1998. Over fifty representatives, a mixture of astronomers and software developers, representing a variety of observatories (ground and space-based, optical, x-ray, infrared) attended this workshop.

The minimal goal of the workshop was to get to know each other, our areas of expertise and priorities. We were to share ideas and encourage cooperation, and if possible come to a consensus on

- *basic shared requirements:* Understand the requirements and procedures at each observatory to determine what are the various software tools that can be included in a common user support tools package.
- *a common tool framework:* Determine if tools can be shared/made compatible with each other. Then define a common set of libraries that allow different software modules to be easily added/reused. Establish broad guidelines that will maximize compatibility of the various tools.
- *shared tools:* Define a software framework that will allow seamless integration of tools across observatories, and also determine what technologies are best suited for such a purpose.
- Develop consensus of where/how to apply specialization.

At the end of the workshop we formed six working groups that will report back in six months. These working groups have very simple short-term goals and will explore the concept of collaboration on their own terms. Broadly, the short-term goals are to develop a common definition of what each tool should contain. The long-term goals are to define interfaces that will make tools inter-operable, share code and pool efforts in the development of the next generation tools' capabilities. The true measure of success of this workshop will be the tangible results that these working groups will produce. For details on the workshop and the working groups, please see the workshop web site at `http://aaaprod.gsfc.nasa.gov/Workshop`.

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