SPECIAL REPORT

DATA REDUCTION AND COMPUTER GROUP

RANGE RESOURCE MANAGEMENT AND SCHEDULING REQUIREMENTS AND GUIDE

WHITE SANDS MISSILE RANGE
REAGAN TEST SITE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ABERDEEN TEST CENTER
NATIONAL TRAINING CENTER

ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
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Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
00/02/2003	N/A	-

Title and Subtitle Range Resource Management and Scheduling Requirements and Guide	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Secretariat, Range Commanders Council, U.S. Army White Sands Missile Ranges, New Mexico, 88002-5110	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es) sponsoring agency and address	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited	
Supplementary Notes The original document contains color images.	
Abstract	
Subject Terms	
Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU
Number of Pages 34	

SPECIAL REPORT

RANGE RESOURCE MANAGEMENT AND SCHEDULING REQUIREMENTS AND GUIDE

FEBRUARY 2003

Prepared by

DATA REDUCTION AND COMPUTER GROUP
RANGE COMMANDERS COUNCIL

Published by

Secretariat
Range Commanders Council
U.S. Army White Sands Missile Ranges,
New Mexico, 88002-5110

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PREFACE

This study represents the initial phase of the Data Reduction and Computer Group's (DR&CG) effort to provide a standard range resource management and scheduling system specification for use by test and training ranges. Preliminary to that effort, an investigation of current methods and systems in use among the RCC member ranges and an evaluation of requirements was determined to be critical to the development of any future systems or standards governing those systems. This study was submitted as RCC task DR-30 and is referred to herein by that name.

This Special Report is based upon research conducted by Ms. Alice Lebron, under the direction of Trish Harrison, NUWC DIV Newport, AUTEC and a member of the DR&CG. Funding was provided by the CTEIP Program, administered by the Department of Defense, Office of the Director, Operational Test and Evaluation (DOT&E).

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ACRONYMS AND INITIALISMS

AFWTF	Atlantic Fleet Weapons Training Facility
AUTEC	Atlantic Undersea Test and Evaluation Center
COTS	commercial-off-the-shelf
COMEX	commence exercise
CTEIP	Central Test and Evaluation Investment Program
DoD	Department of Defense
DR&CG	Data Reduction and Computer Group
FINEX	finish exercise
IEEE	Institute of Electrical and Electronic Engineers
GPS	Global Positioning System
JON	job order number
LRP	long range plan
NUWC	Naval Undersea Warfare Center
NAVAIR	Naval Air Systems Command
PMRF	Pacific Missile Range Facility
RCC	Range Commanders Council
SOAP	simple object application protocol
XML	extended markup language

EXECUTIVE SUMMARY

The Range Commanders Council (RCC), specifically the Data Reduction and Computing Group (DR&CG), recognized the need for an integrated Range Resource Management and Scheduling capability that would facilitate support of all phases of test or training events. Such a tool would span the initial planning phases, the execution and evaluation of an exercise, and finally, the accounting and billing process. Currently, each range not only performs its functions differently, but the tools, systems, and steps followed are also unique to each facility. This study was initiated with the goal of providing the ranges with a document describing the areas to consider when designing and implementing such an integrated tool.

A three-step approach was used in the conduct of this study. First, documentation was solicited from the different RCC members who represent the DoD ranges. Information was gathered that focused on the functionality and capability of current range resource management and scheduling systems. Interviews with subject matter experts complemented the study when actual written material was not available.

Second, the information from each individual range was analyzed, organized, and then compared with the other ranges. Actual requirements were identified from systems documentation or from interviews and generalized in order to present a broader definition of required capabilities. These requirements include the processes, types of data, design documentation, system architecture, and user interfaces in current use.

Finally, a recommended approach for use in developing a resource management and scheduling tool was defined that takes into consideration future requirements as well as current systems development and design practices.

The first phase of the study resulted in the following findings: All ranges share a common definition of scheduling as the *designation of a resource or a service to a specific time and event.* However, significant differences were found in the actual type of activities and tools that are used to manage and schedule resources, how activities are performed, what tools are used, who the users are, and finally the kind of information that is administered and reported.

In terms of automated systems, the ranges currently do not have end-to-end automated solutions that support the total lifecycle of test or training operations. Frequently, the instrumentation and/or logistical planning and scheduling are conducted manually by resource managers and test or training exercise managers.

This information was used to develop the following set of recommendations to be used in the design and implementation of any Range Resource Management and Scheduling capability.

1. Model Template. Define a model template that will fit the broad spectrum of needs, but which will also allow for uniqueness where necessary. Users must define the categories and the levels of configuration that would allow a tool to be both expandable in functionality and flexible in its design.

2. Software Design. Concentrate on configurable software design and distributed implementation where applicable. Current technology allows the system designer to build and deploy software in a modular fashion. The ranges could benefit from a modular design in two significant ways: (a) by sharing development and maintenance costs and (b) by improving the ability to communicate and transfer information within the range community.

3. Core Requirements. Create consensus and determine what are the core requirements that would best support range operations. The following points should be thoroughly studied by all potential stakeholders, and a decision should be made as to what levels of automation and maintenance jurisdiction are to be applied when designing future system capabilities:

a. Resource management levels

b. Aggregation of assets to satisfy the requirements of an event

c. Coordination of information sharing at the different levels of range management

d. Support of the life-cycle operations of a range event (from planning & scheduling, to post-operations support)

e. Support planning and simulation for feasibility of range events and optimization of range resource management

4. Emerging Technologies. Investigate the feasibility of emerging technologies such as:

a. Web applications such as *Semantic Web* that allow sharing of content across the specific communities while matching content to a specific user's profile. Figure 3-3 illustrates how the ranges could reap the benefits from the use of the web-enabled applications.

b. The *eXtended Markup Language* (XML), which would help define multiple configurations of data and services

c. *Simple Object Application Protocol* (SOAP) to help with the exchange of data

5. Management Support. Provide the right project management support with the right combination of technical and operational direction and control. The multiple number of end-users for a Range Resource Management and Scheduling capability dictate that representatives of all functions agree on the functionality that would be provided by the tool. Furthermore, a facilitator should be used during the design of the tool to ensure that all stakeholders' views are adequately represented.

6. Design Considerations. Engage in a phased development approach that would foster the model-test-deploy methodology. Develop and test with end-users all prototype designs of functionality and interfaces early in the design stage. With the rapid changes in technology platforms and techniques, it would be advisable not to engage in long-term development projects that would yield results almost obsolete by the time they reach the end-user. It is recommended that the designers and developers share a constant awareness of new developments in technology and reflect those in the development and implementation of the final capability.

7. Commonality Features. Determine how commonality, sharing of assets, inter/intra range operations relate to the design and deployment of future range systems:

a. Investigate how investment in new range systems could influence commonality of systems lifecycle.

b. Determine how the DoD Business Initiative Council and Foundation Initiative 2010 relate to future range resource and scheduling capabilities.

c. Clearly state where new common processes will be institutionalized, where local governing procedures will be followed, and how it all fits into the range environment of the future.

SECTION 1

INTRODUCTION

1.1 Background

The Range Commanders Council (RCC), specifically the Data Reduction and Computing Group (DR&CG), recognized the need for an integrated Range Resource Management and Scheduling capability that facilitate the logistics and execution of test or training events within the Department of Defense (DoD) test and training ranges. These functions are not new to the DoD ranges. In fact, it is part of their everyday operations, and it is critical to accomplish their mission of providing our armed forces with instrumented facilities to test new systems or train in realistic environments.

A key component to ensuring continuous operations is the management of range resources. Providing accurate knowledge of range resource capabilities, availability status, cost, as well as safety, environmental and other operational data is vital to the effective and timely assembly of the necessary elements to execute a test or training event.

Today, ranges from every Service conduct air, sea, and land operations by following local procedures to execute the same functions of range resource management, resource scheduling, event planning and cost accounting among others. Each range not only performs these functions differently, but the tools, systems, and steps followed are also unique to each facility. Furthermore, event planning, resource management, scheduling, and billing functionality are often supported by manual or stand-alone systems. The culture and uniqueness of the events that occur at each range facility, as well as the ranges' autonomy, have been attributed as the major deterrents of institutionalized commonality of the processes that govern the planning, scheduling, and execution of test and training events. While the overall functional requirements are very similar, few ranges have shared commonality of processes or tools when designing, building or deploying systems.

The fact that all the ranges have requirements to manage their resources and provide systematic planning and scheduling functions in support of their operations presents a prime opportunity to leverage efforts when designing, developing or deploying their supporting systems. Moreover, the increasing trend toward consolidating services and operations across ranges and the assembly of joint operations to test or train new warfare capabilities offer a compelling reason to further study what areas could provide either enhanced operational capabilities or cost savings by sharing or reusing processes, tools and data.

1.2 Purpose

The ultimate goal of this study is to provide all ranges with recommendations describing the areas to consider when building a Range Resource Management and Scheduling System.

It is anticipated that a follow-on task will be initiated to further refine the specific requirements for design and development. Perhaps ranges can leverage funding for design and development, or the ranges could develop a capability focusing on their unique resource management and scheduling needs, but still adhere to a common range format or program. In so doing, all ranges would benefit simply by the definition of their day-to-day scheduling and resource management needs. Such a product could also provide business metric and historical data to all DoD range sponsors.

1.3 Scope

The scope of this task is three-fold: (1) to identify the necessary range resource management and scheduling needs of all test and training ranges; (2) to capture the current state and available methods in use at the ranges; and (3) to review other business processes associated with the management of range resources, such as the planning and execution of events and billing processes.

1.4 Methodology

A three-step approach was used during this study. First, documentation was solicited from the different RCC members who represent the DoD ranges. Information was gathered from those ranges that chose to participate focusing on the functionality or capability of range resource management and scheduling systems. Interviews with subject matter experts complemented the study when actual written material was not available. Second, the information was analyzed, organized, and then compared with the other ranges. Actual requirements taken from either system documentation or from interviews were generalized in order to present a broader definition of the required capabilities and to graphically represent the processes, data, design documentation, system architecture, and user interfaces. Finally, a recommended approach was defined which took into consideration the identified requirements for a resource management and scheduling tool, as well as current systems practices and design features.

1.5 Definition of Terms

1.5.1 Ad-hoc: Off-the-wall, one-time tailored.

1.5.2 Planning: The preparation, coordination, and production of a range event, where *event* is the lowest component of a test, mission, operation or training exercise. Includes all activities that are required to assemble and execute a range event.

1.5.3 Scheduling: The activities performed to allocate a resource to a particular event at a particular time.

1.5.4 Scheduling System: The tool(s) that are utilized to allocate resources to a particular event at a particular time.

1.5.5 Resource Management: The activities performed for the upkeep of a particular resource, including maintenance, allocation to a particular event, and updated information on capabilities.

1.5.6 Resource Management System: The tool(s) that are utilized to maintain all required data regarding a particular resource, including resource status, allocation to a particular event, as well as capability, reliability and maintenance data.

1.5.7 Execution: Refers to the phase that comprises all the activities performed during the actual event, where *event* is the lowest component of a test, mission, operation or training exercise.

1.5.8 Closing: Refers to all the activities performed in order to finalize all required reporting, accounting, data presentation and billing for a range event. Some ranges see this function as part of post operations while others see it as the next phase after post operations.

1.5.9 Post Operations (post ops): Refers to the activities that occur after the execution phase is finalized. Most commonly referred to as the phase where data products are finished. Some ranges include the closing operations as part of post ops.

1.5.10 Event: The lowest component of a test, mission, operation, or training exercise.

1.5.11 Op Area: Operation area is an instrumented portion of a range where events are conducted.

1.6 Applicable References

The following documents were used in the research for this report.

a. Atlantic Fleet Weapons Training Facility, *Preliminary System Requirements Specification,* 21 May 1999.

b. Atlantic Fleet Weapons Training Facility, *Software User Manual for the Replacement Schedules Computer System,* 15 September 2000.

c. Atlantic Undersea Test and Evaluation Center, *Range Scheduling System IT Development Plan*, 6 August 2001.

d. Atlantic Undersea Test and Evaluation Center, *Range Scheduling System IT System Requirements Specification*, 12 February 2001.

e. *Eglin/Edwards Center Scheduling Enterprise Software Requirements Specification*, August 2001.

f. Naval Air System Team (Pax River, Pt. Mugu and China Lake) *Test Resource Management System*, *Process Description*, 20 November 2000.

g. Naval Air System Team (Pax River, Pt. Mugu and China Lake), *Test Resource Management System, Program Support Requirement User Document*, 1 March 2001.

h. Naval Air System Team (Pax River, Pt. Mugu and China Lake), *Test Resource Management System, System Design Description*, 12 March 2001.

i. Pacific Missile Range Facility, Barking Sands, *Range Scheduling System Users Guide*, 2000.

j. Pacific Missile Range Facility, Barking Sands, *Range Scheduling System Software Design Document,* 2000.

SECTION 2

CURRENT RANGE CAPABILITIES

2.1 General Description

2.1.1 Planning and Scheduling Functions. When referring to range business processes, it is important to remember that the ranges exist and are funded to provide instrumentation and measurements for test and evaluation purposes, or to offer a realistic stage for the training of DoD personnel. Therefore, it is vital for each range to be able to support ongoing planning and scheduling of operations. To do that, information regarding its resources and services has to be readily available. Figure 2-1 depicts how the planning and scheduling functions are part of the continuum of a test or training exercise lifecycle. Proper planning and scheduling is critical to the successful execution and management of test and training activities. In this case, success is viewed as the disposition of range resources and services that ensures cost-effective, safe, secured, and timely range operations.

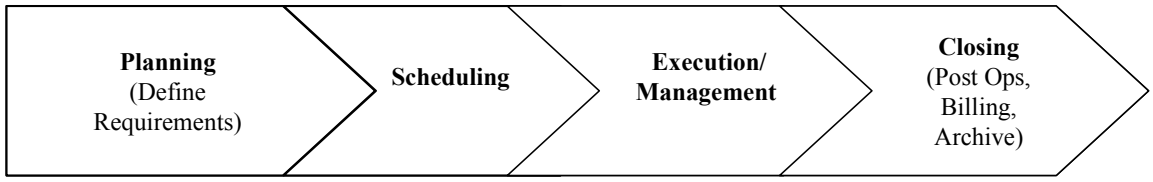


Figure 2-1. Test and training lifecycle.

Aimed at providing guidance to range systems managers and developers, the RCC task DR-30 needed to first establish the scope and definition of a *range resource management and scheduling* capability and whether such definition and scope were equally shared across all the ranges. What was found was that, at a high-level, all the ranges shared a common definition as to how the resource management and scheduling functions supported the test and training process lifecycle. However, there were two key areas that showed significant differences as to how range resource management and scheduling systems have been developed. One is how the system or systems support range business processes, and the second is at what level the resource management and scheduling is supported.

When the actual type of activities and tools that are used to manage and schedule resources were reviewed, there were significant differences in terms of how activities are performed, what tools are used, who the users are, and finally the kind of information that is administered and reported. However, all ranges shared a common definition of scheduling as *the designation of a resource or a service to a specific time and event*.

On the other hand, resource management does not seem to have a commonly shared definition. Some ranges view resource management at the major resource level, such as an aircraft, a platform, or an operational area. These mission-area range resources are the ones that

would be scheduled, and their availability is the piece of data that is most commonly tracked by the scheduling and management systems. All other resource information is usually tracked either manually by the resource manager or by other stand-alone systems. The kind of information managed for each resource also varies from range to range and often differs by the type of resource or the manager in charge. Some of the systems track resource utilization, costs, as well as other miscellaneous information such as maintenance status or any dependencies with other resources.

2.1.2 Use of Automation for Scheduling and Resource Management

Figure 2-2 shows where automation is most commonly used today. Planning often consists of long-range, scenario simulation and development, or actual event arrangement. At this stage, test or exercise managers, as well as schedulers, work together to plan and schedule the events and resources required to support range operations. This is a complex process that often takes up to a year to complete and frequently is not final until days before the actual events are scheduled to take place.

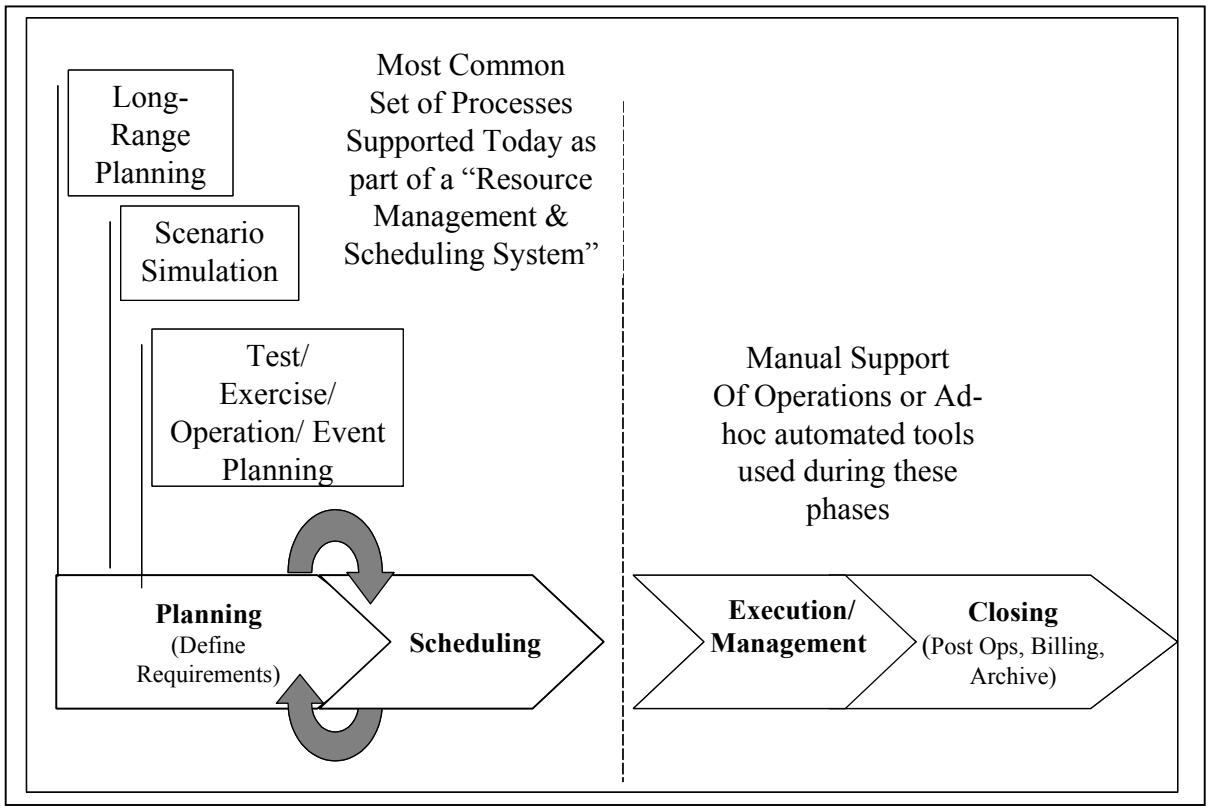


Figure 2-2. Current system support for test and training operations lifecycle.

Current automation falls short at most of the ranges in the areas of execution and closing of the operations. There is minimal integrated automation that takes into consideration other data elements such as resource utilization, costs, and billing associated with each resource or set

of resources. It is common to gather data manually from test conductors or resource managers in order to determine actual utilization for management or billing purposes. It is not uncommon to find schedule information in bulletin boards, spreadsheets, off-the-shelf calendar programs, or simply by statements made during daily or weekly briefings.

Currently, ranges do not have end-to-end automated solutions that support the total lifecycle of test or training operations. However, during the time this study was being conducted, several ranges started to design more robust systems that would integrate automation and support the complete lifecycle.

As mentioned earlier, the levels of scheduling supported by automation vary from range to range. Some ranges schedule only major range resources (platforms, range operational areas, tracking systems). All the instrumentation or logistical planning and scheduling is conducted manually by the resource managers and test or training exercise managers.

Figure 2-3 depicts the different levels of resources or services and how these are incorporated into current resource management and scheduling systems. Note that the lower the level is, the least automation there is and the more likely operations will be supported by manual or stand-alone tools.

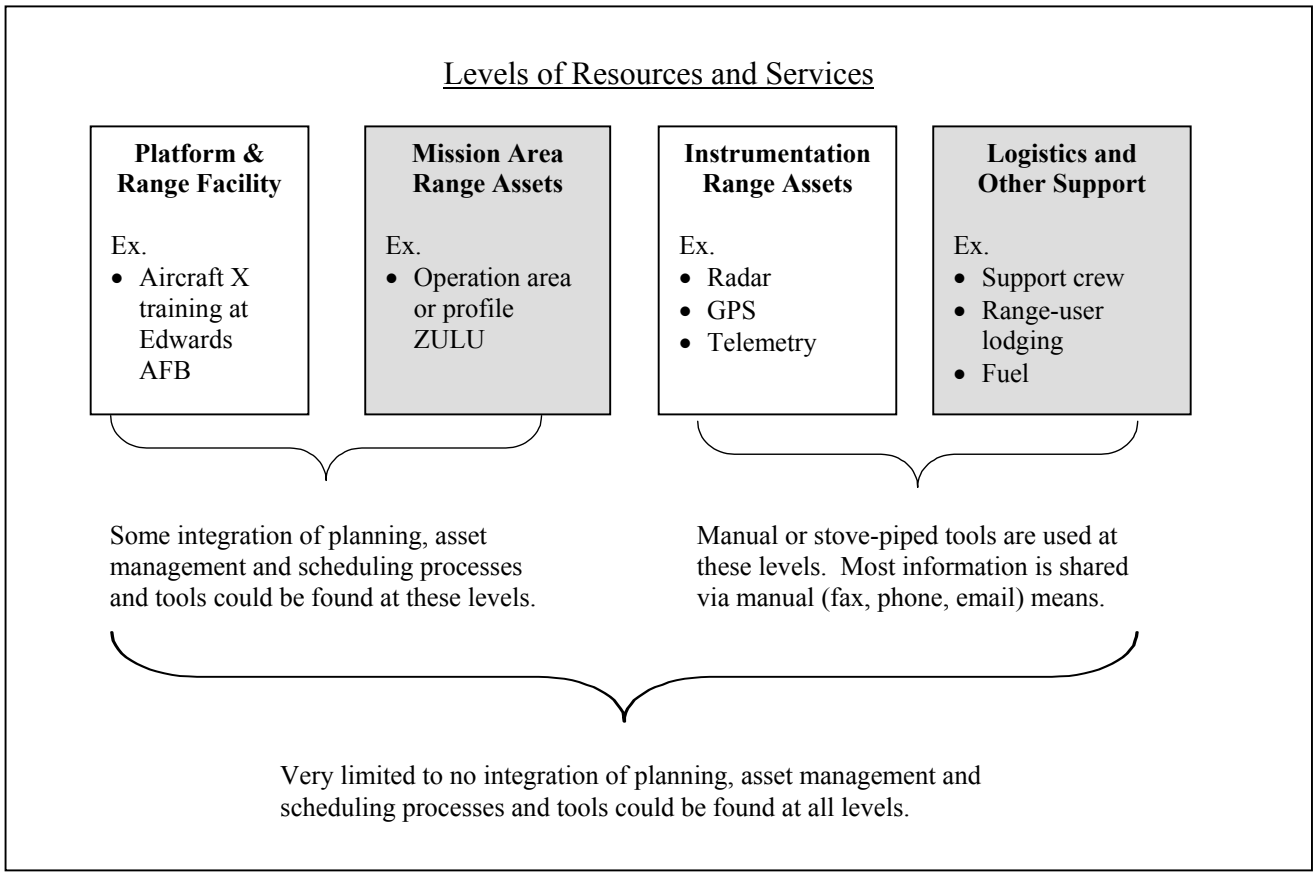


Figure 2-3. Current levels of planning and scheduling.

The lack of integration and automation is offset in most cases by the vast knowledge and experience of range personnel. Even though this is a testament of the ranges' ability to support operations, it is an area of concern as there is a potential for errors due to manual tracking and lack of checks and balances. In addition, personnel reduction, attrition and turnover are factors that highlight the vulnerability of the balance that is achieved today at the ranges. These factors further accentuate the need for a more robust, integrated solution that supports the end-to-end process.

2.2 Business Process View

The various Resource Management and Scheduling Systems in current use generally follow the same high-level business process model depicted in Figure 2-4. As the flowchart indicates, these systems gather input data from the end user and use pre-defined business rules to develop a schedule or a plan depending on the output that has been programmed.

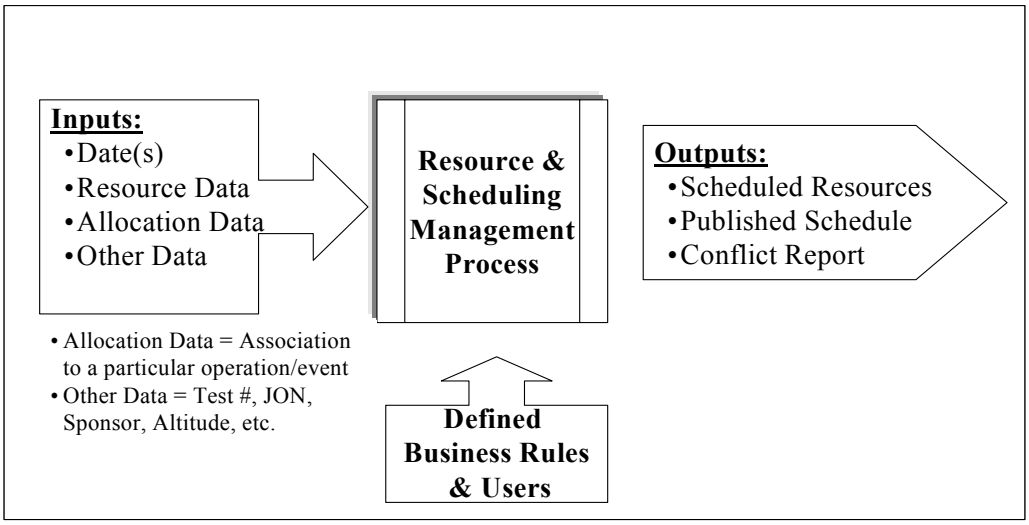


Figure 2-4. Resource and scheduling management process (high-level view).

2.3 User Characteristics

Table 2-1 shows the types of users who interact with the resource management and scheduling capabilities. These were consistent across all the ranges surveyed. However, as mentioned previously, many of the supported functions are not automated. For example, at some ranges, the range operations personnel would find out about the schedule from a test conductor or via a printed version of the schedule.

Table 2-1. User Population			
Type of User	**Create/Edit**	**View**	**Maintain**
Scheduling Personnel	☑	☑	☑
Resource/Resource Managers		☑	☑
Program Managers	☑	☑	☑
Range Managers		☑	
Range Operations Personnel		☑	☑
Test Conductors	☑	☑	
System Developers		☑	☑
Range Users		☑	
System Administrators	☑	☑	☑

2.4 Data Inputs

2.4.1 Types of Data. There are three major data types that relate to resource management and scheduling as depicted in Table 2-2. *Resource, allocation* and *other* data comprise the bulk of the data elements required by a resource management and scheduling system. *Resource* data contains all the data attributes of a particular resource and is often maintained by the resource manager. *Allocation* data pertains to the particulars of the test, training or any other event for which a particular resource could be allocated. Allocation data is often entered into the system by scheduling personnel. *Other* data refers to any additional data elements that are captured by the system. This classification is where all the ranges have developed a significant number of unique data requirements.

Table 2-2. Sample of Data Inputs		
Resource Data	**Allocation Data**	**Other Data**
Name	Test/Exercise #	Test/Operation/Event Data
Number or ID	Test/Exercise Type	Reliability Data
Description	Date (COMEX/FINEX)	Job/Operation/Test Number
Dependencies	Sponsor	Sequence/Planning
Restrictions	Project Manager	Remarks/Notes
Location	Test/Training Engineer	Announcements
Owner	Operational Area	Warnings
Status	Customer	Priority

2.4.2 Factors Affecting Choices of Data Elements. The number of data elements that are required, the mechanisms and the type of input data also varied from system to system. As was mentioned earlier in this document, the level of planning and scheduling, as well as the type of processes supported, dictate what kind of input data is required. A significant difference was also found in how the ranges chose to combine sets of data into templates or profiles. The following three key areas were observed as drivers for the differences in data inputs.

a. The level of scheduling supported:

- Is the process driven by test, exercise, operation or event-type dependency? Are requirements nested?
- Are there any templates/profiles already programmed/configured that contain the bulk of the required data?

b. The desired output:

- Range/resource or long range schedule
- Operations area schedule
- Resource management reporting
- Resource utilization reporting
- Resource availability
- Scenario generation
- Template generation

c. The interfaces to other systems or additional processes supported:

- Cost estimation
- Billing
- Resource utilization
- Approval workflow

2.5 Form of Data Outputs

The type of outputs, as well as the delivery format, also varied from system to system. How reports are developed and processed depends on the sophistication of the reporting tools used. The following list shows the most prominent requirements for output generation.

- On-line and printed forms
- Standard/dynamic query support
- Email/fax/ notification capabilities
- Graphic timeline presentation for water, space, and operation areas
- Interfaces to other systems/applications such as billing, cost estimates, resource utilization, and outages/maintenance

2.6 High-Level Functional Requirements

One of the most prominent differences found for each of the systems reviewed was the way functional requirements were documented. As indicated in Table 2-3, scheduling is a function that is provided by all these systems while resource management, planning or other support functions are not available at all ranges.

Table 2-3. High-Level Functional Requirements Comparison from Available Systems Documentation

AFWTF	AUTEC	Eglin/Edwards	NAVAIR	PMRF
• Request a Long Range Event • **Schedule Event** • Report Conflicts Manage Templates	• Manage Test • **Schedule Test** • **Schedule Test Range Resources** • Report Conflicts	• Request a Mission • Manage a Mission (lifecycle) • **Schedule a Mission** • Manage a Mission Profile • Support a Mission	• Test Program Resource Planning • Test Cost Estimating • **Range Resource Scheduling** • Resource Utilization Reporting • Interface with NAVAIR Financial System	• **Schedule** -Exercise -Operations -Resources • Manage Details -Cost -Approvals -Billing -Post Ops

2.7 Detailed Functional Capabilities

Table 2-4 contains a detailed listing of the capabilities that are supported at the different ranges. These are categorized by the occurrence of automated applications. It was clear that these capabilities are accomplished and, therefore, represent a requirement to support current range operations. Note that the degree of integrated automation is significantly different across all facilities.

Table 2-4. Current Functionality Requirements to Support Range Operations

Number	Description [For comparison purposes, the functionality descriptions are presented in a generic form where appropriate]	Automated Occurrence *** = All Ranges ** = Most Ranges * = Few Ranges
1.0	**Planning**	
1.1	Support long-range planning (LRP) allowing simulation of future range operations	*
1.2	Provide the functionality of converting LRPs into test, mission, operation or event requests	*
1.3	Provide the functionality to create, delete, store and edit a test, mission, operation or event LRP	*
1.4	Provide the functionality to authorize and de-authorize test, mission, operation or event LRP	*
1.5	Provide the functionality to view, copy, and pick from a list of test, mission, operation, event LRP	*
1.6	Provide the functionality of routing the test, mission, operation or event LRP for approval, view, notification to a select pre-defined population via electronic means	*
1.7	Provide the functionality to enable a select population to view or edit a test, mission, operation or event LRP	*
1.8	Provide a means by which test or training planners can build a detailed test, mission, operation or event request and then submit for further management or scheduling	**
1.9	Provide the functionality to create, delete, store and edit a test, mission, operation or event request	**
1.10	Provide the functionality to authorize and de-authorize test, mission, operation or event request	**
1.11	Provide the functionality to view, copy, and pick from a list of test, mission, operation, or event requests	**
1.12	Provide the functionality of routing the test, mission, operation or event request for approval, view, notification to a select pre-defined population via electronic means	**
1.13	Provide the functionality to enable a select population to view or edit a test, mission, operation or event request	**

Table 2-4. Current Functionality Requirements to Support Range Operations		
Number	Description [For comparison purposes, the functionality descriptions are presented in a generic form where appropriate]	Automated Occurrence *** = All Ranges ** = Most Ranges * = Few Ranges
1.14	Provide a means by which test or training planners can build a detailed test, mission, operation or event template that contains particular details related to the specific requirements of a test, mission, operation or event. For example: for a particular event, there are warnings, altitude, specific resources, as well as environmental and safety requirements	**
1.15	Provide the functionality to create, delete, store and edit a test, mission, operation or event template	**
1.16	Provide the functionality to authorize and de-authorize a test, mission, operation or event template	**
1.17	Provide the functionality to view, copy, and pick from a list of test, mission, operation, or event templates	**
1.18	Provide the functionality of routing the test, mission, operation or event template for approval, view, notification to a select pre-defined population via electronic means	**
1.19	Provide the functionality to enable a select population to view or edit a test, mission, operation or event template	**
1.20	Provide the functionality to request and manage a job/test/exercise/operation number	**
1.21	Provide the functionality to create, delete, store and edit a job/test/exercise/operation number	**
1.22	Provide the functionality to view, copy, and pick from a list of job/test/exercise/operation numbers	**
1.23	Provide the functionality of routing the job/test/exercise/ operation number for approval, view, and notification to a select pre-defined population via electronic means	**
1.24	Provide the functionality to configure platforms such as aircraft, vehicles, and submarines to be used as resources during a test, mission, operation or event	*
1.25	Provide the functionality to create, delete, store and edit a platform configuration	*
1.26	Provide the functionality to view, copy, and pick from a list of platform configurations	*
1.27	Provide the functionality of routing the platform configuration for approval, view, and notification to a select pre-defined population via electronic means	*
1.28	Provide the functionality to use a validation criteria and method for templates, configurations, plans and requests	*
1.29	Provide the functionality to create, delete, edit and store validation criteria for templates, configurations, plans and requests	*

Table 2-4. Current Functionality Requirements to Support Range Operations		
Number	Description [For comparison purposes, the functionality descriptions are presented in a generic form where appropriate]	Automated Occurrence *** = All Ranges ** = Most Ranges * = Few Ranges
1.30	Provide capabilities to create management reports containing information related to LRPs, plans, templates, requests, validation, and configurations	*
1.31	Provide the functionality to create individual or consolidated reports related to LRPs, plans, templates, requests, validation, and configurations	*
1.32	Provide the functionality to view availability of select resources based on a defined date	**
1.33	Provide the functionality to create a cost estimate based on the test, mission, operation or event plan	*
2.0	**Management**	
2.1	Provide the functionality to track all modifications by user	**
2.2	Provide the functionality to change the status of a test, mission, operation or event	**
2.3	Provide the functionality to manage a list of status elements such as *pre-planning, schedule requested, in-progress, cancelled* and *closed*	**
2.4	Provide the functionality to notify of a change of status to a select pre-defined population via electronic means	*
2.5	Provide the functionality to approve, view, list a select number of tests, missions, operations or events to a consolidated group	*
2.6	Provide the functionality to create management reports related to the management, status, tracking of tests, missions, operations or events	**
2.7	Provide the functionality to track resource usage	*
2.8	Provide the functionality to report on selected or grouped usage of range resources	*
2.9	Provide the functionality to review and approve actual costs	*
2.10	Provide the functionality to consolidate billing data and create billing reports	*
2.11	Provide the functionality to track all modifications by user	**
2.12	Provide the functionality to create, edit, delete and report on test, exercise, operation or event order to be used by contract or range personnel to further assign secondary resources and execution activities	**

Table 2-4. Current Functionality Requirements to Support Range Operations		
Number	Description [For comparison purposes, the functionality descriptions are presented in a generic form where appropriate]	Automated Occurrence *** = All Ranges ** = Most Ranges * = Few Ranges
2.13	Provide the functionality of routing the test, exercise, operation or event order for approval, viewing, and notification to a select, pre-defined population via electronic means	*
2.14	Provide the functionality to manage priority assignment based on predefined criteria	*
3.0	**Scheduling**	
3.1	Support the functionality to schedule resources based on predefined constraints such as priority, environmental, safety, blackouts, labor, and resource status	*
3.2	Support the functionality to aggregate scheduling requirements based on predefined templates or profiles	*
3.3	Support the functionality to de-conflict schedules automatically	*
3.4	Support the functionality to report schedule conflicts for manual de-confliction	***
3.5	Provide the functionality to report a range schedule on a pre-defined time frequency such as daily, weekly, monthly, quarterly or yearly	***
3.6	Provide the functionality to report a schedule for a particular set of resources, or for a test, exercise, operation or event, or for a particular operation area	***
3.7	Provide the functionality to report on status of a scheduled test, exercise, operation or event	***
3.8	Provide the functionality to schedule a test, exercise, operation or event individually or as a batch or group	**
3.9	Provide the functionality to change the schedule	***
3.10	Provide the functionality to track all modifications by user	***
3.11	Provide the functionality to create and modify scheduling constraints for range resources	*
3.12	Provide the functionality to notify of a creation or change in the schedule to a select, pre-defined population via electronic means	*
3.13	Provide the functionality to create scheduling management reports	***
3.14	Provide the functionality to report on reasons for non-scheduling	*
3.15	Provide the functionality to produce a report of available resources, frequencies, sites or operation areas	**

Table 2-4. Current Functionality Requirements to Support Range Operations		
Number	Description [For comparison purposes, the functionality descriptions are presented in a generic form where appropriate]	Automated Occurrence *** = All Ranges ** = Most Ranges * = Few Ranges
3.16	Provide the functionality to produce a report of scheduled resources, frequencies, sites or operation areas for a specific time	**
3.17	Provide the functionality to allow multiple layers of security for creation, editing, deletion and viewing of the scheduling functionality	**
4.0	**Resource Management**	
4.1	Provide the functionality to manage the information on resources based on predefined resource templates such as changing available status, location, or owner	**
4.2	Provide the functionality to create, edit, delete, store and view a resource template (a resource could be a range resource or a platform provided by the range user)	**
4.3	Provide the functionality to report on resource utilization, status, or detailed resource information	*
5.0	**Support**	
5.1	Provide the functionality to manage end-user information	***
5.2	Provide the functionality to manage electronic mail lists	**
5.3	Provide the functionality to manage communication protocols of automated messages such as news, notification of schedule changes, requests for approval, etc.	**
5.4	Provide the functionality to manage tracking instrumentation information (such as a hydrophone or a radar)	*
5.5	Provide the functionality to manage beacon information	*
5.6	Provide the functionality to manage pod information	*
5.7	Provide the functionality to manage munitions information	*
5.8	Provide the functionality to manage auxiliary systems/communications information	*
5.9	Provide the functionality to manage frequency information	*
5.10	Provide the functionality to manage control facility information	*
5.11	Provide the functionality to manage air/surface/subsurface space information	*

2.8 Systems Architecture

The following list summarizes the most significant findings from the analysis of the system architecture documentation provided by the ranges. The system architectures:

- Vary from range to range,
- Were stand-alone or integrated to the Enterprise Systems,
- Were predominantly client-server and multi-tiered approaches,
- Have a current requirement for web-enabled technology,
- Use predominantly commercial-off-the-shelf (COTS) technology across all ranges for hardware, databases, and reporting tools

2.9 System Documentation

- Limited documentation is available – ad-hoc development of systems has been the norm. Process, system requirements, system design documentation was not readily available at the majority of the ranges surveyed.What documentation is available is at different levels of detail. Some of the documents are process-specific, while others are detailed enough to show inputs, outputs, and processing supported by the system capabilities.
- Some use standards for the requirements gathering, design, or development phases of scheduling systems. IEEE standards were used by some of the ranges for the documentation of their system requirements and design.Most of the system documentation available corresponds to recent (last three years) or planned, ad-hoc scheduling system development.

2.10 User Interface: The Look and Feel

As is depicted by Figures 2-5 through 2-7, the user interfaces implemented by these ranges differ considerably in terms of configuration and also in terms of what data is presented and managed. No consistent standards or guidelines were found to be in use by any of the ranges.

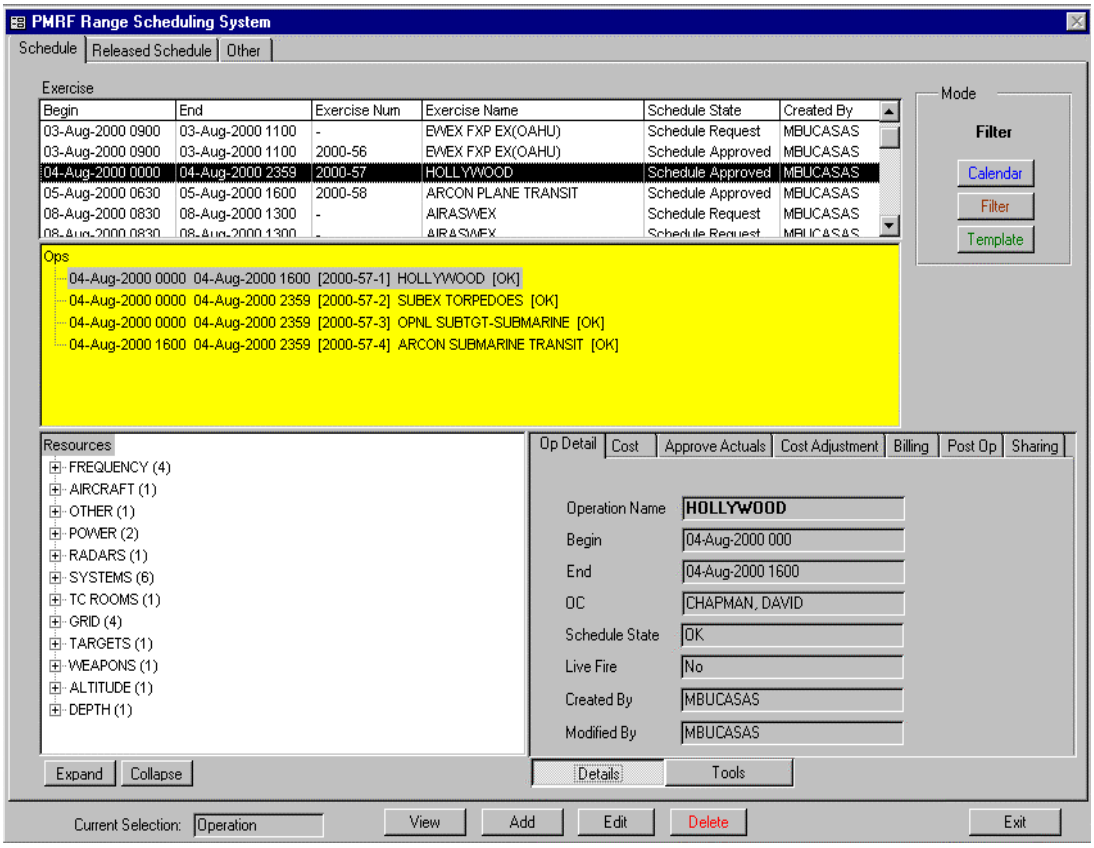


Figure 2-5. PMRF user interface.

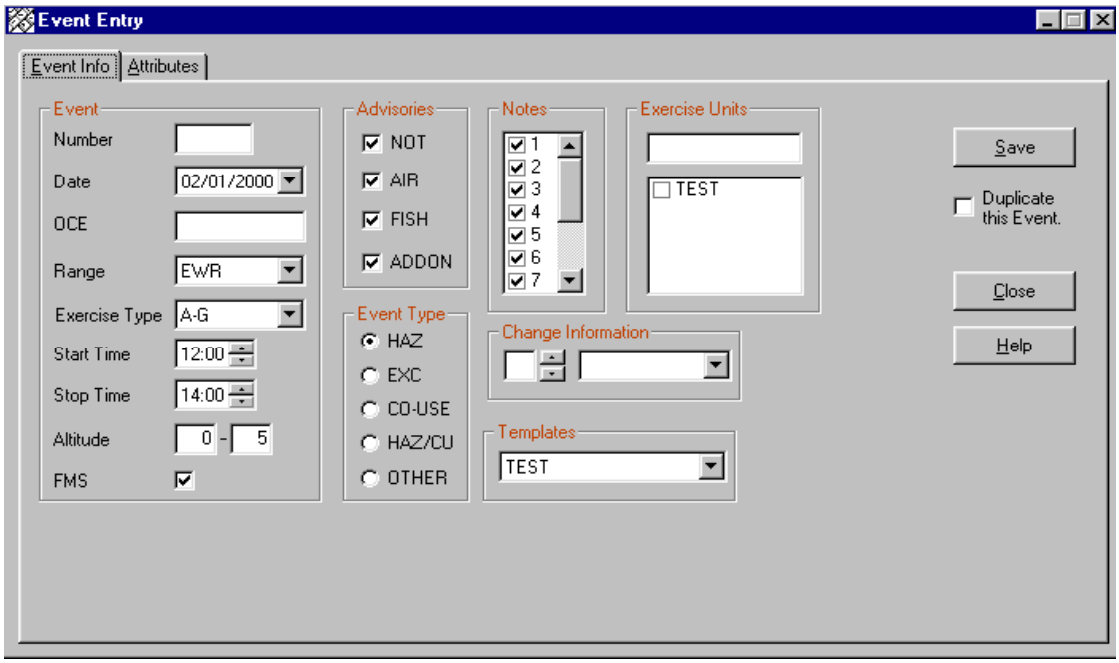
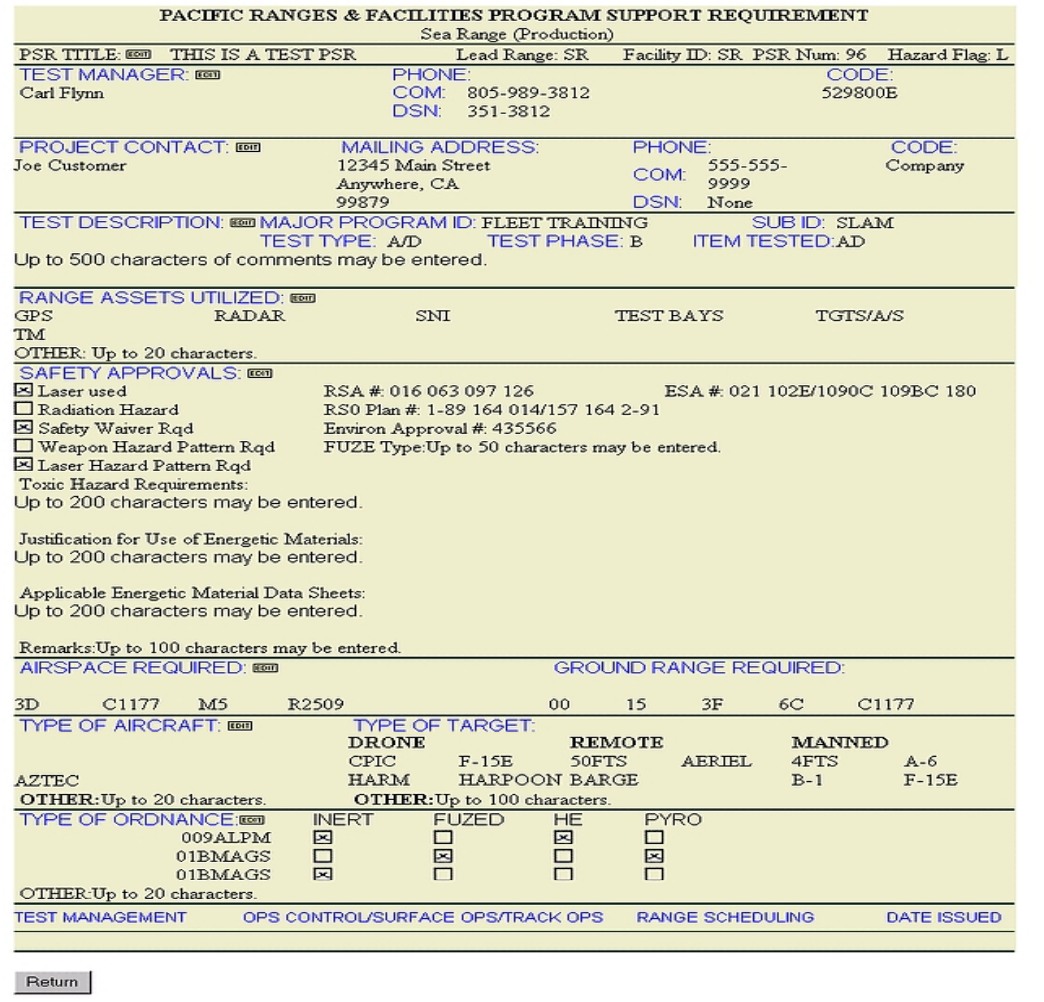


Figure 2-6. AFWTF user interface.



PACIFIC RANGES & FACILITIES PROGRAM SUPPORT REQUIREMENT
Sea Range (Production)

PSR TITLE: THIS IS A TEST PSR Lead Range: SR Facility ID: SR PSR Num: 96 Hazard Flag: L

TEST MANAGER: Carl Flynn
PHONE: COM: 805-989-3812 DSN: 351-3812
CODE: 529800E

PROJECT CONTACT: Joe Customer
MAILING ADDRESS: 12345 Main Street, Anywhere, CA 99879
PHONE: COM: 555-555-9999 DSN: None
CODE: Company

TEST DESCRIPTION: MAJOR PROGRAM ID: FLEET TRAINING SUB ID: SLAM
TEST TYPE: A/D TEST PHASE: B ITEM TESTED: AD
Up to 500 characters of comments may be entered.

RANGE ASSETS UTILIZED:
GPS RADAR SNI TEST BAYS TGTS/A/S
TM
OTHER: Up to 20 characters.

SAFETY APPROVALS:
☒ Laser used
☐ Radiation Hazard
☒ Safety Waiver Rqd
☐ Weapon Hazard Pattern Rqd
☒ Laser Hazard Pattern Rqd
RSA #: 016 063 097 126 ESA #: 021 102E/1090C 109BC 180
RS0 Plan #: 1-89 164 014/157 164 2-91
Environ Approval #: 435566
FUZE Type: Up to 50 characters may be entered.
Toxic Hazard Requirements:
Up to 200 characters may be entered.

Justification for Use of Energetic Materials:
Up to 200 characters may be entered.

Applicable Energetic Material Data Sheets:
Up to 200 characters may be entered.

Remarks: Up to 100 characters may be entered.

AIRSPACE REQUIRED:
3D C1177 M5 R2509

GROUND RANGE REQUIRED:
00 15 3F 6C C1177

TYPE OF AIRCRAFT:
AZTEC
OTHER: Up to 20 characters.

TYPE OF TARGET:

DRONE		REMOTE		MANNED	
CPIC	F-15E	50FTS	AERIEL	4FTS	A-6
HARM	HARPOON	BARGE		B-1	F-15E

OTHER: Up to 100 characters.

TYPE OF ORDNANCE:

	INERT	FUZED	HE	PYRO
009ALPM	☒	☐	☒	☐
01BMAGS	☐	☒	☐	☒
01BMAGS	☒	☐	☐	☐

OTHER: Up to 20 characters.

TEST MANAGEMENT OPS CONTROL/SURFACE OPS/TRACK OPS RANGE SCHEDULING DATE ISSUED

Return

Figure 2-7. NAVAIR user interface.

2.11 Hardware/Software Interfaces

Limited interfaces to other systems are currently in place. Most of the Resource Management and Scheduling Systems are stand-alone. One significant deviation from this trend is the planned Eglin-Edwards Center Scheduling Enterprise System. This system will be used by both Eglin and Edwards AFB facilities. It will have at least twelve different software interfaces, which will include links to their Earned Value Cost Analysis, Historical File Mission and Resources, and to their Military Airspace Management systems. Other ranges such as AFWTF do not have any interfaces to other systems. As mentioned earlier, interfaces to other systems are a function of what kinds of business processes are supported, at what level, and what kind of automation exists at the particular range.

2.12 Implementation Drivers

The following list contains the factors that were consistently found to be critical when developing Range Resource Management and Scheduling systems. No apparent priority or weighting was found to influence a particular design for any of the range systems analyzed.

- User requirements
- Physical location
- Type of events supported
- Security levels
- Remote access
- Number of users
- Process supported
- Levels of scheduling complexity
- Technology
- Budget
- Business rules
- Communication requirements
- Latency requirements
- Reporting requirements
- Interface requirements
- Data management requirements – archival of historical data

2.13 Summary of Findings

Current Resource Management and Scheduling Systems have the following characteristics:

a. Although viewed as mission critical functions, scheduling and resource management are still highly labor intensive, manual processes.

b. Automation is not widespread across the lifecycle of test or training exercises.

c. Not all resource management and scheduling functions are performed by the same system. Scheduling is more commonly automated than resource management.

d. The business processes that are supported by automation vary from range to range. Figure 2-8 depicts how the range systems support their operations. There are three key points to note. First, all ranges perform very similar functions in support of their operations. Second, they do it their own way – some methods are circles and others are squares. Third, as the lines indicate, any information or communication that is exchanged between functional areas is not integrated. Therefore, the risks of communication errors, duplication of effort, and maintenance costs increase proportionally to the number of users and stand-alone systems.

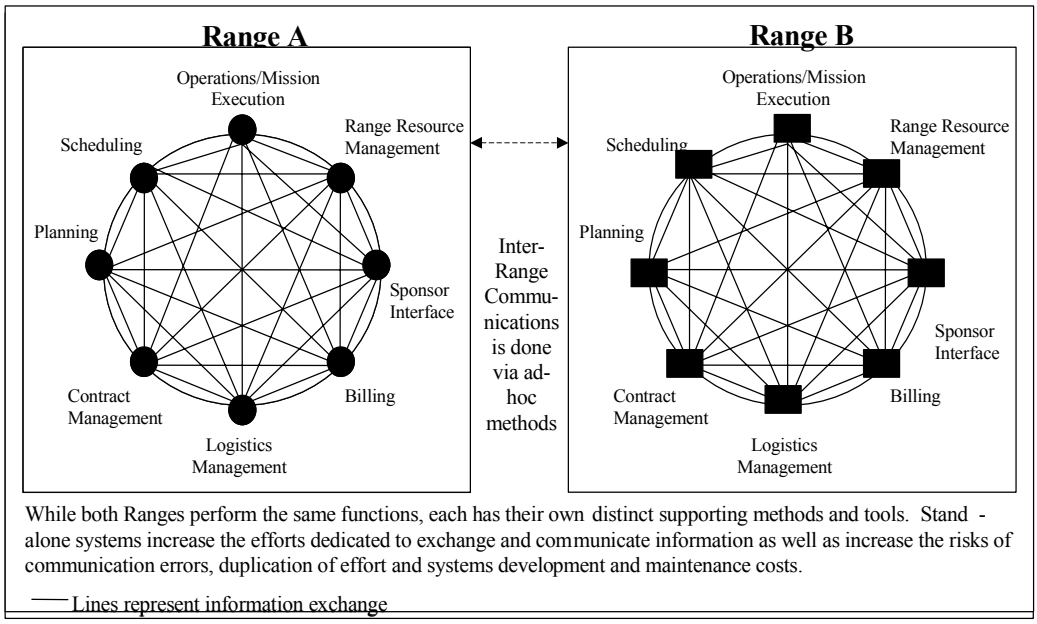


Figure 2-8. A conceptual view of current range operations.

e. The implementation of the systems studied varied depending on the type of processes supported and the level at which resource management and scheduling was conducted.

f. Automated de-confliction of scheduling is not a common function currently supported. At some ranges, automation of scheduling processes still remains as a documented calendar of events, and conflict resolution is a manual function.

g. Requirements at a high level are the same for all ranges. The differences found in the development and implementation deal with how business processes are supported, and what attributes are required by each range facility.

h. There is significant opportunity to leverage system development dollars if a common design schema is used to document and design resource management and scheduling systems.

i. Significant thrust is in place to offer enterprise-wide systems and to share common tools for resource management and scheduling.

SECTION 3

RECOMMENDATIONS

3.1 Recommended Concept

As depicted in Figure 3-1, one recommendation is to consolidate system or tools functionality to support multiple range functions. This type of combined or integrated capability has been a focus for some of the ranges and is slowly gaining momentum as more ranges are defining their business processes in terms of an enterprise model. This is evident in the Air Force's Eglin/Edwards Center Scheduling Enterprise Software Requirements Specification as well as in the NAVAIR Test Resource Management System Design Description. Combining functionality of the tools and the management of data in a single repository that is used by multiple applications ensures data integrity, minimizes development and maintenance costs, and fosters commonality of services.

The benefit of commonality across the ranges is not easily achieved with this scenario since, while it consolidates functions, it does so within the doctrine and procedures of a particular range. However, if we take this same concept and provide the ability for a range to predefine the data and business rules in a template that then could be translated into a common repository of data elements and business rules, then the benefits would transcend a particular range, and the vision of commonality could very well become a reality.

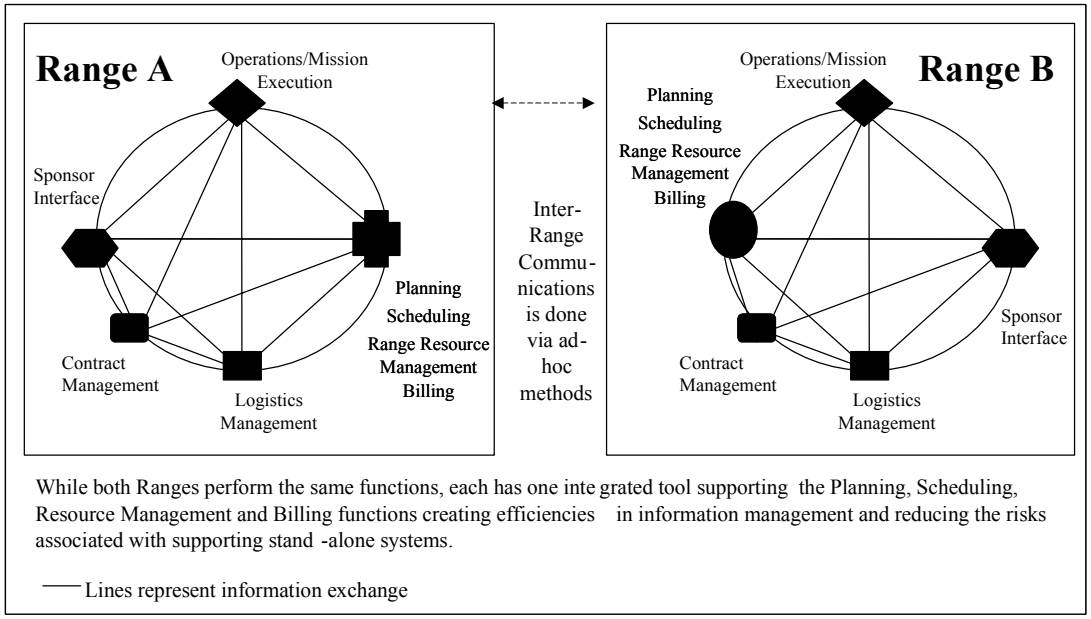


Figure 3-1. A conceptual view of range operations supported by integrated tools but developed to support a single range.

The integrated tool shown in Figure 3-2 provides the translation vehicle to enable a system to be configured to support local and range-specific language, their own "look and feel," and their associated business rules, while still providing the mechanisms to communicate the same information across multiple systems.

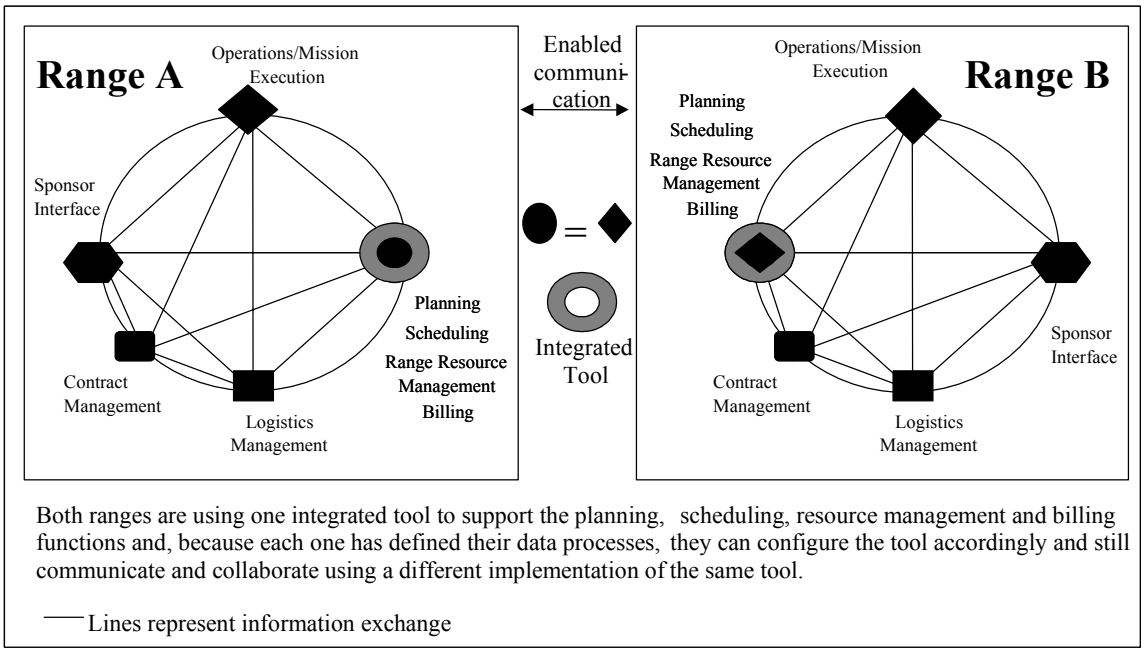


Figure 3-2. A conceptual view of range operations supported by a configurable, integrated tool.

There are many initiatives under way, both commercial and government-funded, that are concentrating on the development of architectures and integration mechanisms that would be required to make this concept a common, everyday reality. However, for the ranges to embrace this concept they would have to define a common business framework. This type of model would allow them to share information and resources and to inter-operate on an as needed basis while continuing to support their customers to achieve their unique test and training goals.

3.2 Recommended Approach

3.2.1 Model Template. Define a model template that will fit the broad spectrum but allow for uniqueness where necessary. Users must define the categories and the levels of configuration that would allow a tool to be both expandable in functionality and flexible in its design. For example, a range could choose to only deploy the functionality that allows for scheduling and continue using other tools for planning and execution. Or, a range could choose to deploy the same configuration of functionality with a different user interface. This form of system design is becoming the approach of choice by leading software and system developers as it allows a wider user population to benefit. This approach would allow specific ranges to preserve uniqueness when necessary to ensure the success of their operations.

3.2.2 Software Design. Concentrate on configurable software design and distributed implementation where applicable. Current technology allows the system designer to build and deploy software in a modular fashion. The ranges could benefit from modular design in two significant ways: (a) by sharing development and maintenance costs and (b) by improving the ability to communicate and transfer information among the range community.

3.2.3 Core Requirements. Create consensus and determine what are the core requirements that would best support range operations. The following points should be thoroughly studied by all potential stakeholders, and a decision should be made as to what levels of commonality, automation, and maintenance jurisdiction are to be applied when designing future system capabilities:

a. Resource management levels

b. Aggregation of assets to satisfy the requirements of an event

c. Coordination of information sharing at the different levels of range management

d. Support of the life-cycle operations of a range event (from planning & scheduling, to post-operations support)

e. Support planning and simulation for feasibility of range events and optimization of range resource management

3.2.4 Management Support. Provide the right project management support with the right combination of technical and operational direction and control. The multiple number of end users for a Range Resource Management and Scheduling capability dictate that representatives of all functions agree on the functionality that would be provided by the tool. Furthermore, a facilitator should be used during the design of the tool to ensure that all stakeholders' views are adequately represented.

3.2.5 Commonality Features. Determine how commonality, sharing of assets, inter/intra-range operations relate to the design and deployment of future range systems:

a. Investigate how investment in new range systems could influence commonality of systems lifecycle.

b. Determine how the DoD Business Initiative Council and Foundation Initiative 2010 relate to future range resource and scheduling capabilities.

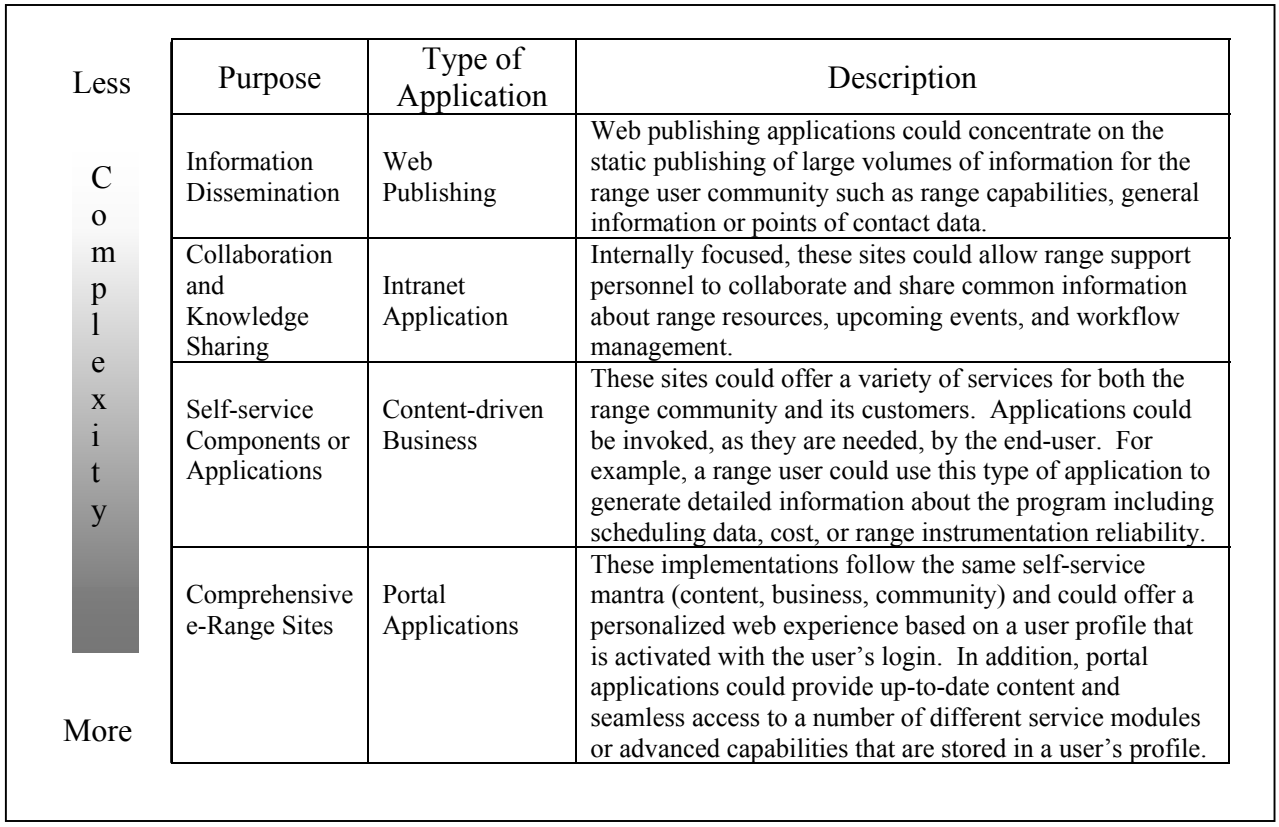
c. Clearly state where new common processes will be institutionalized, where local governing procedures will be followed, and how it all fits into the range environment of the future.

3.2.6 Emerging Technologies. Investigate the feasibility of emerging technologies such as:

a. Web applications such as *Semantic Web* that allow sharing of content across the specific communities while matching content to a specific user's profile. Figure 3-3 illustrates how the ranges could reap the benefits from the use of the web-enabled applications.

b. The *eXtended Markup Language* (XML), which would help define multiple configurations of data and services

c. *Simple Object Application Protocol* (SOAP) to help with the exchange of data



Purpose	Type of Application	Description
Information Dissemination	Web Publishing	Web publishing applications could concentrate on the static publishing of large volumes of information for the range user community such as range capabilities, general information or points of contact data.
Collaboration and Knowledge Sharing	Intranet Application	Internally focused, these sites could allow range support personnel to collaborate and share common information about range resources, upcoming events, and workflow management.
Self-service Components or Applications	Content-driven Business	These sites could offer a variety of services for both the range community and its customers. Applications could be invoked, as they are needed, by the end-user. For example, a range user could use this type of application to generate detailed information about the program including scheduling data, cost, or range instrumentation reliability.
Comprehensive e-Range Sites	Portal Applications	These implementations follow the same self-service mantra (content, business, community) and could offer a personalized web experience based on a user profile that is activated with the user's login. In addition, portal applications could provide up-to-date content and seamless access to a number of different service modules or advanced capabilities that are stored in a user's profile.

Figure 3-3. A conceptual view of web applications for the range community.

3.2.7 Design Considerations. Engage in a phased development approach that would foster the model-test-deploy methodology. Develop and test with end-users all prototype designs of functionality and interfaces early in the design stage. With the rapid change of technology platforms and techniques, it would be advisable not to engage in long-term development projects that would yield results almost obsolete by the time they reach the end-user. It is recommended that the designers and developers share a constant awareness of new developments in technology and reflect those in the development and implementation of the final capability.