REPORT OF THE 7-8 MAY 1998 ONR/CNMOC INTERACTIVE METOC WORKING GROUP

Encl: (1) ANNEX A: Background, Why METOC?
(2) ANNEX B: Minutes of first day plenary session
(3) ANNEX C: List of participants
(4) ANNEX D: Detailed recommendations

1. Purpose:

a. The purpose of this workshop was to develop an appreciation and understanding of the METOC function for Naval Operations. Then, using a scenario-based group discussion method, develop recommendations to facilitate the METOC function.

b. METOC was chosen specifically as the domain because of its unique current state. It provides the most robust, well defined set of components that share properties with the broader C4ISR problem. Due to this status, it has the potential to serve as a submodel example of how one can build the more complex decision making environment for C4ISR because it can employ existing models, visualizations, and expertise that have a history of successful use. Furthermore, the METOC community has leapt ahead by assuming a WEB architecture approach to information management that facilitates research in more current, efficient, and robust information usage by end users. (See ANNEX A for detail.)

c. This workshop was a working experiment on two levels:

1) A new way of integrating basic and applied research , bringing together leading edge research knowledge about systems with forward looking approaches to technology use.

2) Scenario-based problem definition, focusing on user needs and current systems states and possibilities for near term and long term implementations.

c. Issues to think about:

1) Different technologies provide different capabilities

2) Search is NOT FREE

3) Latest/Greatest is not necessarily the RIGHT WAY TO GO

4) Time scale for information change is critical factor in how information is provided for user to access

5) Once information is obtained, what does the user need to do with it – delivery is only part of the problem. How to define interactive information?

d. Therefore, the workshop used the scenarios described below to focus discussion on suggested next steps in evolution that will maximize METOC performance in serving fleet needs, and to g*enerate suggestions for tools that are*:

1) User-centered – Task focused;

2) Can be investigated and implemented by 2000 or before (near term);

3) or about 10 years out (longer term);

4) Define holes in knowledge and suggest basic research directions for building needed systems interactions from the user's standpoint;

5) Produce report for CNR and CNO(096) and provide brief on workshop results.

2. Scope:

a. The METOC problem for the workshop was bound by addressing two specific aspects, METOC support to carrier air strike (STRIKEOPS), and battle group undersea warfare (USW), of a typical battle scenario. The scenario is described below.

1) In preparation for an amphibious assault on RED BEACH, CVN 70 has been tasked to mount an air strike against an enemy command and control complex, east of the beach. The Intel cell has briefed that the complex is defended by 4 motorized surface-to-air missile launchers with a centralized air search and fire and control radar system located within the complex.

2) Strike Force Alpha will consist of 8 F-18 strike fighters armed with Maverick Laser Guide Bombs, preceded by 2 EA-6B electronic warfare aircraft armed with HARM missiles. 4 F-14 fighters will provide CAP.

3) CVN 70 is currently 100 NM west of the target. Latest intelligence reports warn of a possible threat from 2 enemy submarines operating in the vicinity. USW forces include a destroyer with embarked helicopter detachment, and indigenous carrier USW assets.

b. The problem was further bound by addressing the scenario from four specific perspectives:

1) The carrier METOC division’s task with respect to USW

2) The carrier METOC division’s task with respect to STRIKEOPS

3) The regional SMARTCENTER’s task to support the carrier METOC division for both STRIKEOPS and USW aspects of the scenario

4) The METOC production center’s task to support the regional SMARTCENTER and the carrier METOC division for both STRIKEOPS and USW aspects of the scenario.

c. Workshop participants were given realistic, hands-on, demonstrations of the METOC division processes by members of the USS CARL VINSON OA division, and of the SMARTCENTER processes by watch standers at NAVPACMETOCFAC, as outlined below.

1) Watch Floor Demonstration

0 Operations Watch Floor
1 Data and Product Flow
2 Data Product Research and Retrieval
3 Data Analysis and Value Added Generation
4 Internal / External Collaborative Effort
5 Product Distribution

6 Product Improvement Via Feedback
7 Repetitive / Mundane Issues

2) OA Division Demonstration

8 Data Collection and Analysis
9 Forecast Generation
10 TDA Employment
11 Internal / External Collaborative Effort
12 Brief Generation
13 Brief Presentation
14 Commander / End User Feedback

d. After the process demonstrations, attendees were given a tour of the USS CARL VINSON, especially the METOC division spaces.

e. Following the tour and lunch aboard the ship, researchers each spoke briefly about the nature of their professional interests. (See ANNEX B for brief synopsis.)

f. The workshop was then divided among four groups each assigned one of the four perspectives on the problem described above in paragraph 2.b. The groups were given very specific guidance, and asked to identify and prioritize issues with respect to the METOC support process. They were further tasked to make recommendations regarding 6.1-6.3 research to address the issues in the short term (1-3 years) and longer term (say 10 years.)

3. Recommendations:

a. Specific recommendations for research projects are included as ANNEX D. Interested parties among the Navy R&D and METOC communities should study these proposals and try to pool resources to accomplish as many as possible.

b. The approach taken at this working group was extraordinarily effective at not only generating excellent ideas, but documenting them. We in the Navy R&D, and METOC communities should use the same forum again.

ANNEX A: WHY METOC?

What gave us the idea? Why METOC? Information Technology (IT)-21, a strategy to optimize IT acquisition across all the Department of the Navy (DON), is a FLTCINC-initiated achievement to fundamentally change the way DON acquires information technology. The IT infrastructure becomes an electronic commodity with warfare (tactical) and warfare-support (non-tactical) overlays. IT-21 represents a philosophical C41SR warfighting method transformation.

C41SR = Command, Control, Communications, Computer + Intelligence + Surveillance + Reconnaissance information

This process includes:

- Divert away from costly, single-function work stations and focus toward affordable, more efficient PCs
- Extensive use of web technology to manipulate data and produce products
- Seamless ashore/afloat transfer to voice, video and data information
- TCP/IP-based, client-server environment with multi-level security
- Embrace industry standards, open architecture and COTS
- Blend tactical and non-tactical data on a common infrastructure. It is a coordinated effort based on a global DON networking architecture to ensure interoperability, and regional IT acquisition solution based on best business case analyses.

The Navy's approach to IT-21 is one that fused C41SR is essential to DON mission accomplishment. Superior C41SR data fusion and dissemination diminishes potential indecision's. IT is highly important to effective C41SR fusion. Shrinking resources, coupled with the fast-paced technology of the information era, are effecting IT to become the force multiplier for the next century.

Why meteorology and oceanography (METOC)? Even though the application of this technology crosses all warfare areas and disciplines, and some domains offer greater investigative potential than others do, the METOC domain is offered as one of the most advantageous initiatives for the following:

- METOC data is generally unclassified and readily available to the public sector
- International agreements dictate universally recognized data formats for gridded METOC data (GRIB) and textual METOC information (BUFR)
- NETOC data is perishable; the refresh requisite is consistent with the larger battle issue
- Computational and graphic interface requirements for METOC information are can easily translate to other information domains
- The METOC community has already initiated the process with their IT-21 based "SMART CENTER!' concept in San Diego. Resources and Fleet synergy can be leveraged toward a rapid development and transition of this interface technology.

Dr Heffner

ANNEX B: MINUTES OF DAY ONE PLENARY SESSION

METOC INTERACTIVE SYSTEMS WORKSHOP – 07 MAY 98

Conference convened at 0809

Dr. Helen Gigley intro.
Purpose of the workshop is to come up with recommendations for design user-centered direct interactive system. Stated that the METOC is the perfect domain for systems research and emphasized the importance of METOC information to the Navy. Gave some background info on what precipitated this workshop. Started 3-4 yrs ago with Bob Miyamoto and DMARS, and inception of the SMARTCEN and with visit to the USS CORONADO to see how they were doing METOC business. Dr. Gigley indicated that this is a working experiment. Experiment is two-fold process: 1) New way of integrating basic and applied research, bringing together leading edge research knowledge of systems with forwarding looking approaches to technology use. 2) Scenario based problem definition, focusing on user needs and current systems status, and possibilities for near term and long term.

Issues to think about:

1. Different technologies provide different capabilities
2. Search is NOT FREE
3. Latest/Greatest is not necessarily the RIGHT WAY TO GO
4. Time scale for information change is critical factor in how information is provided for user to access
5. Once information is obtained, what does the user need to do with it – delivery is only part of the problem. How to define interactive information.

GOALS for Workshop:

Generate suggestions for near-term tools that are:

- User-centered – Task focused;
- Can be investigated and implemented by 2000 or before;
- Define holes in knowledge and suggest basic research directions for building needed systems interactions from the user's standpoint;

Produce report for N096 and provide brief on workshop results

Dr. Gigley indicated that DMARS-example of user-centered design. Domain knowledge is essential. What is right for the job? Time scale is critical factor. How long does user have to utilize information? How is info posted and used? Generate suggestions for near term tools and goals. Look at 2 levels: Near term and how to evolve this sys and what to evolve to. Define holes in knowledge and suggest basic research directions for building needed systems interactions from the user's standpoint.

CAPT Aldinger: Provided info how METOC community presently does business. We are extremely information/data intensive. Time driven problem. We use the power and technology of IT21 today to solve today's problems. We must anticipate and try to solve threats/problems of tomorrow. We want tech

to be integrated; not the driver. Need out of the box thinking to help the littoral warfare fighter. Excited to be here.

CDR Gunderson: Intro Kraft to discuss Cmd and Control.

Kraft: Mission statement. Defined operational chain of cmd. Defined how the METOC community ties in to EASTPAC chain of cmd. METOC community has staff on board Fleet operators. METOC shore-side chain of command defined. San Diego supports 3rd Fleet staff and all assets. Defined how we fit in to the cognitive hierarchy. We take raw data, add value, to aid the operators afloat in making decisions. Results are operational CDR has better understanding in order to make sound decisions. Where do we fit in the CDR's Intent and Orders (The cycle)- Cycle is ongoing. Observe, orient, act, and decide-common Tactical picture.
Question was asked regarding the time scale that our data must be provided. CO explained that data is extremely time-sensitive and that this would better be explained and visualized in the working group discussions.

Arends: Discussed technology side. – Data flow, circuitry, GGIS, JMSCSS, secret INTERNET w/browsers, UNCLASS circuitry, LAN.

PRECIP Cycle: We add value to data and then send out to SIPRNET/NIPRNET. Defined: Perceive customer's activities: Use all avail. Tools to increase situational awareness. Retrieve; Evaluate and assess, Create forecast, integrate, and post.

AG1 Williams spoke about the actual briefs presented to the fleet commanders. We give theatre commander a METOC brief 3X per week to see where potential threats are. Provided an example of a brief, displaying fleet assets and where METOC support is on board.

LT Sidlauskas: Provided warfare scenario. BIG THURSDAY is name of the operation. Defined operation involving CARL VINSON. Defined strike package.

AG1 Williams: Defined weather patterns that could effect today's strike exercise. Precip expected in area. Seas 4-6 ft along Red Beach area – not significant impact on operational area. Shower impact minimal.

At this point, attendees split into two scenario working groups – one to SMARTCEN and one to USW operation.

Attendees break into two scenario working groups. One group toured the SMARTCEN for demo of systems and products, and the other group heard an example USW/ASW briefing package in that would be developed and presented to the warfighter by the OA DIVO on board the USS CARL VINSON.

0856: LCDR Ledesma, Fleet Liaison Department Head introduced LCDR Jim Berdeguez, USS CARL VINSON OA DIVISION METOC Officer, who would present examples of products his personnel would develop and provide in support of the USW/ASW scenario.

LCDR JIM Berdeguez (OA DIVO on board Carl Vinson): Gave example of briefing pkg in support of the defined scenario to both working groups. Defined CARL VINSON METOC support organization and kind of support provided to customers, briefing package, CO's briefing. Customers defined as COMCARGRU 3 and its assets. METOC information resources avail on board, both internal and external, and where they originate from, defined. Process and tools used defined – dependent on number of factors. Target defined, timeframe, what will be used for strike, etc. They provide the METOC products that will determine the best type of operation and timeframe to carry it out. Indicated GFMPL needs to be improved for future use. Q: How much time and bandwith is available WRT NIPRNET. Operates 24 hrs 7 days per wk, depending on tactical situation. We are competing on bandwith for info

during tactical situations with other ships and OA divisions. Info slows down when everyone is trying to get info from the same source. SCENARIO: Undersea warfare operation mission – take out 2 diesel subs off the coast 50-100 miles. Strike operation mission is to take out the Cmd and Control bunker. Explained that it took 6 personnel 8 hours to produce this briefing package; a package that was needed within 2 hours by the warfare fighter. Due to the time it takes to produce the package needed, when it was really needed in 2 vice 8 hours, warfare fighter ends up receiving a CLIMO vice tactical package. Problem - within the 6 hrs package was being developed, GFMPL crashed several times, resulting in approx. 30 minutes of the 6 hr period dedicated to re-booting the system.

Mission: Find/locate these subs and destroy. Strike Op: Cmd and Control bunker – use FA18s to strike target. Defined packets with products provided for this mission. Provided example briefing that he would provide for this scenario. Bathymetry chart –depth and determination of sound speed. Raytrace, Sensor depth, sea mounts. Summarize data in bullet form; output which comes out of GFMPL – 3D; how much useful info comes from this is questionable. They produce a metric worksheet, tactical summary. How we display data is critical to us; but don't get too hung up on graphics, per CAPT Aldinger. Explained that a hard copy pkg handed to operators (as result of question asked re how interactive we are with customer). Carrier does not currently have capability to pull up BATH data. GFMPL does not give capability of determining where Sensors should be moved to. Gives you a CLIMO package; not a tactical pkg. Takes 4-6 hrs to run pkg. Need right system and right database on board ship; only available at NAVO presently.

Bottomline: VINSON – anytime/anywhere. Doing best we can with the systems we have; trying to improve products to customer. Problems – bandwith competition and availability, timely response, and METOC products. Present applications are not user friendly in aiding the operator in providing useful tactical decision aids (TDAs).
Attendees advised that when they go aboard the CARL VINSON today, they will see the actual working space and equipment involved, as question was asked if it's a problem having 6 people working to produce a single package and what is the size of the space personnel are working in – ½ the size of the Facility's conference room, was the response.
Want to produce product on 1 system, vice having to use 4 or 5 different system to pull products and consolidate into one package.

Discussion ensued:
CAPT A: reviewed again the METOC info resources; internal and external. Explained differences and capabilities of the internal resources. Sat. Imagery, Atmospheric Analysis, Oceanographic Analysis, Intel Data Exploitation, and Strike Mission Planning and variables that can effect the product. Information mgmt problem – that's our challenge today.

Dr. Gigley – two sides of problem – producers and users.
No easy way to pull what's needed. Data comes from wide variety of sources.

Discussion continued on what new applications are available and in the process of coming on-line. Attendees would be provided hands-on opportunity to see how GFMPL works in producing transmitting Bathymetry data.

In the SMARTCEN working group:

LT Burton (N33), BLUE Div. Officer, provided introduction of SMART Center, products provided for the mission, how product is evaluated and distributed.
LT Cantu (N32), GOLD Div. Officer, reviewed the equipment in the SMARTCEN and their function.
Mr. Nelson, (N31) METOC Products Div. Officer, reviewed the forecasting aids available.
AG2 Montgomery reviewed the scenario – USS CARL VINSON wants a forecast.

At this point, Dr. Ballas got a hands on demonstration on the UNCLAS computer on researching ocean fronts, using NEXRAD, and satellite visibility.

On the classified computer, Dr. Long accessed TARPS, STOIC, and annotated satellite imagery.

LT Sidlauskas then discussed customer feedback, improvements, issues, operational area forecast, observation TAFs, need for support, watchfloor design, encode/slicer, TAF verification, and quality assurance.

CDR Gunderson commented on the requirement for a new automated TAF verification system.

1315:

Dr. Miyamoto and Dr. Jim Ballas discussed DMARS project: Evaluating Direct Access to METOC Information. Background: How do you take a variety of products from multi-media sources, and consolidate on CD-ROM, in the fastest, cheapest means possible. Observe and compare paper, WWW, & CD-ROM. Chose 5 tasks in the METOC domain. Evaluated 5 persons 5 tasks 3 media. Paper/WWW Table of contents. DMARs – took paper, WEB, and CD rom product and conducted experiment. Evaluated 6 people from Pax river and 6 fm NASNI with variety of METOC experience and computer experience. No one had experience using DMARS. Chose 5 normal METOC tasks. No interaction until comp. Of task. No time limit.
QC'd finished product though. Complete in reasonable time.

1st task – Normal METOC briefing.
2nd task – Navigation (same presentation; different media for this and following task)
3rd task – Searching (how long does it take to find info fm unk location?)
4th task and 5th task – Presentation of info and analysis.

Performance Measurement – Primary – how long did it take them to do the task. Task timing
Task decomposition
Task outcome
Preference
(Worked with word processing or Pwrpoint, or DMARS.)
Timing results:
Task 1 – (Normal brief prep): No differences btwn 3 different types of media.
Search time: Using the WEB (at NAVO using the SIPRNET) took much longer than other 2 types of media source (paper, CD ROM)
Number of images – Used more DMARs; already formatted for presentation.

Task 2 – Record the mean tide (Navigation). Fastest with paper, slowest was WEB.
Search time: Web slowest

Task 3 – Is there any shrimp trawling. (Search-total time)
Paper fastest.

Task 4 – Taken to the page. Dealt with sound/speed profile
(at location) (times about equal)

Task 5 – Total time (Daylight at location). DMARs was quicker.

Accuracy: well below 100% for all media.
Paper and WEB 84%
DMARS 75% - Why did they make the errors.

User preference: DMARs.

Videotape presented: Xerox Parc Video
Dr. Peter Pirolli and Dr. Card
Tasks they are interested in: Knowledge crystallization. Defined characteristics and gave examples. Involves multiple phases of interaction: Info foraging, Sensemaking, and Knowledge product. They've been trying to predict the Degree-of-Interest, given history, user interface, document architectures, document services.
They collect data, tracing people as they travel around WEB sites. Developing visualization tools to determine what exactly is going on at each WEB site. Once data is collected. they can predict future usage, correct bandwith problem, etc. Presented short video demonstrating WEB forager, 3D environment – allows you to bring in several pages at one time. Can collect info together. This system solves the two problems involved with the WEB. Can bring in groups of pages, and allows you to view more than 1 page at a time, from different sources, to compare, etc.

Dr. Susan Kirschenbaum – NEMO-Naval Expert MOdel. (She's fm NUWC Div., Newport) – Submarines –
Comparison of tool space (and time spent using) and the actual task space. Looked at ratio of time between tool and task. (Analyzed several different tools used in the submarine community). Also reviewed Tool/Task distribution. Used this measure to see how good or bad a tool actually is.

Dr. Susan Gerhart – Web researcher: Discussed need for improved search engine. Reviewed WEB domains relating to METOC and developing a way of clustering them. Discussed browsing and context approach for organizing products and data.

Dr. Mary Hegarty – UC Santa Barbara. Cognitive Psychologist. Discussed her research into comprehension of graphics. Studied mental animation. Discussed her research on how people integrate information into text and graphics. Current work is in trying to apply what we've learned in order to design hypermedia manual. Developing prototype manual. Looking at which media are best for which types of information. Issue she is looking at includes: What order do you present info in. Free or guided interaction. Found that this is very dependent on individual differences.

Research Team presentations:

Dr. Narayanan, Auburn U and Georgia Tech. – Research into visual/diagrammatic reasoning; designing hyypermedia information presentation systems {work in 2 domains – machines and algorithms (concrete and abstract)};
Multimodal (gaze and speech) interaction and navigation in hypermedia information spaces.

Dr.Robert Moorhead/Dr.Sam Russ, U of Mississippi –
Working on Tools for Ocean Model Visualization (worked with scientists at NRL Stennis. Showed some images they've been able to model; color-wheel mapping technique, can go global and over-lay oceanographic and meteorological data. Discussed breaking simulation data into 4D "Tiles". Discussed need for multiple resolution data.

Dr. W. Wulfeck discussed IMAT training systems. Pre-deployment and at-sea training and mission support, IMAT
Sonar employment training, deployable sonar operation training/interactive mission assessment training (FY98-02),
Submarine training from school to operational real-time.

Mr. Stiles (Lockheed Martin) PM for ONR project called VRML. Demonstrated products of VRML.

Dr. D. Long – UC Santa Cruz – Discussed the REINAS project;
3 components to REINAS - Sensors, Dbase, Visualization to End User. Discussed current instrumentation and video instruments, configuration of instrument and database nodes, environmental visualization with REINAS. No downtime in last 2 years.

Dr. James Hofmann – NRL – works on Command and Control Decision-Making. Discussed applications they have explored - Sensor planning and power projection planning.
Working on development of a electromagnetic steering computation application.

Dr. Richard Alterman – Brandeis U. – Working on a project called Training a System. (working w/Sue Kirschenbaum at NUWC). Can assist in managing the interface on a system. Main domain/focus is computer-mediated group problem-solving and he provided a scenario utilizing this media.

Dr. Sandy Marshall, SDSU – Worked with TAOs and decision-making. How do they use knowledge they have to interact and make decisions. Using I-Track technique. Tracking officers with this system in conjunction with AEGIS CIC.

1555:

CDR Gunderson: Explained 4 working groups and some changes to personnel assigned thereto

Working group perspectives: USW and Strike Warfare
Look at perspective in two "slices". Develop specific recommendations for Short Term Goal and Long Term Goal.

Each group to look at diff. Pieces of the problem.
Production, collection, distribution, and QA.

Defined areas of concern.

Discussed Goal Development and group dynamics. Put boundaries on the problem. What are issues of interest.
Decide which issues are relevant to short or long term or both. Prioritize them. Take look at what doing now with the issues. Re-prioritize based on practical considerations of bang for buck. Articulate reasonable improvements based upon working group recommendations.

Delineated group facilitators and defined responsibilities.
Provided point paper format required in order to record issues, findings, and recommendations. Pt Papers become recommendation portion of the report that will be forwarded
to N096 for consideration for research funding.

Groups split up. To terminate at 1730. Reconvene at 0900, 8 May for discussion.

APPENDIX C

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APPENDIX D
RECOMMENDATIONS

8 May 1998

STANDARD FORMAT AND DATABASE

BACKGROUND

Dependency analysis shows that most potential improvement in the near and far term depends on standard format and databases. For example:

REINAS represents a quantum improvement in METOC data collection; distribution and processing made possible through a truly standard database.

DISCUSSION

1. There are some METOC standard formats like RTF, GRIB and BUFR METOC data base standards include TEDS, COTS flatfile, TDBMS with API's. The number of "standards" is high.

2. There are many essential elements in the data manipulation process, which are not standard including message formats, object formats, thin client operating systems.

RECOMMENDATION

1. Continue to improve TEDS data base and assign a high priority to the project

2. REINAS and TEDS projects coordinate and share lessons learned to mutual benefit

3. Develop potential of API's

4. Insure TEDS is compatible with all NAVY data standards

5. Explore advantages of object oriented approach

6. Develop strategy to choose or develop standard message format, object format, and thin client.

NECESSARY STEPS TO PROVIDE RAPID DESEMINATION OF QUALITY DATA

BACKGROUND

In order to provide quality data products, there are a number of tasks that must first be completed. These tasks can be arranged into a partial order where some may be done concurrently, while others have dependencies that will allow them to be done sequentially.

DISCUSSION

1. In order to provide briefings in a timely manner, it is necessary to have a better presentation tool. This tool could take the form of an intelligent template that would automatically include the latest observations and run models on demand.

2. A presentation tool will rely on interoperability of system components. Currently there is a large number of distinct components will poor interoperability. Interoperability would enhance system integration, but requires standard data and interchange formats. Examples of such interchange formats are CORBA, Java Beans and DCOM.

3. Central to enabling rapid dissemination of data products is having easy access to the data. Currently data is gathered from disparate sources in an ad hoc fashion, resulting in long delays. If this process were automated, a briefing should be able to be assembled in a matter of seconds using the intelligent templates. A database is the key component to providing easy and uniform data access.

4. The use of a database is an enabling technology that allows new technologies such as data mining. Data mining will allow new important information, such as local expertise, to be available. It will also allow thresholding and data fusion for use in decision support.

RECOMMENDATION

1. Determine the components necessary to providing the goal of rapid access to quality data.

2. Determine the dependencies between these components. Components with no dependencies can be begun immediately. Components with no interdependencies can be completed concurrently.

<<ATTACH FIGURE>>

USER FEEDBACK/ RECONSTRUCTION/ FORECAST VERIFICATION

BACKGROUND

The CV Strike requires detailed mesoscale (1-10 km, 2-8 hour) forecasts of cloud cover and thickness, precipitation, three-dimensional winds, turbulence and visibility. There is little documented user (pilot) feedback and verification of these forecasts available now.

DISCUSSION

1. Improvement in forecasting requires forecast verification and evaluation. A forecaster can not improve unless forecast errors are documented and reasons for poor forecasts are determined. The users of the CV Strike forecasts (pilots) can provide eyewitness recap or reconstruction of the target weather and related EO-EM ranges and local winds. This feedback is not collected now on an organized basis. Furthermore, there is no database available for these data to facilitate analysis of the forecasts and site observations. This database can guide forecast improvement, indicate areas of needed training for the OA division forecasters, suggest better models and data, and capture knowledge of local weather phenomena of tactical import.

RECOMMENDATION

1. Procedures to collect data on the accuracy of the CV Strike forecasts must be developed. One approach would be to include detailed meteorological feedback in the post-mission debriefs by the intelligence officers. Other valuable information is number of aborted missions due to unfavorable cloud, wind, visibility or other conditions. These data and forecast should be put into a database in order to evaluate and improve forecasts, enhance training, and describe local weather phenomena that critically influence the strike. This work could start initially with case studies and more detailed analysis from SHAREM exercises.

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CAPTURING LOCAL EXPERTISE

BACKGROUND

Capturing local expertise was a recurring theme for improvement during the workshop on interactive meteorology and oceanography (METOC) operations 07-08 May 1998 at NPMOF, San Diego, CA.

DISCUSSION

1. The CV STRIKE section working group chose “Feedback and Reconstruction” as a long term, highest priority recommendation for improvement. Capturing local expertise was listed as one of three key areas that should be improved under the “Feedback and Reconstruction” umbrella (the other two areas were “metrics” and “conceptual meso-scale models and training”)

RECOMMENDATION

1. Replace the current OA Division post deployment trip reports with the FOAM (Facts: Oceanographic and Meteorological) on-line system (a subset of TRMS OA Division Tracking System recently developed at NPMOF, San Diego).
2. Add MET post deployment reports to database of old trip reports that can be queried for specific topics real-time, on-line.
3. Make available climatology on-line from The National Data Collection Center, Asheville, N.C.
4. Make the data sources available to automate construction of STOIC are on-line.
5. Put all required OA DIV Pubs in on-line system (similar to DMARS?)
6. Include other Lessons Learned including any Gouge or Safety Issue, Model/database update, or Regional/Production Center update
7. Organize the use of CHAT for METOC collaboration.
8. Expand use of CHAT to include gridded fields/TDA discussion via white board

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ENVIRONMENTAL SENSOR PLANNING TOOL

BACKGROUND

1. The primary job of tactical METOC personnel is to explain the effect of the environment on operations.

2. To understand the effect on operations, METOC personnel must understand the environment. Understanding the Battlespace requires knowledge of what data is present, how reliable the available data is.

3. Currently, no means of making a rapid environment battlespace assessment exists.

4. Additionally, graphically displaying the effect on operations over a common operating picture (COP) is difficult.

DISCUSSION

0 Rapidly assessment of critical environmental data availability and reliability allows a forecaster to develop a forecast confidence factor. Applying an objective or subjective confidence factor to a forecast would enhance an operational commander’s decision on whether to commit assets.

1 Force METOC Officers need to have an objective means to rapidly demonstrate to themselves and to warfare commanders, the benefits and effects of deploying environmental sensors. As a result, sensors, such as bathythermographs (BT), are deployed based on “gut feel”. Linking available sensor performance with environmental data status would allow the development of an illustratable sensor deployment plan. Past instances of saturating choke points with BTs when additional sensors provided little value could be avoided.

2 Although COMQUAD, under development in NITES II, has the basic ability to look through several different databases, and display the result graphically over the COP, it does not assign a confidence or reliability factor over any part of the data. This is critical in that the resolution, reliability and availability will be different for different types of data. Examples include searching through bottom

type, bathymetry and slope records to determine the suitability of placing mines.

RECOMMENDATION

0 Develop reliability or confidence methods that can be assigned to databases.

1 Continue the development of tools that can access and operate on several different data fields and provide graphical output over the COP. Thresholds should be editable to support different scenarios and commanders.

2 Develop tactical decision aids (TDA) that can analyze available data and develop a sensor placement plan.

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DEVELOP METRICS

BACKGROUND

Investment decisions require information on the improved capability that a proposed system will deliver. For METOC systems, this information is available and routinely collected on forecast accuracy. However, METOC systems serve tactical operations customer, and what is needed is information on the value added by METOC information and products for the effective planning and execution of the tactical missions. In order to produce this information, metrics have to be defined which quantify the effectiveness and importance of the METOC information.

DISCUSSION

1. Currently, there is no systematic quantification of the effect of METOC information on either the planning or the execution of strike missions. Since strike planning is a team decision making process, typically governed by JFACC doctrine and CONOPS, metrics on the effectiveness of METOC information need to be developed within this context. A model of distributed planning developed under ONR funding may provide a framework for the development of these metrics. Work within the ARPA planning initiative that has addressed the assessment of a plan is also relevant. NAWCTD has developed methods of assessing team processes, which could be applied to the assessment of the involvement of METOC personnel in the development of the strike plan. The planning process itself (i.e., concurrent development of multiple strike plans in different phases) will complicate assessing the impact of METOC information.

2. The second type of metric falls within the general problem of evaluating C4ISR systems. Evaluation of these systems is expensive and challenging, but possible. For example, the ASCIET (All Sources Combat Identification Effectiveness Team) program developed a method of assessing the track inconsistencies on different systems during live exercises. 3. Through instrumentation and data analysis, they were able to overlay the track pictures from different systems within a couple hours of a live exercise. By showing these overlays to the exercise participants in an after action briefing, the program could get immediate assessment and analysis of the track ID problem and potential solutions. The Joint Command Warfare center is

also developing evaluation methods for C4ISR systems that may be relevant to the evaluation of METOC systems. After action briefs offer a source of information from which candidate metrics might be computed. However, these briefs are not conducted in a standard manner, the information is often not recorded, and the specific information needed to assess the impact of METOC information on the mission outcome is not always recorded. Current duties and responsibilities will preclude intensive involvement of METOC personnel in after action briefs.

RECOMMENDATION

1. Form a team to develop candidate metrics for strike planning and strike execution. This team should be composed of METOC personnel, experienced planning and strike execution personnel, and personnel expert in the evaluation of team processes and C4ISR systems.

2. Conduct a demonstration of the candidate metric.

PRESENTATION TOOLS

BACKGROUND

1. The primary goal of METOC operations in the CV Strike context is to provide timely and comprehensive weather related guidance to personnel involved in strike operations. Critical requirements of this briefing are:
   a. All relevant METOC information be provided
   b. There is no information overload
   c. Operational consequences of this information (e.g. recommendations such as weapons parameter setting) are clear
   d. Cause-effect relations between forecast and recommendation are understandable.

2. Some of these requirements conflict (e.g. 1 and 2, 2 and 4) current practice, in order to achieve 2, focuses mainly on 3 and is weak in 1 and 4.

DISCUSSION

1. Current METOC information presentation capabilities are limited to manually created power point text and graphics slides, GFMPL, JMV and other TDA’s.

2. Briefing products consist of a mixture of text slides and different kinds of graphics slides.

3. Text is not an appropriate medium for conveying large amounts of spatial information in a compact and comprehensive fashion.

4. Mixed media presents in current briefings can make it difficult for operation people to cognitively integrate all relevant information. There are dangers of confusion and omission.

5. A small set of carefully designed graphical presentation of forecast conditions and recommendations has the potential to improve the efficiency and effectiveness of METOC briefings.

RECOMMENDATION

1. Conduct basic research on effective graphical representations to convey METOC information and recommendations.

2. Apply results emerging from basic research to the design of a set of visualization templates that match METOC data/recommendation to different classes of customers and their tasks.

3. Build and deploy a presentation tool that utilizes these templates to generate effective briefings quickly

4. Investigate ways of making this tool automatically adapt the presentation it generates individual customers or tasks.

TRAINING

BACKGROUND

1. AG's analyze complex environmental phenomena from a combination of abstract data and visual observations. The task here both procedural and cognitive components. They must recognize "out-of-range" data and identify missing information in the performance of their job. The data they work with arrive from multiple sources and in dissimilar formats. Many of their products require that they first create a cognitive model of the environmental information prior to creating their end product for the user. Current A and C school training is largely text-based presentation of basic physical science materials. "Wash-backs" are common in schools, which lengthens the training pipeline. Once on-the-job, AG's use self-study and OJT to achieve the required skills. These include sophisticated computer software skills required to manipulate, manage, and present METOC products.

DISCUSSION

1. Inspectable physical models are becoming available and can make abstract environmental phenomena visible to support classroom-training objectives. School curriculum, to be effective must be focused solely on job performance and the enabling skills needed to achieve them. Sounds curriculum, supported by inspectable physical models and manipuable animations, will improve performance on abstract environmental concepts.

2. Instructor led computer supported training with self-paced practice and drill in the classroom can improve learning and make better use of limited instructor resources. Re-design of school curriculum to support classroom practice and drill will reduce student wash-back and improve on-job skills.

RECOMMENDATION

1. Revise A school to ensure all learning objectives support on-job tasks.

2. Integrate inspectable physical models and manipuable animations into curriculum.

3. Re-design "labs" as self-paced practice and drill within the context of the classroom.

4. Use instructor resources to introduce learning objective and to demonstrate initial tasks performance: thereafter, the instructor role is to monitor and assist students in self-paced computer supported labs.

USW Data Collection and Integration

BACKGROUND

The current database status does not support the warfighter’s needs.

DISCUSSION

1. Currently, afloat units do not automatically receive real-time METOC data collected by other assets, nor is there a mechanism for accessing the most updated historical data. This results in analysis inconsistencies between different end-users and less than accurate predictions. There is no mechanism to share the data in the local databases, or to establish requirements for current/future data collection.

2. There are USW databases currently available, for example, existing BT data, surface temperature, fronts/eddy messages, and historical/average ambient noise. These are not fused, integrated, up-to-date; and data are sparse in most areas.

3. Primary data are needed, such as salinity, ambient noise, sound velocity, bottom composition, optical properties and magnetics to support higher fidelity characterization of water space.

RECOMMENDATION

1. Short Term: USW data collected by all sources should be posted (e.g. on the WEB) so, when the need arises, data can be shared. Make “BT Extract” available through SIPRNET.

2. Long Term: Focus data collection to high priority areas.

3. Develop real-time automated and fused USW database and data retrieval/distribution system.

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USW Display

BACKGROUND

The current USW briefing tools are clumsy and time-consuming to use given the different levels of customer needs. Furthermore, they do not adequately convey assumptions and uncertainties.

DISCUSSION

1. High level “go-no-go” briefs have to be augmented with paper copies of charts and diagrams and are not interactive. 3-D graphics technology is available today and is believed to be a highly effective way to convey complex spatial interactions. However, there are no theoretical principles to guide the design of 3-D graphics.

RECOMMENDATION

1. Short Term: Improve the color graphics manipulation and exportability in the current USW systems to include hyperlinks too more detailed information.

2. Long Term: Conduct research on perception and comprehension of “quick-look” graphics that enable decision-makers to efficiently visualize the USW problem.

3. Develop interactive, 3-D visualization system with “what-if” capabilities.

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STANDARD ASSUMPTIONS

BACKGROUND

Although all analysis tools use the same Navy Standard Models, different assumptions produce different results. Currently there is no standardization of assumptions made by the various systems.

DISCUSSION

1. Currently, different analysis tools (GFMPL, ICAPS, SIMAS, etc.) are used by different members of the Battle Group. Each individual system has different default values for parameters such as recognition differential, target strength, ambient noise, etc.

2. It is critical that these basic assumptions are made readily apparent to the end user.

3. There is no communication between different users regarding assumptions that have been made. Therefore, different end-users using the same data and same models end up with different answers.

RECOMMENDATION

SHORT TERM

0 Log the assumptions that have been made.

1 Communicate assumptions among end-users.

LONG TERM

1. Conduct a sensitivity analysis in order to establish the relative importance of the estimated assumptions. Then use this information to develop standard assumptions.

2. Develop a common analysis tool for all end-users.

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TACTICAL PARAMETERS

BACKGROUND

The goal of the METOC forecast is to support the warfighter's mission. Therefore data collection and analysis should be guided and focused by the specific goals of the warfighter.

DISCUSSION

1. Different information is required to support different missions.

2. In order to optimize collection of real-time and insitu METOC information, a full understanding of current and projected operations is required to fully support the warfighter.

3. By fully understanding the tactical picture, the OA Division can focus their efforts more efficiently. This reduces the impact of the time accuracy trade-off.

4. Currently this is done informally at the discretion of the Staff/OA Division Officer and depends upon individual expertise.

RECOMMENDATION

LONG TERM

1. Study the decision process. Describe the links between the various types of missions and specific METOC data elements and then validate the links.

2. Create a computational cognitive model of the decision making process and use that to drive the development of an automated decision aid.

3. Develop a decision aid for the METOC Officer to assist in data collection and analysis decisions.

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VARIABLE PRODUCTION CENTER OUTPUT

BACKGROUND

Historically data has been available only at 12 hour intervals (00 and 12Z) from the primary production centers. Users have a requirement to produce mission forecasts at times that rarely coincide with these base times. The forecaster is therefore required to interpolate between available data sets to produce a forecast, which results in unnecessary work because the data is available at the production center but not to the filed forecaster.

DISCUSSION

1. Forecasters need the ability to select data sets to meet varying requirements. This requires that data be made available at alternate times and in various resolutions. For example, if a user needs to support a mission brief for a 1700 strike time, the user should have the ability to request and receive data sets at hourly intervals from 1600-2000 or some other specified interval. Additionally, a low-resolution geostationary satellite image with the ability to superimpose a high resolution polar swath depicting special sensor data sets for a specific mission and area. In order to preserve bandwidth, control must be placed on amount of data and frequency of the request.

2. Presently forecasters in the field are required to make lower quality interpolations to support mission planning of values for which higher density data is available at the production center. This is a source of unnecessary work under time critical conditions and a potential source of serious error.

RECOMMENDATION

1. Provide user-defined data sets at user-requested times and intervals.

2. Provide variable resolution tiles (production-defined regions) to meet user requirements (i.e. high to low resolution data).

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INTEGRATED PRODUCTION CENTER DATA SETS

BACKGROUND

The user requires and uses data from numerous production centers. Currently, data is only routinely available from FNMOC and NAVOCEANO.

DISCUSSION

1. Multiple data sets are required to provide the forecaster with the ability to create quality product blends and to assess environmental conditions throughout the world. This is done through the compilation and assimilation of various types of data to create a mental four-dimensional perspective of the atmosphere. Often time's one model may handle a feature better than another may. These performance characteristics are well known and documented through local rules of thumb. For example, lee side troughing, filling of dynamic low-pressure systems, system movement, rapid cyclogenesis, etc.

RECOMMENDATION

1. Study the process of "blending" progs at smart centers to identify opportunities to automate the process (get away from paper and pencil prog blends).

2. Centrally locate and distribute data sets from the national and international METOC production centers at a site to facilitate distribution and access.

3. Develop a display and visualization toolkit that will co-register data sets from the various national and international METOC production centers.

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VISUALIZATION FOR DATA SELECTION

BACKGROUND

Users currently are restricted to retrieve METOC data stored by arbitrarily defined regions at standard pressure levels, parameters, and 12 hour time intervals. The exact region of interest may be dependent on the data content (regions of interesting or dynamic weather, areas of operations, etc.) Downloading more than the essential data/information unnecessarily consumes valuable bandwidth and production time.

DISCUSSION

1. Without an overview of the data, it is difficult for the user to determine minimum essential data needs, thus the user over collects data/information to ensure that everything that could possibly be needed is available. A low-resolution overview would help the user focus their data/information requirements, making the downloading, local sorting and managing of data more efficient for production of tactical support products. Currently fielded visualization tools are limited to two-dimensional, plan view of traditional METOC products. Sophisticated users with personal computers possess the hardware required to render data/information in “non-traditional” ways.

RECOMMENDATION

1. Develop a method to perform a low bandwidth data overview of production center data.

2. Develop non-traditional 3-dimensional visualization methods that focus on operationally relevant, sensible weather parameters.

3. Investigate pre-packaging METOC information into mission specific sets to support user requirements.

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ANALYZE WEBSITE STATISTICS FOR OPTIMIZATION

BACKGROUND

Web sites have become the primary methods of cataloging and distributing Production Center and Smart Center METOC data/information. Limited data is being collected to optimize the design of the site so that the sites can be optimized for customers. Commercial and research software is becoming available to assist with metrics and understanding of what products are of most use to the customer.

DISCUSSION

1. A wealth of information regarding who uses various nodes of the web site, what information is being viewed, the path users follow to retrieve information, frequency of retrieval, peak periods of retrieval, etc. would be of value in determining resource allocation to support the web. Information gained through metrics can be used to focus on product generation, product quality, usability, etc. thereby enhancing customer support. Many organizations are doing data mining on their web statistics to derive future capabilities and use.

RECOMMENDATION

1. Implement metric analysis programs to improve customer support, product operational effectiveness (marketing) and new product development or offerings.

2. Include product-sizing information as part of the web catalogue.

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CLIMATOLOGY

BACKGROUND

Climatology data is of great value for planning operations and learning about the weather in a broad sense. User access to climatology is limited to CD ROMs with relatively restricted interaction allowed. Vast amounts of climatological data is available at the National Climactic Data Center (USN and USAF Centers are co-located), however their production process takes on the order of weeks and delivery is on CD. The NCDC and Service climatology centers should be viewed as production centers and funded to be responsive on similar time scales as FNMOC and NAVOCEANO.

DISCUSSION

1. Climatology is widely used as the basis for METOC planning of support of military operations. Direct user access to the vast amount of data stored at the NCDC is not supported. General user requirements for a region and time period are provided to FNMOD Asheville; FNMOD personnel then access the data sources and generate a suite of products on a CD ROM, that is then shipped to the requesting organization. There is a significant amount of work performed by METOC personnel to tailor the climatology to naval operations. Climatology outputs are strictly in traditional METOC formats (plan view, standard pressure levels, etc.) The formats do not facilitate extraction for entry into tactical decision aids. The data formats do not typically support direct entry into military briefings, and they must be re-formatted for utility. Funding for FNMOD Asheville has been significantly reduced over the past several years, reducing the development of new types of products to support evolving requirements.

RECOMMENDATION

1. Initiate development of applications that allow direct user access to on-line climactic databases.

2. Modify climactic data output formats to support direct input to, and interoperability with, Tactical Decision Aids.

3. Provide flexibility in climatology information output formats that allow the information to be rendered in several formats that will be useful to non-METOC personnel.

TRAINING, MANAGING, AND OPERATING THE SMARTCENTER

BACKGROUND

At the 1998 Interactive METOC Workshop, a working group consisting of researchers and SMARTCENTER personnel were tasked to address technological improvements that can be made at the METOC regional centers. This group identified the fundamental, over-arching goal as the attainment of seamless information flow among production centers, regional centers (SMARTCEN), and customers.

DISCUSSION

1. Over the next 10 years, the METOC community will continue to see an increasing amount of available information, an increasing demand for diverse METOC products and a decreasing amount of time to provide that product to their customers.

2. To attain this goal it is imperative that the SMARTCENTER:

a. Optimize the processes that we use to manage information and deliver products (imagery, maps, charts, text, video, animation, etc.), based on customer problems and constraints.
b. Develop and optimize processes for collaboration between customers and SMARTCENTER.
c. Evaluate training at both ends of the pipeline.

RECOMMENDATION

1. Develop on-site simulation of a shipboard METOC office to provide an interactive environment to simulate customer resources, requirements and constraints.

2. Conduct a cognitive, operational task analysis that is not a traditional Efficiency Review

a. It needs to be an on-site, day-to-day study.
b. It should include site visits and studies of other, existing regional centers.
c. It should identify inefficiencies, recommended improvements, develop mechanisms for feedback and continued improvement, lessons learned, etc.

3. Develop integrated training procedures for operators of SMARTCENTER, as well as shipboard METOC personnel. These products should address both initial and follow-on training.

LEVERAGING TECHNOLOGY WITHIN THE SMARTCENTER

BACKGROUND

As part of the 1998 Interactive METOC conference, a working group consisting of researchers, operators and SMARTCENTER personnel were tasked to address technological improvements that can be made at the METOC regional centers.

DISCUSSION

SMARTCENTER San Diego is currently a leading-edge facility that provides technological leadership for other regional centers. A key aspect of the SMARTCENTER is that it utilizes available technology from commercial sources as well as government-funded research, and it provides a testbed for experimenting with and evaluating new products. This approach has been extremely successful and has impacted operations at regional centers across the world. In order to maintain this technological edge as the SMARTCENTER transitions to a full-fledged regional center, focus on high-payoff technology areas is warranted.

RECOMMENDATION

1. Upgrade and develop web-management tools to maintain the quality and efficiency of the SMARTCENTER's web site;

    a. Create better tools for browsing, packaging, and making sense of web-based METOC information;
    b. Develop a framework for organizing, cataloging, and establishing confidence levels of web-linked information used by the SMARTCENTER.

2. Optimize use of bandwidth

    a. Develop intelligent pre-staging caching; (i.e., smooth out peaks and valleys of data transmission by automatically staging information transmission)
    b. Explore alternative data formats for more efficient data transmission;

3. Develop tools that will provide collaboration among tactical decision makers and information providers

    a. Combines web-based and chat technologies;
    b. Investigate ways to facilitate the transmission of

information from the decision makers to the SMARTCENTER so that
SMARTCEN information provided to them is maximally useful.

METHODS AND INTEROPERABILITY

BACKGROUND

OA centers must use several incompatible tools to process data in order to prepare briefing support planning efforts, and support mission. They run separate analysis packages, enter data by hand and manually combine the results into briefings. The entire process typically takes 8-12 hours.

Ways to automate this process improve turnaround time, and reduce workload can offer significant process improvements.

DISCUSSION

1. COTS software products already support methods of interconnecting apllications. They can integrate legacy application by using interface "wrappers" and provide API's for development of new applications.
2. OA crew can typically decompose a tactical situation into analysis requirements relatively easily.
3. By starting from the "end goal" a presentation of a forecast or nowcast to interested parties - OA–crew can construct a "smart template" of a briefing, indicating places where data need to be obtained and/or analysis performed.
4. This template represents a list of tasks- databases queries, processing steps, data requests- that can be executed. This execution process can be completely automated as the data and analysis packages are known.
5. As underlying data changes (for example, as new forecast products arrive) the data in the briefing packages can be updated rapidly and automatically.
6. Some data templates may dictate the need for specialized products and/or analyses from smart centers and production centers. There is a consequent need for these centers to move from providing data on demand to providing services on demand in support of operations. The software infrastructure to support this concept can be based on COTS technologies. An example is a new mesoscale model run driven by fleet movements.
7. One "end goal" of this is the creation (and modification) of tools with a much higher degree of compatibility and interoperability, permitting data overlay, data fusion, sophisticated querying, and tighter coupling of execution.
8. This notion of smart templates derived from tactical situations and requirements naturally leads tot he concept of intelligently deriving templates from tactical needs.

Recommendations

Near Term

1. Perform ongoing exploration and exploitation of COTS integration technologies.

2. Develop prototype heterogeneous execution environments capable of starting from a template, acquiring needed data, running necessary analyses as data arrives, and dispatching execution of remote services.
3. Develop software infrastructure to overlay updated and disparate data sources into standard presentation formats.
4. Develop software infrastructure to dispatch execution of remote services of production centers/smart center, monitor progress, and obtain results.

Far Term

1. Explore ways to develop more interoperable software, and establish interoperability goals. These goals should be from the perspective of the end-user.
2. Explore ways to automatically decompose missions and mission planning into data and analysis dependencies.