



## JOINT METOC REPOSITORY -- THE FRAMEWORK

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The Natural Battlespace Environment [NBE] impacts the entire spectrum of military operations. To achieve Information Superiority envisioned in *Joint Vision 2010* and the Services' attendant visions, the DoD is automating the sense-detect-decide-engage process (i.e., Command & Control, Intel, Reconnaissance, and Surveillance [C2ISR]). Without full integration of the awareness of the NBE and the decision-support tools necessary to take advantage of that awareness into those automating processes, our Joint Vision will be more like 20/40.

Most C2ISR development programs have indeed recognized this and consequently have specified significant Military METOC support integration requirements. Unfortunately, they quickly discover that Military METOC C2 functionality is quite far behind state-of-the-art and decide that the risks (i.e., costs) are too high for any one of them to take on. For Military METOC to ever fulfill its true potential, a DII COE repository of software components that C2ISR requires is desperately needed.

This repository, dubbed the *Joint METOC Repository (JMR)*, would be made up of three components: The **Joint METOC Database**, the **Military Ops METOC Knowledgebase**, and the **Joint METOC Exploitation Segment (JMES)**. Much of what is needed is being developed by many different organizations, but they are not available in coherent package that C2 developers can use. JMR as a framework would bring all the work together into a coherent, synergistic enterprise, and provide a ready-made transition conduit to future efforts. This paper discusses some of the issues involved and fleshes the framework out.

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## Introduction

The Natural Battlespace Environment [NBE] (i.e., the "weather" from the depths of the oceans to the depths of the sun) can adversely impact the entire spectrum of military operations. This declaration is well documented and well accepted. It follows then that the NBE will be adversely impacting all four Joint Vision 2010 operational constructs: *Dominant Maneuver*; *Precision Engagement*; *Full Dimensional Protection*; and *Focused Logistics*. It will also be adversely impacting the overarching enabler: *Information Superiority*. Hence, it is imperative to the success of Joint Vision 2010 that awareness of

the NBE and its impact on operations be fully incorporated within military decision-making processes.

How we get that awareness incorporated is the subject of this paper. In our current fiscal environment, making progress has been extremely difficult. Current trends in the pursuit of Information Superiority, however, do point to a solution. The issues involved leading to such a conclusion and the framework that solution should take are discussed here within.

## Issues

It may be well accepted that the NBE adversely effects military operations, but what can we do about it?

Military METOC is the professional corps that provides information necessary for military operatives to avoid the adverse conditions our forces can not operate in and to exploit the conditions that we can operate in but our adversaries can not; “*to choose the weather for battle.*” This Corps’ abilities are also well documented and well accepted, but whether their forecasts are good enough to base planning decisions on is highly debated within the C<sup>2</sup> Warrior community; as was demonstrated in the planning activities during Kosovo air operations where planners attempted but failed to use the forecasts in their decision-making. However, the accuracy of forecasts may not be the culprit. It may be how decision-makers use them.

The Command & Control, Intelligence, Surveillance, and Reconnaissance (C2ISR) Enterprise consists of EVERYTHING needed to provide Information Superiority, including a professional corps of C<sup>2</sup> Warriors. It is the comprehensive, integrated system of systems, from sensors to decision-makers to shooters (Sense, Detect, Decide, Engage), that will achieve the Information Superiority that JV2010 envisions.

In this quest, the DoD is automating as much of the C2ISR Enterprise as possible. It is important to note that the C2ISR community is automating the decision-making processes, not the decisions. No one yet trusts computers and software to MAKE the decisions. Operators want “decision-support” tools that present the data, information, and knowledge in a concise, coherent, and user-friendly way. They have been consistently emphatic that they be made aware of the facts and be given the means to quickly enter their decisions. Awareness can automatically pop up, options generated, and decisions automatically disseminated, but the decisions themselves must be made by humans in the loop.

Without full integration of the awareness of the Natural Battlespace Environment (NBE) and the decision-support tools necessary to take advantage of that awareness within these automated, decision-support systems, the humans in the loop will not be able to exploit what Military METOC has to offer. Consequently, many of our future military operations will be foiled by the adverse NBE conditions within their operational environments.

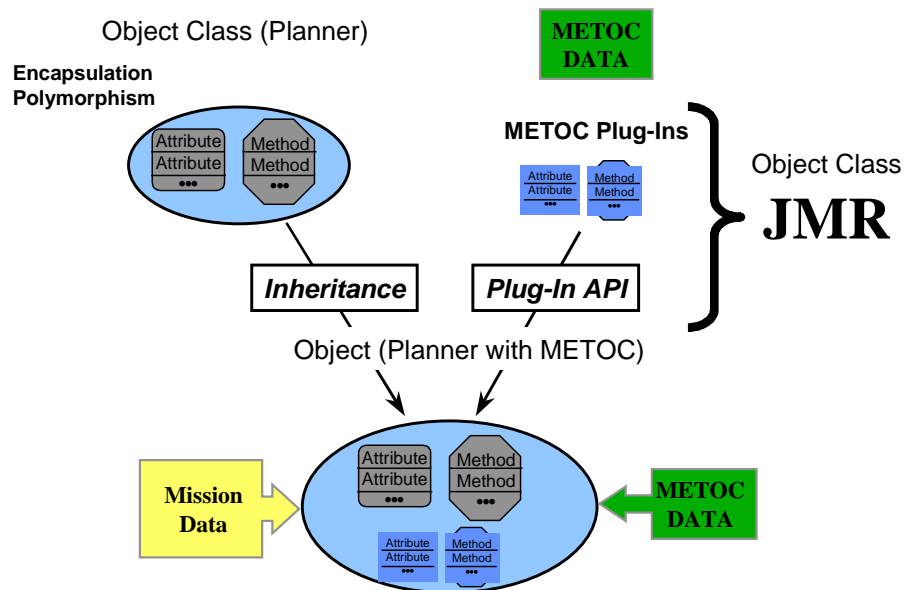
Most C2ISR development programs have indeed recognized this and consequently have specified significant Military METOC support integration requirements. Unfortunately,

they quickly discover that Military METOC automation is quite far behind state-of-the-art and decide that the risks (i.e., costs) are too high for any one of them to take it on. Or worse, they assume that Military METOC support automation is sitting on a shelf ready to be incorporated, only to find later that the shelf is filled with things they can't use. Since they did not make plans to work the issue, they end up with no means of getting the required functionality. Military METOC is left high and dry.

For Military METOC to successfully participate in the automating C2ISR Enterprise, automation developers must be provided a DII COE repository of software components and a supporting Software Developers' Toolkit. In this way, developers may plug to play any or all Military METOC support capabilities without spending much of their own program funds.

## The Joint METOC Repository (JMR):

The dictionary definition of a repository is a “*place where things may be put for safekeeping.*”<sup>1</sup> In the computer world it has come to mean an officially validated, verified, and accredited, coherent, comprehensive collection of the objects (software and data) needed to fulfill a function. It is the toolkit or toolbox, classes/methods (i.e., library), and data necessary to be part of the automated decision-making process (Figure 1).

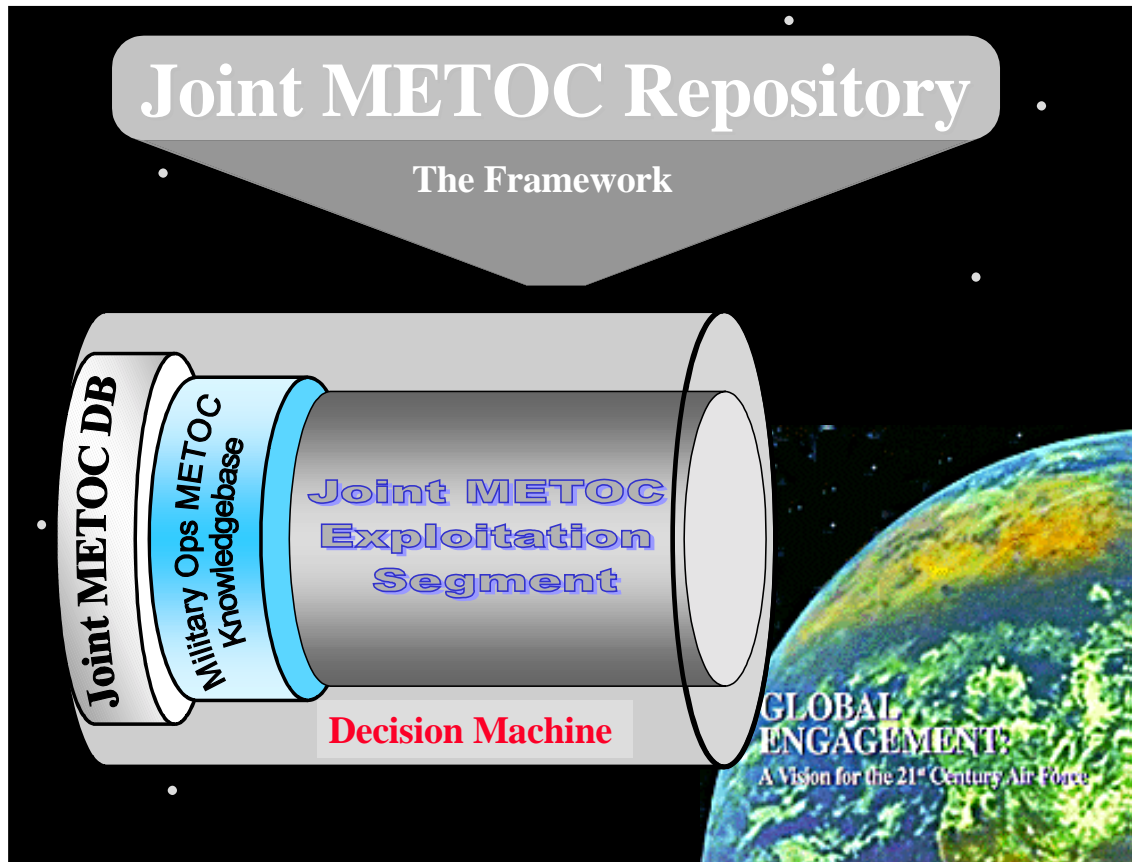


**Figure 1: JMR as Plug-n-Play Objects**

<sup>1</sup>The American Heritage® Dictionary of the English Language, 1992

The Military METOC repository, dubbed the *Joint METOC Repository (JMR)*, should be categorized into three components:

- The Joint METOC Database (JMDB)
- The Military Ops METOC Knowledgebase (MoMK)
- The Joint METOC Exploitation Segment (JMES)



**Figure 2: Taxonomy of the JMR**

As depicted in Figure 2, the components are part of the overall C2 infrastructure, each part imbedded deeper than the next. Each of these components is detailed below, going from outside in.

### **The Joint METOC Database (JMDB):**

The JMDB is already a well established concept. It is a driving factor in the current draft of the Joint METOC Architecture.<sup>2</sup> JP 3-59 does not specifically mention a joint METOC database, but it expounds on the need for unity of effort:

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<sup>2</sup> Joint METOC Architecture, Draft 12 June 1998

**Unity of Effort.** METOC information that influences a JFC’s decision usually cannot be derived from a single source. Instead, METOC data from the MFC [METOC Forecasting Center], component, and tactical sources should be assembled into a data base that contains a complete and integrated summary of [... NBE] conditions of interest to the JFC and all component commanders. This will simplify access and ensure consistency of data used by multiple forecast activities. Within a joint force, there must be unity of effort to ensure the METOC database is complete, up-to-date, consistent, and accurate.<sup>3</sup>

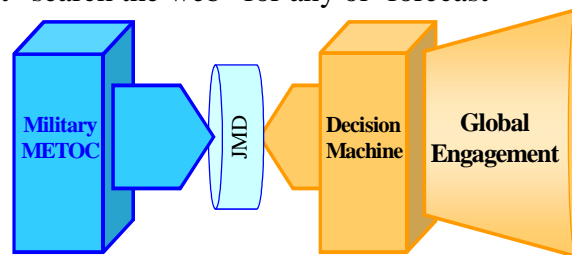
This process is universally regarded in the METOC community as supporting a “**one theater, one forecast**” concept<sup>4</sup>.

Joint Publication 3-59 states that this unified database, the JMDB, will be populated by data sources designated by the Senior METOC Officer (SMO), which will vary depending on the mission and location of the Joint Task Force (JTF). The Joint METOC Officer (JMO), in coordination with the SMO, will promulgate Area of Operations data collection and dissemination plans. It also states explicitly that the Joint METOC Forecasting Unit (JMFU) must be the entity populating this database<sup>5</sup>. Who, what, and where the JMFU is, is decided by the SMO.

The JMDB must be a database containing all of the data needed to completely specify the state of the NBE within any given theater of operations. In accordance with DoD policy, the elements in the JMDB must conform to the DISA METOC Data Dictionary<sup>6</sup>. All formats (Gridded, imagery, vector, raster, alphanumeric); All environments (Ocean, Tropospheric, Ionospheric, and Space); and all time frames (historical, current, forecast, and climatological) must be represented. If a decision-maker needs it, it must be in the JMDB.

How the JMDB is populated has been decided by the Services but there are still issues to work out. Whether there will be one JMDB that everyone reaches into or whether there is a master in the JMFU and synchronized copies at the respective C2 nodes is a significant CONOPS issue that needs to be resolved.

As Figure 3 shows, the JMDB is THE link between the Military METOC enterprise and the decision-making parts of the C2ISR Enterprise. If decision-makers want to learn what the status of the NBE is, their applications MUST go to the JMDB. Doctrine and Joint Publications state that they may not “search the web” for any ol’ forecast they want. Indeed, as the JMR successfully pervades the military decision-makers’ decision-support systems, it will become paramount to successful command that all decision-makers, at all echelons, support their decisions with an identical forecast.



**Figure 3: JMDB is THE Link**

<sup>3</sup> JP 3-59, Chapter 3 2.d., p. 22

<sup>4</sup> JP 3-59, p 7.

<sup>5</sup> JP 3-59, Chapter 4 5., p. IV-11

<sup>6</sup>DoD Directive 8320.1-DoD Data Administration, 1991

For C2ISR automation development programs to use the JMDB, the JMDB system must provide these developers Application Programming Interfaces (APIs). The Military METOC community can not depend on any given C2ISR system developer to build the means of getting the data from the JMDB and decoding it, nor should it. It must ensure that the necessary APIs are built, validated, verified, and readily available. Well documented JMDB APIs should be provided to developers as part of the JMR Software Developer's Toolkit.

So the JMR Software Developer's Toolkit would contain the following:

1. Well-documented JMDB schema
2. Well-documented APIs ready to insert into developer's code
3. Access to an operational JMDB holding canned data that developers may use to test their code

The Navy's Tactical Environmental Data Server (TEDS) is a first instantiation of what is needed. There is of course room for enhancements and maturation of the APIs into the JMT, but it is by far the closest thing in existence to a JMDB Server. To work within JMR, SPAWAR would need to populate the JMDB part of the Software Developer's Toolkit.

## **The Military Ops METOC Knowledgebase (MoMK):**

As C2ISR automation advances at mach speed, "decision-support" applications are increasingly becoming comprehensive expert systems. The definition of an expert system is, "*A program that uses available information, heuristics, and inference to suggest solutions to problems in a particular discipline.*"<sup>7</sup> It automates the application of knowledge. Expert systems, or at least the knowledge within them, that are embedded within a decision-support system are knowledgebases. A knowledgebase is simply a database of knowledge in a format that inference engines may use.

For Military METOC to participate in future developments, it must have a database of Military METOC knowledge at the ready. This knowledgebase is presently dubbed the Military Operations METOC Knowledgebase (MoMK). "Military ops" is used to reverberate full spectrum dominance. "Joint" is left out to add variety. However, leaving it out should not imply that it is not joint. Since the MoMK will be supporting Joint Task Forces, it must be Joint.

The MoMK would contain two categories of knowledge:

- How to analyze and forecast the NBE, especially in remote areas
- How the NBE impacts military operations and what can be done about it

The first category is an automated collection of domain experience. It is the rules of thumb, regional forecast notes, case studies, model strengths/weaknesses, standard operating procedures, guidance, policies, regional climatologies, and any other domain knowledge deemed pertinent. It is all in a format that is easily manipulated and searched.

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<sup>7</sup>*The American Heritage® Dictionary of the English Language, 1992*

Most of this data is for browsing but some of it is for supporting inference engines and imbedded expert systems. Exploitation of this knowledge would be realized using Joint METOC Exploitation Segments as described in the JMES section below.

The second MoMK category must be more than just thresholds. It must be a comprehensive, consolidated database of thresholds, rules for operating, rules of engagement, and procedures used to manage workflow. It is how the computer knows what to do, how to do it, and when it needs to be done. Even if developers are slow to exploit the strengths of knowledgebase technologies, the Military METOC community still needs such a well-documented database now, to advise the C2ISR development community on the whats, hows, and whens of incorporating Military METOC support within military decision-making processes.

The MoMK needs to be comprehensive. It must include the thresholds, rules, procedures, and workflows for ALL players (JOINT, COMBINED, Coalition, and Adversaries), and ALL Functions (Counter air, Strike, Airlift, SOF, TEL mobility, space lift, air lift, etc.). The contents of the knowledgebase would define how all of these relate. If there are holes in the knowledgebase, there will be holes in automated support.

Whether this knowledgebase should be classified or not is a contentious issue. Current practice publishes Joint Force thresholds in public documents. Some, including the author, believe that if exploiting the NBE is as much of a force multiplier as they claim, then operating thresholds should be critical enough to classify SECRET. When the community successfully compiles the comprehensive list of thresholds into a knowledgebase, it will be a large collection of essential elements of friendly information and should be classified SECRET.

Adversarial thresholds are SECRET and above to protect the sources, not to hide what we know. Since our sources for Joint Force thresholds do not need protection, it follows that we do not need to classify our thresholds. The problem with that reasoning is that if we are going to truly exploit the NBE by operating where we can but our adversaries can not, it is paramount to successful operations that the “weather deltas” be classified SECRET. The only way we can do that is to classify everybody’s thresholds.

As if that were not enough, we also have a problem when working within coalitions. Some coalition partners’ thresholds are unclassified and others classified. Partners are allowed to see some partners’ thresholds but not others. Many of our Allies wish to keep their true thresholds classified. The MoMK needs multi-level security capabilities just as the rest of the C2ISR Enterprise does. Unless we maintain a classified MoMK, Military METOC is not going to get all of the thresholds it needs to support all that it needs to support. How is Military METOC going to handle this?

The Joint community needs an official process to collect and maintain the MoMK. There needs to be a robust Verification, Validation, and Accreditation (VV&A) Process. Unity of command dictates that there be only one person in charge of the MoMK. That person should obviously be in Joint Forces Command. Whether we decide to go with unity of effort or shoot for unity of command, OPRs in each Service need to be officially appointed to participate in the VV&A process. Collectors of the data and approvers of what goes into the MoMK must be appointed. VV&A needs to be part of their specific job descriptions. Without such an officially sanctioned process, the MoMK will never attain

the currentness and level of knowledge it needs to reach to successfully add value to the automated military decision-making process.

Who maintains the MoMK is a major CONOPS issue that must be resolved. Should there be one, universal MoMK or separate instantiations for each CINC? Should it be an office at Joint Forces Command? The SMOs? Should the JMOs at each individual JTF be allowed to keep their own versions? Should it be managed by the METOC, Intel, or Ops community? Configuration Management is critical to successful operations.

How the MoMK is maintained during military operations may or may not be a separate issue. Consider the following example: During the planning of an air battle, cross-winds at a given airfield are forecast to be beyond the classified war-time limits of the F-22. A decision-support application shows red. The JFACC decides to adjust the local MoMK to reflect a higher limit and thereby changes the flag to green; okay, maybe yellow. The mission is allowed to proceed. As time progresses, the National Command staff notices on their Common Operational Picture that the JFACC is about to execute a mission that is red for weather. Although their system is using the same forecast via the JMDB, their MoMK was not changed to reflect the newly established threshold. They have a spasm, abort the mission, and realize later what happened.

The CONOPS for maintaining the MoMK during operations must include a procedure for changing thresholds and having it percolate throughout the C2ISR Enterprise. With improvements in C2 automation and envisioned seamless command and control, we will not be able to function if rule sets are allowed to diverge. If a rule or threshold is changed at one C2 node, it must be changed simultaneously at every node that is participating in the operation. Thresholds should also not be allowed to change on a whim. There must be an official, robust way of getting it changed. A specific crew position in the C2ISR Enterprise must be given the authority and responsibility to make the changes. The automation can and should allow duty officers wishing to make a change, to submit a request and have it automatically go to the approving authority. The requestor would get a response back and, if it was approved, would see the change take effect. How high up do we need to put the approval authority? Would the request have to go through command channels? How fast does the response have to be? Priority? User defined? A METOC person? A Senior Duty Officer? There are a lot of CONOPS questions to tackle.

How ever it is handled, having an operational MoMK is imperative to state-of-the-art computer-assisted operations and training, especially the virtual, distributed training that is envisioned. The Military METOC community must start compiling the knowledge now to have any hope of being ready when the C2ISR Enterprise is ready for it. Although the MoMK needs to be more than just thresholds, the Integrated Weather Effects Decision Aid (IWEDA) and its compliment, the Joint Thresholding Segment (JTS), could be the first instantiation of this component of the JMR.

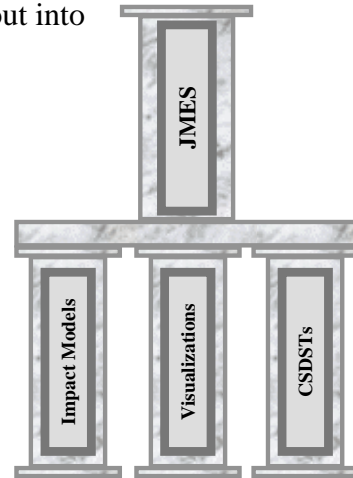
## **The Joint METOC Exploitation Segment (JMES):**

The Joint METOC Exploitation Segment (JMES) contains the objects necessary for the DII COE to harness the power of Military METOC support. JMES is the rubber meeting

the road; the pointy end of the METOC spear. It is the cog needed to mesh the C2ISR decision-support machine and Military METOC. Without this cog, Military METOC is a HMMWV without the “W”. Looks cool, won’t get anywhere.

To facilitate discussion and understanding, JMES is broken out into three categories, but there is a fine line between them:

- **Visualizations**
- **Impact Models**
- **Context-sensitive Decision-support Tools (CSDST)**



Obviously, without visualizations, humans would have no idea what is going on inside a computer. Visualizations are the data within the computer presented in a format that humans can understand. A line of text, tables of numbers, and 4-dimensional virtual reality displays are all visualizations. The trick is presenting the data in a format that humans can quickly browse to find what they need, and understand it without having to study it. A visualization of clouds as a table of numbers will not do; imagery overlaying a map is much better.

Impact Models crunch the data into smaller packages that humans can more easily digest, and are necessary to inform decision-makers of effects that will affect what they are trying to do. A visualization of cloud imagery is usually not enough. How do those clouds impact what is going on? An impact model is necessary to provide that type of information.

Providing useful visualizations of data and impacts will quickly overtax the decision-maker. The more C2 automates, the less time decision-makers will have to comb through piles of "information" to find the bits they need to make the best decisions. To keep from over-saturating decision-makers, decision-support systems must present only the information that is applicable to a specific decision. The support the computer provides must be sensitive to the context in which the decision-maker is working. Consequently, JMES must provide Context Sensitive Decision Support Tools (CSDS Tools) to the automation developer.

### ***An Important Consideration***

It is important enough to digress here to emphasize an important point. There is a difference between integration and incorporation. Consider the quick analogy: A vacuum cleaner is integrated into a house by the common interface of polarized plug and outlet, interface of sweeper and standard floorings, and the fact that it fits through doors. A central vacuum system is incorporated. Eye glasses are integrated on a human face; contacts are incorporated. Systems have to be integrated; decision-support has to be incorporated. Web pages are integrated; CSDSTs as part and parcel of decision-support applications are incorporated.

Integrated decision-support will not stand up to the rigors of future military operations using the highly automated decision-support systems on the horizon. Successful information exploitation demands that advice be part and parcel of the decision-making process; it must be incorporated. Decision-makers will not have the time to leave decision-support applications to use a web browser to scan 64,000 products and then return to their application. Advice must be incorporated within their decision-support applications and in ways that may be understood quickly and without overwhelming the decision maker. If the knowledge is not incorporated within their automated decision-support systems, military decision-makers will not be able to effectively exploit it. If they can't use it, there is no point in having it.

### ***METOC Visualizations:***

Modules/classes are necessary to display the huge amount of METOC information that decision-makers need; do it in a timely manner; and incorporate it within decision-support applications.

There is much work in this area to leverage. However, there is no coherent effort to define specific user needs and no coherent effort to transition capabilities into C2 systems. The C2ISR community must document user needs/desires; identify existing capabilities that match needs, make DII COE modules out of them, install them within JMR, and support R&D to fill gaps. A repository like JMR will be able to orchestrate the complicated process of making these capabilities available and useable.

Automation developers, using the JMR Software Developer's Toolkit, will be able to plug-n-play any of the METOC visualizations available. If specific needs are not addressed in the JMR, developers contact the JMR Program Office who, given the funding, would in turn launch coherent, concerted development activity to meet the need.

### ***METOC-Impact Models:***

Modules/classes are necessary to convert METOC data into information that military decision-makers can use to deduce the impact the NBE has on what they are trying to accomplish. A Military METOC tenet should be, "Provide impact not data."

There are many computer models that determine impact of the NBE on military operations. Indeed they are too numerous to list. The problem is that most are locked within their own user-interfaces and processing applications. Most have been necessarily made stand alone. Consequently, re-using code is difficult if not impossible, and as a result, incorporating the output of impact models into military decision-support applications has been overwhelmingly difficult and under current fiscal constraints, impossible.

To be used successfully, impact models need to be validated, verified, segmented, documented, and installed within the JMR. Once part of the JMR Software Developer's Toolkit, the different modules may be strung together to compute impacts that developers need to have computed. As researchers find better ways to compute the different pieces parts, the JMR Program Office will be able to simply swap them in. For

example, once someone builds faster MODTRAN modules, we can swap out the transmissivity model module that is currently in TAWS and a host of other systems.

Because the impact models will be part of the well-documented JMR Toolkit, Program Offices will be able to readily see what Military METOC support is available and will consequently have a greater sense of what to ask for.

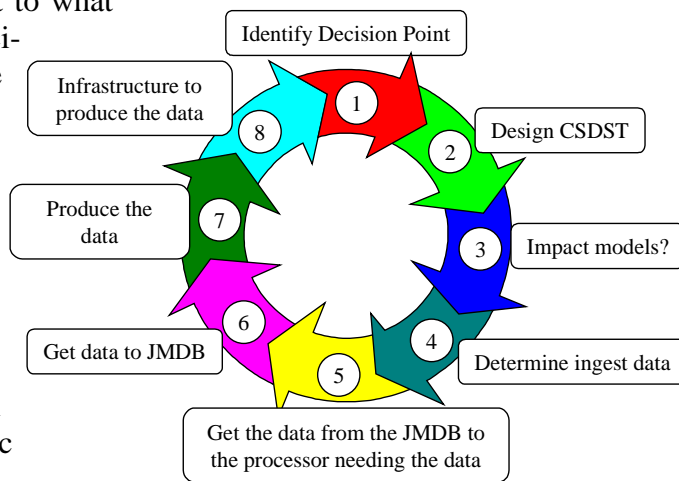
***Context-Sensitive Decision-Support Tools:***

The mission of the entire Military METOC Enterprise is to support military decisions - - to add value - - and do it without bogging the decision-makers down or overwhelming them with data. Hence, decision-support tools must be in a format that military decision-makers can use quickly to make intelligent decisions. They must supply only information sensitive to the context of the decision at hand; and be incorporated within the decision-making process so they do not waste their precious time trying to get at it or find it.

Therefore, the Military METOC community needs to supply C2 developers with Context-sensitive Decision-support Tool (CSDST) modules, so that they may readily INCORPORATE them within their automated decision-support systems.

CSDSTs can be anything from an automated email message; to a window of radar imagery overlaid on a user’s common map that they may adjust in perspective, altitude, or time; to a complicated 4-D rendering of the solution/constraint space. CSDSTs will need to prompt or cue decision-makers to problems - How else will they know what they don’t know? Once alerted, decision-makers need the tools to base decisions on and enter/submit their decisions. Decision-support tools present solution-space and/or constraint-space and the means to click-2-pick desired answers/taskings/plans.

To determine what CSDSTs are needed , the Military METOC community needs to work backwards from the decision point to what is needed to add value to that decision. As depicted in Figure 4, the first step is to identify decisions that could benefit from Military METOC support. Then build the Decision-Support Tool objects to support those decisions, all the while being sensitive to the context in which those decisions are being made. Developers must get constant feedback from the actual decision-makers of those specific decisions.



**Figure 4: Incorporation Process**

The third step is to figure out what impact models are needed to populate it. The fourth step is to determine what data those models need to generate accurate output. The fifth step is getting the data to the processor needed it via the JMDB. Data will be pushed via subscription mechanisms for some things and pulled via user manipulation of decision-

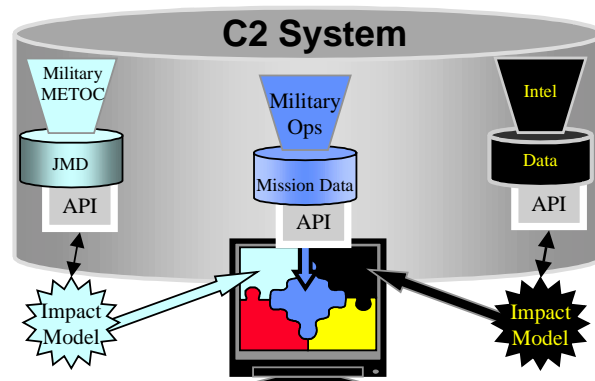
support tools for others. The decisions on how the data is passed must be made for each specific CSDST. The Sixth step is to determine how to get the data to the JMDB. The seventh step is to produce the accurate data that is needed. The eighth and final step is to determine the infrastructure<sup>8</sup> needed to produce the data and build it.

Just as military decision-makers are insisting on strongly tying strategy to task and being able to readily display the thread linking them, Military METOC needs to do the same thing for every decision-to-data-element thread. They need to readily answer questions like, “Why are you providing temperatures at 500mb?” and in the other direction, “How are you helping me decide which PGM to use?”

Because military decision-makers do not have time to look at several decision-support tools specific to different domains (i.e., METOC, Enemy Air Defense, Rules of Engagement, Collateral safe zones, etc.) and then somehow fuse them together in their minds, CSDSTs must strive to consolidate ALL relevant information into one CSDS view. Hence, there may be a few CSDSTs specific to METOC, but the majority will encompass multiple domains.

This is going to pose interesting ownership problems. Will the Military METOC community have responsibility for CSDSTs that include enemy air defense constraints? Will the Intel community have responsibility for CSDSTs that include METOC constraints? Or will each domain have responsibility for their specific modules and an overarching program office to maintain the CSDSTs?

As has been shown in years past, consider the following example of a CSDST, sensitive to the context of the decision and incorporating multiple domains.<sup>9</sup> Figure 5 below depicts the consolidating of data from multiple domains, using multiple impact models, into one decision-support visualization.



**Figure 5: Integrating multiple domains into one CSDST**

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<sup>8</sup> Infrastructure is the facilities, people, and business practices needed to perform a function, in this case Military METOC.

<sup>9</sup> Farrell, 1996



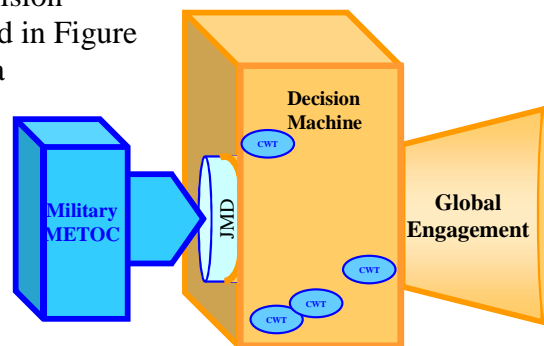
## *An Important Consideration*

Since the JMDB is Military METOC's portal into the military decision-making machine and JMT is the primary constituent of the JMDB, Military METOC must go to every length possible to ensure that the JMT is the best it can be. Toward that end, it is crucial that Military METOC Duty Officers add value to numerical model output. To do that in an operational setting at operational paces, Military METOC requires an application to view the output of forecast models and adjust the gridded fields to improve their accuracy. This is a contentious issue. Many feel that human forecasters do not have enough experience to add value to what the computer puts out. Does the Military METOC community really want the C2ISR Enterprise to work straight from model output without a human in the loop? What about ensemble forecasting? What should the CONOPS be to provide the best JMT possible?

## Summary

There are a lot of questions to be answered. But adopting a framework like the Joint METOC Repository would help the Military METOC community formulate answers. It would help get our collective arms around a complicated enterprise.

This paper suggests a framework to manage the complicated business of incorporating Military METOC support into the military decision-making process. The taxonomy, as represented in Figure 8, is a triad consisting of a database segment, a knowledgebase segment, and an exploitation segment. Analysis of each leg reveals many concrete requirements. The Military METOC community is meeting many of them and close to meeting many more, as presentations at BACIMO 2000 attest. However, the analysis reveals that they are far away from some needs.



**Figure 8: An Integrated JMR**

All three legs are crucial to meeting the needs of current and future automated decision-support systems. To participate in the current development environment, all three legs need to be sturdy and made available to the development community via a Software Developer's Toolkit.

The Software Developer's Toolkit will provide the means of cost-effectively integrating Military METOC support modules within C2ISR programs, and easily lining up the support threads necessary to populate those modules. The Toolkit also presents a ready-made target for transitioning automated Military METOC decision-support capabilities.

# Conclusion

There is more to the Military METOC Enterprise than just supporting decisions. It also acquires awareness of the Natural Battlespace Environment (NBE), and forecasts the future states of the NBE. Hence, JMR is not the complete answer.

But Military METOC does do those two other functions for the sole purpose of adding value to military decision-making, and if incorporation of Military METOC into the C2ISR Enterprise does not happen, the ever-accelerating pace of automated military decision-making will out strip Military METOC's abilities to contribute. If it can not contribute, our Armed Forces will suffer expensive consequences. In particular, we will not be able to efficiently accomplish any of the four operational constructs laid out in Joint Vision 2010. Without full incorporation, our Joint Vision will be more like 20/40.

Much of what is needed is being developed by many different organizations, but the products of this work are not available in a coherent package that C2ISR automation developers can use. The JMR construct would bring all the work together, virtually, into a coherent, synergistic enterprise, make it easily accessible to developers via a Software Developer's Toolkit, and thereby provide a well greased transition conduit for future developments.

# References

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