SPAWAR
Systems Center
San Diego

INFORMATION and DECISION MANAGEMENT

Tools for Decision-Makers

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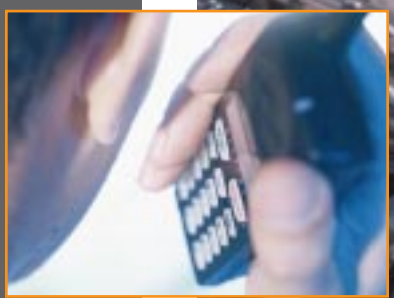
Information Management—providing the user sufficient and timely information and associated tools to plan and execute effectively

Decision Management—application of planning, decision aids, and decision- making tools to assist decision-makers at all levels achieve rapid and effective operational decisions and direct implement-ing actions

I&DM Systems—Tools for Decision-Makers

Emergencies. Disasters. Crises. Whether these are natural events or man-made incidents, successful preparation and response requires managing information from diffuse sources and making effective decisions. Decision-makers must be able to give the right people the right information at the right time. And whatever the mission, no matter how dynamic or information-intensive, whether a single agency or interagency coalition, Information and Decision Management (I&DM) systems can offer critical tools. I&DM systems will help integrate disparate groups and functions into coordinated operations.

Good decision-makers find ways to succeed—that is what makes them good. The best I&DM systems in the world will not make poor planners or strategists good, nor will they automatically ensure effective and timely decisions. But high-quality I&DM will lead decision-makers to better decisions and improved likelihood of success.



The Changing Environment

The American public is besieged daily with news reports about weather and other natural disasters and, most recently, about new weapons of mass destruction including nuclear, biological and chemical threats, and attacks on our core infrastructure services. A parallel can be drawn with contemporary military thinking and policy with regards to leveraging Joint resources for collecting information, collaborative planning of responses, and execution of these plans. In the civil community, civilian and governmental emergency response agencies must also plan and act cooperatively. Their actions are also based on acquiring information, interpreting this information, planning courses of action, and executing plans—often under extreme conditions where timely actions are of the utmost importance. Anticipation and thus planning for these emergency response situations is difficult. Often, civil agencies find that they must deal with situations on a reactionary basis. Our communities need help in preparedness planning, as current communication and crisis planning procedures within most communities are insufficient for current risks and for ensuring public safety. This is a large task whose demands typically exceed available funding. Thus, readiness, information management, planning, and decision-making are all fundamental issues in crisis response and emergency management.

Robust communications, information security, and collaborative planning tools are but a few examples of technologies being refined for military applications that can be used for civil crisis management needs. The use of commercial off-the-shelf equipment suggests new dual-use applications requiring experimentation, system integration, and operational test and evaluation. Thus, the commercial sector has a major role to play. It is likely that, in the future, all large, high-risk communities will need to identify centralized approaches to coordinate community crisis management assets (governmental, medical, business, educational, military) that can be used both for community education and exercises, as well as I&DM during any catastrophe.

Ready-access information and the ability to rapidly manage and interpret that information for decision-making are at the core of crisis management. I&DM ensures that all crisis management participants, from the first response field teams to the senior planners and decision-makers, can act with the best and most complete information our technology can provide.

Information—The Heart of the I&DM Vision

I&DM is both a process and a system. The process is what we do and how we do it. The "system" is the network of hardware and software that supports the decision-making process.

The process involves people making decisions in a dynamic, complex environment—in sufficient time to have a positive impact on the outcome of a rescue, relief, or other operation. The elements of the I&DM process follow their own timeline, as listed below. The "it" refers to relevant information.

Get It—Information is typically acquired from local or remote human resources and electronic sensors and from local and remote databases. Strategies of "user pull" and "producer push" ensure that the right data and information go to the right individual at the right time.

Protect It—Tools and techniques to confuse, spoof, and destroy our information bases are readily obtainable. Adversaries may try to infiltrate or sabotage our critical information infrastructure systems. We must be prepared to thwart such attempts. At all costs, we must ensure the integrity of our I&DM systems.

Analyze It—Once collected, information must be made usable. Rapid, accurate analysis of information to obtain knowledge and understanding is key to the I&DM process.

Use It—Knowledge and understanding can then be used to make decisions (for example, selecting courses of action and managing resources).

Share It—Information may be of little use unless it is shared among the people that need it. Appropriate communications and networking, along with collaborative tools, allow users to share critical information. It is more than merely "getting the word out." Information must be shared up, down, and laterally so that all relevant players achieve a clear, consistent understanding of the situation.

Future I&DM systems must provide all of these elements. SSC San Diego envisions systems that

- Allow users to acquire or access all necessary data
- Provide tools to support analyses that transform data into information and knowledge
- Provide mechanisms for using and sharing the knowledge to assess alternatives and to build consistent understanding
- Protect all the processes and information

Further, the envisioned system supports virtual organizations, operating out of virtual spaces and command centers anywhere, each accessing distributed information bases.

A tall order? The multi-polar world and the advancing rate of technology demand no less.

IMPERATIVES

1 **Dynamic Interoperable Connectivity** will provide assured voice, video, and data connectivity, on demand, in user-selected formats, to any desired location.

2 **Information Protection** will protect our information.

3 **Information Access** will use interoperable connectivity to access strategically located database servers and anchor desks and provide users, at all levels, with key information.

4 **Distributed Collaboration** will provide the tools necessary for users in the field and higher level decision-makers to agree on issues and options.

5 **Consistent Situation Understanding** will facilitate a consistent near real-time understanding of the operational situation.

6 **Resource Planning and Management** will provide the tools necessary to define and allocate resources for a given task or to meet an unplanned contingency.

Acquisition to Understanding via SSC San Diego's Corporate Imperatives

SSC San Diego's vision—making effective I&DM a reality—is based on achieving six interrelated objectives, termed Corporate Imperatives.

I&DM requirements derive from the roles and missions assigned, allocable resources, capabilities, and operating procedures. I&DM depends on an underlying command structure. To support operations, our system capabilities must span the entire range of roles, missions, organizational structures, and politics, or any subset of these.

The six SSC San Diego Corporate Imperatives form the core capability for I&DM. The Corporate Imperatives are interdependent—all six are required for successful decision-making:

- Without Dynamic Interoperable Connectivity and Information Protection, Information Access is not assured.
- Without Information Access and Distributed Collaboration, Consistent Situation Understanding within a defined area cannot be achieved.
- Without the first five imperatives, operations cannot be planned, resources allocated, or plans carried out, and the ability to perform effective I&DM can be lost.

1

Dynamic Interoperable Connectivity

Dynamic Interoperable Connectivity is the conduit for all data and information, whether that information moves 15 feet or 15,000 miles. Ensuring Dynamic Interoperable Connectivity gives users reliable and secure access to all needed information.

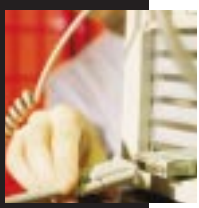
Dynamic connectivity is flexible—it can support specific user needs in rapidly changing scenarios at different times. Because it also supports sharing of resources, dynamic connectivity is economical. Telephone connections, for example, are dynamic, with all resources, from user handsets through physical links and central switches, shared among many users. A given set of dynamic resources can thus provide more service than dedicated static resources. In addition, although users are often part of a multiuser community, they seldom perform all tasks, all of the time. Resources can be used more productively, workload reduced, and efficiency improved by tracking and assigning tasks according to actual need.

Specifically, ensuring reliable and secure access to all needed information requires that

- Fixed installations and mobile sites are connected
- Connections are established when needed; information is transferred when needed
- The length of user–user interaction is assured and appropriate
- Connections are "robust," or immune to disruption
- Integrity and accuracy of information is maintained
- "Simultaneity" (e.g., conferencing) is provided

Interoperability is critical. Users define the connectivity they need for common activities. When the community of users expands, interoperability must be based on the needs of the larger community; this places demands on underlying processes and infrastructure. Interoperability implies a common (human or machine) language, common protocols, and common modulation formats or methods. Where these items are not shared in common, translation mechanisms must be provided.

Some resources needed to support Dynamic Interoperable Connectivity are inherently limited. For example, physical space for communications equipment is often limited, and today's radio systems are usually dedicated to a single user or group. Sharing equipment and spectrum will increase efficiency, expand communications access, and reduce costs.



2 Information Protection

Information must be protected. Information availability, integrity, authentication, confidentiality, and non-repudiation must be ensured. Systems should incorporate protection, detection, and reaction capabilities for restoration if compromised.

Information Protection defends against the exploitation of our own information by such means as encryption, firewalls, or physical isolation. Information Protection also counters intrusions, misuse, deception, and other types of attack, preventively where possible, and otherwise through timely detection and containment of an attack and recovery from its effects.

Within the overall information environment, the information infrastructure includes all of the people, organizations, and systems that collect, process, or disseminate information for decision management. SSC San Diego's Information Protection focus encompasses most of our corporate research, development, and test and evaluation of the information infrastructure, including automated information systems.

3

Information Access

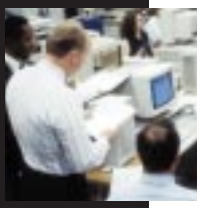
SSC San Diego can provide advanced information tools for decision-making. But it is the user who thinks, plans, and carries out an operation. Based on the concept of "user pull/producer push," every new SSC San Diego Information Access solution considers the user central to the I&DM system.

Users must be able to access the information they need. User pull gives the user the capability to "pull" or retrieve the information he or she needs to carry out a task.

Producer push allows command centers and other information sources to provide information specific to the user's operational needs. Large volumes of data can overwhelm users—data must be filtered to alert the user to critical incoming information. Anchor desks serve as a support information infrastructure at the command level and control the volume of information distributed to the user. Equally significant, these desks provide for human interaction with the user in the field.

New tools for accessing information focus on display systems because they remain the primary interface to information. Research in human–system interface technology is rapidly evolving to make display tools simpler and more natural to use. Such tools include compact user terminals, improved video/graphic capabilities, and intelligent search agents for accessing data sources. The design of these software tools and expert systems will allow users to rapidly obtain, understand, and process the right information for their operational needs without requiring them to possess knowledge of system architecture or connecting paths.

While Information Access focuses specifically on the user, supporting technologies in information collection, operational planning and execution, and network communications are required to make it work. Dynamic connectivity is essential to acquiring information on demand and planning operations. This connectivity must allow data systems to be interoperable and allow users to access time-critical, high-volume data at any time.



4

Distributed Collaboration

Improved computer-based technologies will enhance the user's ability to conduct multi-location, multi-level, multi-agency I&DM. SSC San Diego is exploring technologies to provide a distributed collaborative workspace that will support situation assessment during uncertainty, continuous planning and replanning, execution monitoring, localized planing and replanning, and collaborative decision-making.

Distributed Collaboration must support a changing operations tempo—from minutes for decision-making, to days for planning—anytime, anywhere, with a mix of organizations, government agencies, and even other countries. Collaboration will be among peers and across operational expertise, up and down echelons, and across all critical functions. The size of groups may be a few people to teams of teams. Collaboration will allow for augmentation (for example, several planners doing the job in one day vice one person working many days),

integration of multiple specialists' knowledge, and debate to reach a better decision. Collaborative planners working within stringent time constraints will also be able to rapidly access experts and relevant changing information.

SSC San Diego's vision of Distributed Collaboration requires technological enhancement to the collaborative infrastructure. A collaborative virtual environment is an interactive, computer-generated environment that supports multiple users both synchronously and asynchronously performing their jobs. The virtual multimedia workspace is a smart, virtual environment where one can integrate customized, automated work mechanisms with distributed human expert collaborative activities. A graphical, intelligent, multi-person cyberspace will support group decision-making, information retrieval, shared situational awareness, assessment, planning, and execution monitoring scalable to all decision-making levels. SSC San Diego is working to meet these technological challenges.

5

Consistent Situation Understanding

Consistent Situation Understanding is the desired result of the processes of tasking, collecting, evaluating, disseminating, and displaying information. Consistent Situation Understanding is both a "process" and a "view." The process involves getting the right information to the right people at the right time. The shared view becomes a common operating picture.

SSC San Diego is pursuing several areas to enhance Consistent Situation Understanding: new sensors for increased volume of quality data; improved information fusion methodologies to yield more useful, accurate information; fusion of data sources to produce a common, universally understandable representation of the operational situation, i.e., a common operating picture; and improved methods for real-time management, display, and dissemination of the common operating picture.

New systems will give users decision-making tools that are much more capable and yet more disciplined than any system in the past. Features of new systems will include

- Interactive, scalable, 3-D, audio, and visual representation in a geographical/spatial format
- Past, present, or future projections of activity and near-term situations

- Functional symbology
- Voice commands in lieu of point-and-click mouse commands
- Automatic, simultaneous generation of the common operating picture
- Data sort and view options (e.g., all data regardless of sensor source/accuracy or accurate data only)
- Direct access to underlying textual information
- Ability to interface “live” by voice conference or keyboard with geographically distributed experts

6

Resource Planning and Management

Resource Planning and Management will provide the necessary tools to define and allocate resources for a given task or to meet an unplanned contingency. Tools are non-task specific and relate across the spectrum of tasks/missions that will employ them. Tools related to specific tasks, missions, or contingencies are considered “applications,” not part of the necessary infrastructure.

This imperative includes tools for modeling and simulation to assist in planning the assignment of resources. In the context of I&DM, SSC San Diego envisions a quick-time simulation capability to allow analysis of potential outcomes based on various mixes of resources brought to bear on a contingency operation or disaster. For example, the effects of alternate mixes of military, National Guard, law enforcement, and civil defense personnel/equipment can be assessed prior to their employment. SSC San Diego also envisions tools to plan for logistics to support personnel and medical requirements.

A major issue in coordination of personnel to execute tasks over distributed geography is the real-time allocation of electromagnetic resources. Both access to and requirements for these critical resources are dynamic. They require predictive models and the ability to tailor those resources to ensure rapid response to the changing environment while maintaining necessary interoperability of personnel. Resource Planning and Management will provide those tools.

Information path control tools will be included in Resource Planning and Management as well to ensure that the requirements for critical information access are maintained, regardless of the changes in the environment.

SSC San Diego is working to provide the Resource Planning and Management tools to perform the general control and allocation functions for I&DM environments.

I&DM Systems—Attributes

Several attributes desired in I&DM systems—*user-centric and intuitive, integrated, interoperable, seamless, consistent and scalable, adaptable/configurable/tailorable,* and *survivable*—are achievable today. Each new I&DM system SSC San Diego develops will incorporate these attributes to the maximum extent possible. Additional attributes will be incorporated as they are identified and as technology makes them available.

User-Centric and Intuitive—"User-centric" systems are built for and focus on the user's needs at all operational decision-making levels. Users/decision-makers are encouraged to participate throughout the systems development process so that they can understand the possibilities of emerging technologies, visualize how new technologies might be applied to real-world I&DM situations, and provide ongoing input into new systems.

"Intuitive" systems incorporate features that make them physically and mentally easy to operate. Systems will operate on a level of convenience and performance such that virtually anyone can use them.

Integrated—In "integrated" systems, every component and all decision-making levels can be electronically joined, connected, or networked to provide rapid access to the information, agency, or point of contact required by a user.

Interoperable—"Interoperable" systems allow information or services to be exchanged directly and satisfactorily between the systems and/or their users.

Seamless—With "seamless" I&DM systems, users need not be concerned with how to get information or where it is located. Systemic, procedural, and administrative boundaries around functional disciplines will, in effect, disappear to the user. Users/decision-makers can focus more on their task and less on the connectivity and process when obtaining information.

Consistent and Scalable—"Consistent" means that the uniformity of the common operating picture's data content and information presentation will be clearly understood across all levels of decision-making.

"Scalable" means that both the Consistent Situation Understanding process and the common operating picture can be sized to fit the particular situation in which it is being applied. Starting from a global perspective, data and information can be managed in decreasing subsets of time, space, composition, tasking, and levels of decision-making down to the level of unique, individual I&DM users.

Adaptable/Configurable/Tailorable—"Adaptable/configurable/tailorable" means that the system will respond to the user's unique requirements for information to support specific tasks or functions.

Survivable—"Survivability" may be regarded as a matter of a system's life or death or as a matter of incremental upgrades. The decision-making portion of I&DM systems is being conceived and implemented with commercial off-the-shelf hardware and software, and government off-the-shelf software components in an open-systems architecture. As such, survivable is being defined more in terms of life and death and the total replacement of inoperable system components with new (spare) components rather than incremental improvement or on-site repair.

SSC San Diego's Approach to I&DM Evolution

SSC San Diego is uniquely qualified to provide the expertise and tools to allow users to plan and make effective decisions in time-critical situations. Almost every SSC San Diego project deals with acquiring data, transforming data into information, using information to operate, or moving data and information from where they reside to where they are needed. SSC San Diego is at the cutting edge of technologies to support the processes of transforming data into information; information into knowledge; knowledge into understanding; and understanding into decisions.

Our great strength at SSC San Diego is our unique experience across the spectrum of I&DM. This ranges from basic research through prototyping and fully produced systems and to life-cycle support of fielded systems. Furthermore, SSC San Diego's facilities, laboratories, and communications capabilities allow our engineers and scientists to replicate environments unachievable in the commercial world. These can include crisis response situations, disaster relief scenarios, infrastructure attack events, etc. At SSC San Diego, the pieces of the overall I&DM system can be integrated and tested in both laboratory and operational contexts. We are aggressively applying our unique expertise and capabilities to the key elements of future information and decision management.

SSC San Diego's approach to the development of I&DM systems embraces the concept of evolutionary acquisition, coupled with a strong commitment to standards-based architecture. The development process is a continuous sequence of *visioneering, prototyping, demonstrating, integrating*, and *evolving* all the components of our I&DM systems.

Visioneering—We are always on the lookout for new ideas. We seek new ways to apply emerging technology to I&DM. Promising ideas are translated into models. We can then look at how those models might be used in a command setting.

Prototyping—We develop a working example of the model, or prototype, so that it can be shown in the context of I&DM.

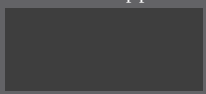
Demonstrating—We demonstrate and showcase our emerging technology in operational settings. These demonstrations give us feedback prior to "hardening" the design for delivery and integration.

Integrating—Before any decision to proceed with an addition or upgrade to an element of the I&DM system, we make sure integration and associated testing occur in a laboratory setting that replicates, as much as possible, the operational one. A successfully integrated component will not adversely affect the performance of the total system when placed under operational stress.

Evolving—"Evolving" completes the development cycle for a new concept. Once the element is successfully integrated, two parallel processes occur. First, users review and analyze system performance/ operational effectiveness and give periodic feedback to the developers. Armed with knowledge of both deficiencies and suggestions for improvement, we can then get busy with new ideas that lead to additional cycles of development.

Our goal is to achieve optimal I&DM—providing the right people the right information at the right time in the right context to successfully accomplish any dynamic, information-intensive mission.

Reviewed and approved by



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