ADVANCED TECHNOLOGY CONCEPTS FOR COMMAND AND CONTROL pdf

1: Communications, Command, and Control (C3)

The book is not only an excellent overview of the latest technology in command and control, but also a wonderful guide to the application of automated decision aids for management of any complex time critical activity.

Further Reading Communications, Command, and Control C3 Communications, Command, and Control C3 technology encompasses the capability to acquire, process, and disseminate information across force elements including international coalition forces. The capability must be reliable, provide secure multilevel access, and be protected from enemy attacks. This will require advances not only in computing hardware and software but in the interconnecting fabric of communications. The goal is seamless and effective integration of capabilities for planning and preemption, integrated force management, and effective employment of sensor-to-shooter system-of-systems. As reflected in the Army command, control, communications, computers, and intelligence C4I technical architecture and the interoperability objectives of the Army Digitization Office, digitization of the battlefield is expected to rely largely on the effective use of commercial-off-the-shelf COTS equipment. While this may provide many of the building blocks, integration and demonstration of the technology in the field remains a significant challenge. Widespread mass market availability of low-cost computers of unprecedented power and global connectivity over the Internet has led to rapid expansion and proliferation of information system technologies. Seamless communication means robust, survivable, multilevel secure communication systems that provide the warfighter access to mission-essential information over the entire operational continuum without requiring user intervention to achieve connectivity across heterogeneous networks. Seamless communication includes the technologies associated with networks, network management, and advanced radio communication systems. The technical challenge is to provide local area networks and ground mobile radio networks that will survive the hostile and demanding environment of the modern battle and that are capable of being interfaced to fixed-backbone or space-based wide area networks. France, Germany, and the U. Canada also has significant capabilities in tactical interoperability. Initial efforts involve Germany but it is envisioned that this testbed will accommodate joint testing between U. In addition to traditional NATO allies, Japan also offers significant capabilities in networking and high-speed communications. Of particular interest is its world-class work on fuzzy logic. This area of technology is expected to play an important role in future automated and autonomous systems. Information management and distribution provide the backbone infrastructure to allow near-perfect, real-time knowledge of the enemy and the ability to automatically disseminate that information to dispersed forces and command centers. Technical challenges relate to heterogeneous distributed computing environments, distributed database management, multilevel information security, advanced human-computer interfaces HCIs , and automated information distribution. In addition, Canada has strong capabilities in advanced data display. Another NATO country with noteworthy capabilities is The Netherlands, which has particular strengths in natural language processing as well as knowledge base and database science. South Korea and Canada have significant efforts ongoing relative to data fusion and the underlying technology applied to military intelligence. Cooperative efforts with these countries would be beneficial in applying state-of-the-art technologies to address the data fusion problem. Applications of distributed intelligent systems to real-time data fusion and combat battle management. The objective is to incorporate AI into large synthetic computing environments to handle networking and process management automatically and transparently for the network user. France has extensive experience and a sound information technology infrastructure combined with strong capabilities in battlefield communications. To increase information flow to and from the land forces Army commander. Advanced asynchronous transfer mode ATM switching promises many advantages to the next-generation information infrastructure for commercial as well as military tactical and strategic applications. France has significant capabilities in this area of technology. For information exchange between U. Military communications offer a promising area for implementation of machine translation because of the relatively

limited and specialized military lexicon. Two areas are of special interest, one with Germany and one with France. The German Army has developed a prototype translation system consisting of a channel recorder, a server, two workstations, and an electronic military lexicon. They are interested in further development of this capability in the areas of language and speaker identification. World-class research in machine translation is being done in Germany at Siemens and the University of Karlsruhe. A French-English interlingual-based machine translation system, capable of high-quality translation of complex sentences in the domain of military free text messages, is being developed under a 4-year effort between France and the U. Finally, Japan offers world-class capabilities in high-speed switching and networks that could be a valuable contribution to this area. Decision making or battle command remains a combination of art and science. The nonhierarchical dissemination of intelligence, targeting, and other data, facilitated by seamless communications and effective information management and distribution, will replace the current hierarchical command structure. Units, key decision makers, and commanders will be more independent and dispersed. Information will be voluminous, nonsynchronous, ambiguous, partial, and at times erroneous. To support this revolution in battle command, dispersed command units must be able to share a common, accurate picture of the battlespace. To take advantage of this information, a multilayered reasoning environment is required to aid the warfighter and commanders in making battlefield decisions. Technical challenges include developing an environmental and force structure database and reasoning mechanisms that are scalable, dynamic, extensible, and robust. In addition, the system must be affordable and offer real-time response. The decision making and planning aspects require improved machine learning and reasoning paradigms coupled with intelligent agents or aids. France and the U. The French are doing world-class research on automated mission planning and decision making. Automated mission planning systems require evaluation of potential paths based on a perception of the current true situation. In virtually every case this is based on vague or uncertain data e. Conventional rule-based approaches do not work well with this type of data. Fuzzy logic approaches for data collection, aggregation, and potentially deaggregation are being integrated into an automated system to allow manipulation of vague data to increase realism of simulation and, ultimately, of decision making. Intelligent command aids could be extremely important in simulation and computer-generated forces CGFs. A common problem is the fact that it is far too expensive to have human controllers "command" the CGFs. Rather than using large rule-based systems to construct "command agents" that attempt to model individual decision making entities, fuzzy logic and fuzzy inference engines are an approach that can enhance current intelligent command aids and provide more realistic and effective simulations. Halstead will be the testbed system. The current rule-based inference structure will be "fuzzified" by augmenting or replacing it with fuzzy rules and fuzzy inference mechanisms. Since the current system is nonfuzzy, direct comparisons of complexity, behavior, and other performance parameters will be possible. Israel also has strong capabilities in automated battle management that could offer an important contribution to this effort. Japan has world-class capabilities in fuzzy logic. Most Japanese work is related to control of industrial processes or consumer products, however, it is also applicable to military decision making and mission planning.

ADVANCED TECHNOLOGY CONCEPTS FOR COMMAND AND CONTROL pdf

2: Expeditionary Advanced Base Operations

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An accurate COP is essential to NCO, as it facilitates the self-synchronization of NCO, decreasing the need for communications to establish a common understanding of a situation and thereby increasing the speed of command. While the COP as it exists today does provide important information, the current system has significant shortcomings. This situation is discussed below according to the four components of the COPâ€"the air picture, the maritime sea surface picture, the undersea picture, and the ground picture. But first, there should be some clarification of the nature of a COP. Access to data is the key here. From a network-centric perspective see the discussion in Chapter 3 , users should have access to data as soon as they are in some comprehensible form, even though further processing of the data might be intended. This is because different users will have different needs for the data, and the additional processing might remove information content according to the perspectives of some users. For example, air vehicle tracks could be processed with the criteria of minimizing false-alarm rates or in order to display all potential leakers; the resulting processed data would not be the same in the two cases. Common processing will have to be applied in cases, for example, in which the parties involved need to see the same air picture, but the data should still be accessible in their preprocessed form. The particular problems in the air picture relate primarily to aircraft and cruise missiles, given the typically unique and observable nature of ballistic missiles. Shortcomings in the air picture include missing tracks, multiple track designations for one object, swaps of track number between objects, and object misidentification. The National Academies Press. Incremental progress has been made in addressing these problems over the years, but a wholly adequate solution may not result unless a new COP for the air picture is designed from the ground up. Work is now being done on components that can be used for such a new development. Given the development of a common track manager, the issue will be the extent to which this track manager is available throughout the force all Services and inadequate legacy track-management capability is phased out. At the same time, however, as is noted above, the track data prior to processing by the common track manager should be accessible for those who have a need for those data. This requirement has implications with respect to the design of air picture systems in terms of the data interfaces and posting mechanisms that must be provided. This maritime picture is established from sensor data collected from national assets, aircraft, helicopters, and, in the future, from unmanned aerial vehicles UAVs. The airborne assets can be both naval and, potentially, those of other Services and coalition parties, too. Navy officers interviewed during the study indicated that the quality of the current maritime picture, while improving over the past few years, still has significant shortcomings. In particular, sensor coverage typically is not adequate to provide full, persistent coverage, and those sensor inputs that are available are manually assembled rather than being networked together. The consequence of these shortcomings is a maritime picture that is far less complete and accurate than it could be. OPNAV staff had formulated a potential program, called the Single Integrated Maritime Picture, to network the sensors providing maritime surveillance, but this proposal was not included in the budget for funding. A program such as that appears necessary to meet the surface threat in the littoral environment, including the possibility of swarms of small boats, particularly given the importance of littoral operations. There are significant shortcomings in the ability to detect quiet submarines and stealthy minefields see Chapter 7 , Section 7. Means for improving the networking of the undersea sensors also appear necessary, but the first priority is the need to improve the sensor detection and processing. The reason is that the scope of this study does not include the operational maneuver of Marine Corps forces ashore except for those aspects of the ground picture necessary for naval fires from or directed by

expeditionary strike groups against ground targets in support of Marine Corps and other Service or coalition forces. This ground picture includes friendly, neutral, and hostile entities. AFATDS automates the fire planning, tactical fire direction, and fire-support coordination required to support maneuver from the sea and subsequent operations ashore. It provides a suite of tools and interfaces for horizontal and vertical integration across battlespace functional areas. ADOCS has evolved into the automated support system in actual wartime situations for deep operations in several theaters. Page Share Cite Suggested Citation: The trackers used by the Marines are not yet part of a program of record, and interoperability problems exist between tracker types, although actions appear to be under way to resolve these issues. The Navy is largely dependent on the sensors of other Services and on intelligence means to provide information on coalition, neutral, and hostile entities for the ground picture, although the Navy does have some applicable organic sensors see Chapter 7 , Section 7. At the present time there is no funded programâ€”joint or in any of the Servicesâ€”to provide a composite ground picture on which the Navy can draw. In the face of this uncertainty, the Navy should ensure that it has the necessary external inputs, and that these inputs can be correlated with organic Navy inputs, to provide it with the necessary ground picture. As all the Services and intelligence entities move toward network-centric operations and post their sensor and other data, input from the external sources should become readily available to the Navy. Becoming a 21st-Century Force, Vol. That committee also noted, however, that building this technical infrastructure for network-centric operations is an exceptionally large undertaking. The programs, with the responsible organization for each, are listed and discussed below.

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3: David S. Alberts - Wikipedia

World's Most Innovative Technology & Concepts for Future Aircraft, Jet-Fighter,Commercal Aeroplane How to Escape the Command Centre & Stop Irons FAST & EASILY COD Advanced Warfare.

Linked Operations-Intelligence Centers Europe 4 systems have facilitated the sharing of intelligence among selected coalition partners. Many warfighters involved came away from the Gulf War with the view that improving C4I capability and interoperability would add more to military operations than additional improvements in weapons. In addition, the challenges of operating in urban environments and in rough, wooded areas must be addressed rather than simply extrapolating the successes achieved in a desert environment. Some evidence to support these concepts is available from studies and exercises and experiments, 5 but for the most part their full significance has not been demonstrated in real-life operational scenarios. Information Superiority and Greater Situational Awareness To exercise authority and direction effectively in combat and other military operations, commanders must have situational awareness. To the extent that the promise of C4I technologies is realized, reduced force size might be compensated for by information superiorityâ€”the ability of a force to have, and protect, a comprehensive view of enemy and friendly forces as well as the combat environment, while denying the enemy a comparable capa- 4. See, for example, H. Page 37 Share Cite Suggested Citation: Realizing the Potential of C4I: The National Academies Press. The growing list of land-, air-, sea-, and space-based sensors combined with other sources makes the fusion of information an essential dimension of situational awareness. Fusion of data from this multitude of sources is indispensable to achieving information superiority in the regional environment. The challenge in doing so goes beyond the receipt and display of sensor data to include reconciling those data eliminating redundancy and outdated information and extends to the fusion of multiple sources of information into timely and meaningful intelligence. Through this process, true information dominance can be achieved. In that regard, information dominance must also include situational awareness with regard to space-based systems. Knowing friendly, enemy, and neutral satellite coverage and capability will be of vital concern to the joint commander and his component commands. The cornerstone of information superiority is advanced C4I technology and systems, which can provide to all tactical levels of command a robust, continuous, common operating picture of the battlespace. A common operating picture is a central element in a number of initiatives, including the following four: The Army Digitization Master Plan is intended to "create a simultaneous, common picture of the battlefield from soldier to commander at each echelon 6. In some usages, the term "common operating picture" refers to a view of the battlespace that is near-real-time; in other usages, it refers to a view that lags by as much as an hour. This report adopts neither usage, preferring instead to make the time dimension explicit when it is relevant to the discussion. This is not to say that the notion of a common operating picture is new. The JMCIS common operating picture integrates reports from a variety of sensors, including some on the ship where the common operating picture is displayed and other off-board sensors on accompanying platforms dispersed in the battlespace. The intent of the programs described is to pass a common operating picture to tactical echelons that are much lower in the command hierarchy. Page 38 Share Cite Suggested Citation: The program provides the communication and displays which allow participants to aggregate information and maintain an awareness of what is happening around them, both friendly and enemy. Digitization allows the employment of forces in a highly mobile, synergistic, and overwhelming manner. The Theater Air and Missile Defense program. Conducted by the Ballistic Missile Defense Organization, the Theater Air and Missile Defense program seeks to develop capabilities to display a single integrated air picture, available to all relevant units in the theater, that is accurate, resolved, consistent, and timely essentially real-time. The single integrated air picture, which would integrate data on air and cruise-missile threats provided by multiple sensors possibly of different types and sources located on different platforms, is intended for use by commanders at all levels to identify, prioritize, and execute air defense engagements. It

integrates a wideband, low-cost broadcast mechanism, information management services providing user access to a wide variety of information sources including unmanned aerial vehicle and national imagery; Global Command and Control System operational data; and combat information systems such as the U. Air Force Combat Intelligence System, and the Common Ground Station , and battlefield awareness services that present to the user a coherent picture of enemy and friendly forces integrated with terrain, image, and video data. Adapted from the BADD program overview: Page 39 Share Cite Suggested Citation: The ELB ACTD is intended to enhance the advanced warfighting concepts of the Navy and Marine Corps by providing or enabling theater-wide situation awareness, integrated sensors, responsive remote fires and targeting, and over-the-horizon connectivity. Further, it proposes a range of operational and tactical concepts that leverage command, control, communications, computational, and other technologies to exploit information and improve precision firing and targeting in future operations. For example, it would enable the effective employment of dispersed and disaggregated units as well as increasing the capability for rapid operations by conventionally configured forces. Disaggregated units could operate in an enlarged battlespace, presenting few concentrated targets to the enemy while employing massed remote firepower to harass, damage, and destroy. Central to ELB is a beyond-line-of-sight tactical information infrastructure with wideband communications networks and enhanced situation understanding that would provide common situational awareness at all levels of command. Peer unit collaboration in achieving local objectives and increased autonomy would thus become more feasible and could lead to higher operational tempos. Using C4I to Conduct Precision Strikes In the traditional context of ground warfare, overwhelming force was applied by massing forces at points of contact with the enemy. Adapted from the ELB program overview: A potential downside to a common operating picture is that detailed awareness at all levels of command above those that are the "trigger pullers" creates the potential for second-guessing, with a negative impact on the initiative of those who are engaged in combat. Whether this and other potential problems in fact turn out to be real problems, and if they are, how they can be managed, are research areas that need to be explored. Page 40 Share Cite Suggested Citation: Indirect fire launched from assets that are widely dispersed and not in direct contact with enemy forces could produce effects comparable to those possible with forces massed at points of contact. Sensors would be deployed close to or within enemy operating areas and would be linked directly to the forces that are engaging those enemy forces. These same sensors would be used to feed the C4I infrastructure that provides the real-time common operating picture of the battlespace. Such an approach would significantly increase the effectiveness of remotely delivered firepower, reduce friendly losses, and provide significant increases in the effectiveness of the maneuver forces, thus constituting a major shift from the traditional notion of attrition-based warfare. Using C4I to Enhance the Effectiveness of Air Operations Advanced C4I offers the means to achieve greatly improved effectiveness in carrying out most of the challenging tasks in air operations. The single integrated air picture is critical to improving the effectiveness of the air and missile defense missions. Creating a single integrated air picture SIAP is a significant technical challenge, given the extremely short time lines against which the air assets must operate. Subsequent developments have yielded capabilities that allow the creation and maintenance of a single integrated air picture, but these systems still have clear deficiencies in such areas as integration and the ability to share information with potential coalition partners. Today the problem has become even more challenging with increased concerns about ballistic missiles and stealthy cruise missiles. Engaging targets that are mobile or relocatable or that have short dwell times is another challenging air task that could be improved through rapid assessment of target changes and feedback to the attacking units. The use of advanced sensor technology and the fusion of data from applicable sensors of each of the services could help the further development of a single integrated air picture. This advanced C4I capability would also enhance the effectiveness of precision guided weapons against fixed targets by providing timely and precise target location information. Page 41 Share Cite Suggested Citation: The effective attack of such targets demands a seamless flow of information across service, organization, and system boundaries if they are to be consistently attacked within their short windows of vulnerability 1 to 2 hours or less. Emergent targets operate

inside the Joint Targeting Cycle because information is decelerated as it crosses organizational and system boundaries. The warfighter is not receiving the full benefit of our massive investment in information and weapons technology. The Joint Continuous Strike Environment advanced concept technology demonstration seeks to improve the responsiveness of U. The Joint Continuous Strike Environment functionality will encompass deep-strike assets from all services and selected allied assets. It will take advantage of existing but untapped potential for servicing emergent targets to shunt and accelerate information along the sensor-to-shooter pathways, thus enabling a joint force commander to hold emergent targets at risk without disrupting other aspects of his campaign plan. Its goal is to reduce by at least one order of magnitude the latency associated with correlating command guidance, weapons, targets, and airspace deconfliction and launching attacks against emergent targets. Page 42 Share Cite Suggested Citation: In principle, engagements of an incoming cruise missile far away from the threatened target are highly desirable, because such engagements allow multiple attempts to destroy the cruise missile. An important collateral benefit is that the long-range destruction of a cruise missile carrying chemical or biological weapons reduces the likelihood that the chemical or biological weapons agent will affect the target. Cruise missiles can be engaged with surface-to-air missiles or fighters. The horizon line-of-sight limitation can be overcome by increasing the altitude of the radar e. It is often the case that over-the-horizon sensors are present, but in general these sensors will be associated with platforms other than the one that can fire the surface-to-air missile. Since fly-out ranges are often four to five times the distance to the radar horizon, the improvement in air defense coverage is significant. Today, the ability to employ networks of heterogeneous sensors is limited by the fact that fire-control-quality data cannot in general be shared among all the shooters that might come into play in an engagement. Moreover, the "stovepipe" architecture in place can prevent even the surveillance data generated by some sensors from being available to certain shooters. Page 43 Share Cite Suggested Citation: In particular, DOD has identified a technology-enabled "revolution in military affairs" as one that involves "harnessing new technologies to give U. For each of these concepts, information superiority is a critical enabler.

ADVANCED TECHNOLOGY CONCEPTS FOR COMMAND AND CONTROL pdf

4: FCW Workshop: AI -- FCW

The 'advanced technology concepts' referred to in the book are in reality various types of information systems that either exist or are in the planning phase. The authors of this book argues that 'Control Theory' and its applications offer the means to create a radical and entirely new generation of C2 systems.

The commander must work in a medium which his eyes cannot see; which his best deductive powers cannot always fathom; and with which, because of constant changes, he can rarely become familiar. This understanding will become the basis for developing a theory and a practical philosophy of command and control. No single activity in war is more important than command and control. Command and control by itself will not drive home a single attack against an enemy force. It will not destroy a single enemy target. It will not effect a single emergency resupply. Yet none of these essential warfighting activities, or any others, would be possible without effective command and control. Without command and control, campaigns, battles, and organized engagements are impossible, military units degenerate into mobs, and the subordination of military force to policy is replaced by random violence. In short, command and control is essential to all military operations and activities. With command and control, the countless activities a military force must perform gain purpose and direction. Done well, command and control adds to our strength. Done poorly, it invites disaster, even against a weaker enemy. Command and control helps commanders make the most of what they haveâ€”people, information, material, and, often most important of all, time. In the broadest sense, command and control applies far beyond military forces and military operations. Any system comprising multiple, interacting elements, from societies to sports teams to any living organism, needs some form of command and control. Simply put, command and control in some form or another is essential to survival and success in any competitive or cooperative enterprise. Command and control is a fundamental requirement for life and growth, survival, and success for any system. We often think of command and control as a distinct and specialized functionâ€”like logistics, intelligence, electronic warfare, or administrationâ€”with its own peculiar methods, considerations, and vocabulary, and occurring independently of other functions. But in fact, command and control encompasses all military functions and operations, giving them meaning and harmonizing them into a meaningful whole. None of the above functions, or any others, would be purposeful without command and control. Command and control is not the business of specialistsâ€”unless we consider the commander a specialistâ€”because command and control is fundamentally the business of the commander. Sometimes this recognition takes the form of a conscious command decisionâ€”as in deciding on a concept of operations. Sometimes it takes the form of a preconditioned reactionâ€”as in immediate-action drills, practiced in advance so that we can execute them reflexively in a moment of crisis. Sometimes it takes the form of a rules-based procedureâ€”as in the guiding of an aircraft on final approach. Some types of command and control must occur so quickly and precisely that they can be accomplished only by computersâ€”such as the command and control of a guided missile in flight. Other forms may require such a degree of judgment and intuition that they can be performed only by skilled, experienced peopleâ€”as in devising tactics, operations, and strategies. Sometimes command and control occurs concurrently with the action being undertakenâ€”in the form of real-time guidance or direction in response to a changing situation. Sometimes it occurs beforehand and even after. Furthermore, planning increases knowledge and elevates situational awareness. Effective training and education, which make it more likely that subordinates will take the proper action in combat, establish command and control before the fact. The immediate-action drill mentioned earlier, practiced beforehand, provides command and control. Likewise, analysis after the fact, which ascertains the results and lessons of the action and so informs future actions, contributes to command and control. Some forms of command and control are primarily procedural or technical in natureâ€”such as the control of air traffic and air space, the coordination of supporting arms, or the fire control of a weapons system. Others deal with the overall conduct of military actions, whether on a large or small scale, and involve formulating

concepts, deploying forces, allocating resources, supervising, and so on. This last form of command and control, the overall conduct of military actions, is our primary concern in this manual. Unless otherwise specified, it is to this form that we refer. Since war is a conflict between opposing wills, we can measure the effectiveness of command and control only in relation to the enemy. The basis for all command and control is the authority vested in a commander over subordinates. Authority derives from two sources. Official authority is a function of rank and position and is bestowed by organization and by law. Personal authority is a function of personal influence and derives from factors such as experience, reputation, skill, character, and personal example. It is bestowed by the other members of the organization. Official authority provides the power to act but is rarely enough; most effective commanders also possess a high degree of personal authority. Responsibility, or accountability for results, is a natural corollary of authority. Where there is authority, there must be responsibility in like measure. Conversely, where individuals have responsibility for achieving results, they must also have the authority to initiate the necessary actions. We suggest a different and more dynamic view of command and control which sees command as the exercise of authority and control as feedback about the effects of the action taken. The commander commands by deciding what needs to be done and by directing or influencing the conduct of others. Control takes the form of feedbackâ€”the continuous flow of information about the unfolding situation returning to the commanderâ€”which allows the commander to adjust and modify command action as needed. Feedback indicates the difference between the goals and the situation as it exists. Feedback may come from any direction and in any formâ€”intelligence about how the enemy is reacting, information about the status of subordinate or adjacent units, or revised guidance from above based on developments. Feedback is the mechanism that allows commanders to adapt to changing circumstancesâ€”to exploit fleeting opportunities, respond to developing problems, modify schemes, or redirect efforts. The result is a mutually supporting system of give and take in which complementary commanding and controlling forces interact to ensure that the force as a whole can adapt continuously to changing requirements. But given the nature of war, can commanders control their forces with anything even resembling the omnipotence of the chess player? We might say that a gunner is in control of a weapon system or that a pilot is in control of an aircraft. But is a flight leader really directly in control of how the other pilots fly their aircraft? Is a senior commander really in control of the squads of Marines actually engaging the enemy, especially on a modern battlefield on which units and individuals will often be widely dispersed, even to the point of isolation? Are commanders even remotely in control of what the enemy does? But it is a delusion to believe that we can truly be in control of the enemy or the situation. And the further removed commanders are from the Marines actually engaging the enemy, the less direct control they have over their actions. We must keep in mind that war is at base a human endeavor. We could not get people to act like mindless robots, even if we wanted to. Given the nature of war, the remarkable thing is not that commanders cannot be thoroughly in control but rather that they can achieve much influence at all. We should accept that the proper object of command and control is not to be thoroughly and precisely in control. The turbulence of modern war suggests a need for a looser form of influenceâ€”some- thing that is more akin to the willing cooperation of a basketball team than to the omnipotent direction of the chess playerâ€”that provides the necessary guidance in an uncertain, disorderly, time-competitive environment without stifling the initiative of subordinates. A complex system is any system composed of multiple parts, each of which must act individually according to its own circumstances and which, by so acting, changes the circumstances affecting all the other parts. A boxer bobbing and weaving and trading punches with his opponent is a complex system. A soccer team is a complex system, as is the other team, as is the competitive interaction between them. A squad-sized combat patrol, changing formation as it moves across the terrain and reacting to the enemy situation, is a complex system. A battle between two military forces is itself a complex system. But even if this is not so, even if each of the parts is fairly simple in itself, the result of the interactions among the parts is highly complicated, unpredictable, and even uncontrollable behavior. Each part often affects other parts in ways that simply cannot be anticipated, and it is from these unpredictable interactions that complexity

emerges. With a complex system it is usually extremely difficult, if not impossible, to isolate individual causes and their effects since the parts are all connected in a complex web. The behavior of complex systems is frequently nonlinear which means that even extremely small influences can have decisively large effects, or vice versa. Particular factors can often be decisiveâ€”details only known to those who were on the spot. It is not simply the number of parts that makes a system complex: A machine can be complicated and consist of numerous parts, but the parts generally interact in a specific, designed wayâ€—or else the machine will not function. While some systems behave mech- anistically, complex systems most definitely do not. Complex systems tend to be open systems, interacting frequently and freely with other systems and the external environment. Our approach to command and control must find a way to cope with this inherent complexity. While a machine operator may be in control of the machine, it is difficult to imagine any commander being in control of a complex phenomenon like war. This view of command and control as a complex system characterized by reciprocal action and feedback has several important features which distinguish it from the typical view of command and control and which are central to our approach. First, this view recognizes that effective command and control must be sensitive to changes in the situation. This view sees the military organization as an open system, interacting with its surroundings especially the enemy , rather than as a closed system focused on internal efficiency. An effective command and control system provides the means to adapt to changing conditions. We can thus look at command and control as a process of continuous adaptation. Second, the action-feedback loop makes command and control a continuous, cyclic process and not a sequence of discrete actionsâ€—as we will discuss in greater detail later. Third, the action-feedback loop also makes command and control a dynamic, interactive process of cooperation. Command and control is thus fundamentally an activity of reciprocal influenceâ€—give and take among all parts, from top to bottom and side to side. Fourth, as a result, this view does not see the commander as being above the system, exerting command and control from the outsideâ€—like a chess player moving the chess piecesâ€—but as being an integral part of this complex web of reciprocal influence. And finally, as we have mentioned, this view recognizes that it is unreasonable to expect command and control to provide precise, predictable, and mechanistic order to a complex undertaking like war. The basic elements of our command and control system are people, information, and the command and control support structure. The first element of command and control is peopleâ€—people who gather information, make decisions, take action, communicate, and cooperate with one another in the accomplishment of a common goal. People drive the command and control systemâ€—they make things happenâ€—and the rest of the system exists only to serve them. The essence of war is a clash between human wills, and any concept of command and control must recognize this first. Because of this human element, command is inseparable from leadership. The aim of command and control is not to eliminate or lessen the role of people or to make people act like robots, but rather to help them perform better. Human beingsâ€—from the senior commander framing a strategic concept to a lance corporal calling in a situation reportâ€—are integral components of the command and control system and not merely users of it. All Marines feel the effects of fear, privation, and fatigue.

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5: 4 Command-and-Control Systems | C4ISR for Future Naval Strike Groups | The National Academies Pre

Command and Control theory, and associated operational concepts that enable us to leverage shared awareness to improve the effectiveness and efficiency of assigned missions.

Automation -- a staple of federal IT initiatives for decades -- can only go so far when it comes to improving the performance and cost-effectiveness of government operations. The problem is that traditional software can only do so much without human intervention. That is where artificial intelligence comes in. The interest in AI is not to replace people, but to augment their ability to do their jobs, whether that involves managing IT operations, analyzing data or delivering services. With AI applied, predictive analytics become more powerful, software-defined infrastructure can be increasingly self-healing, and the Internet of Things opens new opportunities for systems automation. Market research firm Gartner has identified AI as a megatrend over the next ten years, because of its potential to drive innovation in other fields. This workshop brought together IT leaders from government and industry to explore the future of AI and machine learning in government. The sessions looked at key issues that agencies must consider when adopting AI-based solutions and highlight emerging best practices in early efforts in augmented government. Potential topics addressed included: Since he has supported the Department of Defense in the areas of Information Assurance and Cybersecurity. From , in his most recent position, Mr. Dennis leads a team of subject matter experts to address a variety of homeland security challenges, including automated risk assessment, social media analytics, and data driven investigations using big data and internet of things technologies. This program has delivered the first commercially supported open source platforms for big data analytics to ICE to support data driven investigations. Dennis holds MBA and M. Alexander Kott Chief Scientist, U. Alexander Kott serves as the Chief Scientist for the U. Between and , Dr. Army Research Laboratory He was responsible for a diverse portfolio of fundamental research and applied development in network science and science for cyber defense. His efforts helped start the Cyber Security Collaborative Research Alliance, a unique program of creating basic science of cyber warfare. From to , Dr. Technologies developed in programs under his management ranged from adversarial reasoning, to prediction of social and security phenomena and command and control of robotic forces. There, his work focused on novel information technology approaches, such as Artificial Intelligence, to complex problems in engineering design, and planning and control in manufacturing, telecommunications and aviation industries. He earned his Ph. Kott has published over 80 technical papers and has served as the initiator, co-author and primary editor of over ten books, including Advanced Technology Concepts for Command and Control, ; Information Warfare and Organizational Decision Process, ; Adversarial Reasoning: His passion is to bring together technology and innovation to solve government and citizen problems. Michael Marchuk Technology Evangelist, North America, Blue Prism Click for Bio Author, speaker, and business leader Michael Marchuk has been working with organizations for over 35 years to provide a positive impact using technology to advance business objectives. He started his career within statistics and bench marking for a small professional services firm. From there he moved to one of the largest and most advanced telcos for 10 years to be a SQL developer and eventually leading teams such as the Six Sigma team, consolidated customer experience analytics team, and then prior to leaving leading analytics strategy and planning. Since then he has been practice leader for multiple global systems integrators. Geoff has also spoke and written on numerous topics within the analytical space.

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Command, Control, Communications, Computers, Intelligence, and Space (PEO[C4I&S]), but a significant number of programs for C2 systems more directly involved with weapons systems are in the Program Executive Office for Integrated Warfare Systems (PEO[IWS]) and the Program Executive Office for Strike Weapons and Unmanned Aviation

(PEO[W]).

7: Command and control - Wikipedia

Command and control warfare encompasses all the military tactics that use communications technology. It can be abbreviated as C 2 W. An older name for these tactics is "signals warfare", derived from the name given to communications by the military.

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