# THE SECOND REVOLUTION IN MILITARY AFFAIRS

**Laurian GHERMAN**
"Henri Coanda"Air Force Academy , Brasov, Romania

*The four components of the OODA loop can be split into three which are associated with processing information, and one which is associated with movement and application of firepower. Observation-Orientation-Decision is information centric while Action is kinetic or centered in movement, and firepower. Armed with a general understanding of the concepts of Information Superiority and Network Centric Warfare, enterprising individuals and organizations are developing new ways of accomplishing their missions by leveraging the power of information and applying network-centric concepts. Creating a military structure based on NCW concept represent the first revolution in military affairs. Most of the weapons used are based on an old technology which achieved a maximum level of evolution. In order to increase the envelope of that weapons in term of mobility, firepower and precision other technology should been created. On the other hand all weapons are based on oil fuel for mobility and chemical energy on fire power. For that reasons a second revolution in military affaires should happen.*

**Key words:** revolution in military affaires, network centric warfare, information warfare, railgun.

## 1. INTRODUCTION

The subject of military transformation has expanded to the point that it transcends focused discussion. From a cult phenomenon among military historians, government officials, and policy analysts in the 1980s and 1990s, the concept has morphed into a 21st-century all-purpose explanation for military decision making. It provides a rationale for expanded foreign policy objectives. Further, it has been adopted as a touchstone by the Department of Defense (DOD), especially the civilian leadership, to justify weapons programs and operational approaches. Finally, it has been the object of scholastic attention. Transformation is thus in danger of being the most oversold military-strategic concept since deterrence. A vast academic and military literature and extensive policy-related discussion have raised important questions about U.S. military policy, strategy, and war. Transformation, as understood by Pentagon planners and the political leaders, has the potential to improve military performance in important ways. But it is far from a guarantor of strategic success or sensible policy choices at the margin. This discussion asks pertinent questions about what transformation means and explores its implications for policy and strategy issues that have both immediate and longer-term importance.

## 2. THE FIRST REVOLUTION IN MILITARY AFFAIRS

From a broad perspective the introduction of networking techniques into war fighting systems is the military equivalent of the digitization and networking drive we observed in Western economies between 1985 and 1995. Military networking, especially between platforms, is far more challenging than industry networking due to the heavy reliance on wireless communications, high demand for security, and the need for resistance to hostile jamming. The demanding environmental requirements for military networking hardware are an issue in their own right. It should come thus as no surprise that the introduction of networking into military environments has proven more painful and more protracted than the industry experience of over a decade ago. At the most fundamental level networking aims to accelerate engagement cycles and operational tempo at all levels of a war fighting system. This is achieved by providing a mechanism to rapidly gather and distribute targeting information, and rapidly issue directives. A high speed network permits error free transmission in a fraction of the time required for voice transmission, and permits transfer of a wide range of data formats. In a more technical sense, networking improves operational tempo (optempo) by accelerating the Observation-Orientation-Decision phases of Boyd's Observation-Orientation-Decision-Action (OODA) loop.

The four components of the OODA loop can be split into three which are associated with processing information, and one which is associated with movement and application of firepower. Observation-Orientation-Decision is information centric while Action is kinetic or centered in movement, and firepower. If we aim to accelerate our OODA loops to achieve higher operational tempo than an enemy, we have to accelerate all four components of the loop. Much of twentieth century war fighting technique and technology dealt with accelerating the kinetic portion of the OODA loop. Mobility, precision and firepower increases were the result of this evolution. There are practical limits as to how far we can push the kinetic aspect of the OODA loop - more destructive weapons produce collateral damage, faster platforms and weapons incur ever increasing costs. Accordingly we have seen evolution slowdown in this domain since the 1960s. Many weapons and platforms widely used today were designed in the 1950s may remain in use for decades to come, the B-52 being a good case study.

For this reason the attention had focused on accelerating the Observation-Orientation-Decision phases centered in information.

Information is a resource created from two things: phenomena (data) that are observed, plus the instructions (systems) required to analyze and interpret the data to give it meaning. The value of information is enhanced by technology, such as networks and computer databases, which enable the military to

(1) Create a higher level of shared awareness,

(2) Better synchronize command, control, and intelligence, and

(3) Translate information superiority into combat power.

The current DOD term for military information warfare is "Information Operations" (IO). DOD information operations are actions taken during time of crisis or conflict to affect adversary information, while defending one's own information systems, to achieve or promote specific objectives. The focus of IO is on disrupting or influencing an adversary's decision-making processes.[2]

DOD identifies five core capabilities for conduct of information operations:

(1) Psychological Operations,
(2) Military Deception,
(3) Operations Security,
(4) Computer Network Operations, and
(5) Electronic Warfare.

These capabilities are interdependent, and increasingly are integrated to achieve desired effects.

DOD defines PSYOP as planned operations to convey selected information to targeted foreign audiences to influence their emotions, motives, objective reasoning, and ultimately the behavior of foreign governments, organizations, groups, and individuals.

Deception guides an enemy into making mistakes by presenting false information, images, or statements. MILDEC is defined as actions executed to deliberately mislead adversary military decision makers with regard to friendly military capabilities, thereby causing the adversary to take (or fail to take) specific actions that will contribute to the success of the friendly military operation.

OPSEC is defined as a process of identifying information that is critical to friendly operations and which could enable adversaries to attack operational vulnerabilities.

CNO includes the capability to:

(1) Attack and disrupt enemy computer networks;

(2) Defend our own military information systems;

(3) Exploit enemy computer networks through intelligence collection, usually done through use of computer code and computer applications.

EW is defined by DOD as any military action involving the direction or control of electromagnetic spectrum energy to deceive or attack the enemy. High power electromagnetic energy can be used as a tool to overload or disrupt the electrical circuitry of almost any equipment that uses transistors, micro-circuits, or metal wiring. Directed energy weapons amplify, or disrupt, the power of an electromagnetic field by projecting enough energy to overheat and permanently damage circuitry, or jam, overpower, and misdirect the processing in computerized systems. DOD now emphasizes maximum control of the entire electromagnetic spectrum, including the capability to disrupt all current and future communication systems, sensors, and weapons systems.

DOD transformation seeks to reorient us and focus our attention on emerging and future missions, change the way we fight (operate) to leverage Information Age concepts and technologies, and change our business processes to make us an Information Age organization.

Transformation is about continuous adaptation to the Information Age. A report to Congress on Network Centric Warfare began its executive summary by saying that “Network Centric Warfare is no less than the embodiment of an Information Age transformation of the DOD.” This transformation must focus on C2, where information is translated into actionable knowledge. Without a transformation of C2, it is far less likely that we will be able to meet the challenges that lie ahead. A transformation of C2 provides us with the best opportunity to achieve the one organizational characteristic that is sure to stand us in good stead for the foreseeable future–agility. Armed with a general understanding of the concepts of Information Superiority and Network Centric Warfare, enterprising individuals and organizations are developing new ways of accomplishing their missions by leveraging the power of information and applying network-centric concepts.

Two key realities dominate thinking about *command and control* (C2) in the 21st century. The first is the nature of the 21st century military mission space. This space is characterized by its extreme uncertainty. In addition to the high intensity combat operations that are traditionally associated with military operations, the 21st century mission space has expanded to include a wide spectrum of mission challenges, ranging from providing support to multi-agency disaster relief operations to complex coalition efforts within a political-military environment involving a large variety of military and non-military actors; which we describe as *Complex Endeavors* [1].

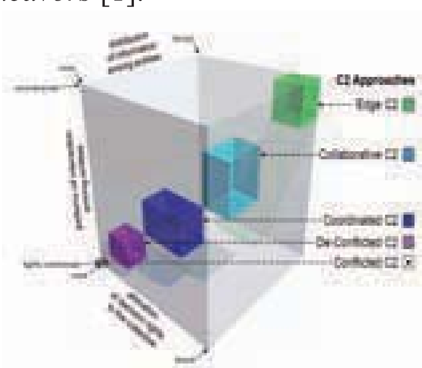

**Fig. 1** C2 Approaches as regions in the C2 Approach Space

The second reality is the ongoing transformation of 21st century militaries, and for that matter, other 21st century institutions and actors from the Industrial Age to the Information Age. With this transformation comes the ability to leverage new information technologies. This has had, and will continue to have, a profound effect on how institutions manage themselves and how they can work with coalition partners.

These fundamental realities put the emphasis on command and control (C2), interpreted in its broadest sense to include acquiring, managing, sharing and exploiting information, and supporting individual and collective decision-making. In particular, more mature C2 includes the ability to recognize situational change, and to adopt the C2 approach required to meet that change – which we term *C2 Agility* [1].

The C2 approach space contains the different possible approaches to accomplishing the functions that are associated with command and control. This approach space can be viewed from two perspectives. First, it can be used to think about C2 within existing organizations. Second, it can be used to think about how a disparate set of independent (yet inter-dependent) entities, that is, a collective, can achieve focus and convergence.

We define NCW as an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization.

In essence, NCW translates information superiority into combat power by effectively linking knowledgeable entities in the battle space. Creating a military structure based on NCW concept represent the first revolution in military affairs. Most of the weapons used are based on an old technology which achieved a maximum level of evolution. In order to increase the envelope of that weapons in term of mobility, firepower and precision other technology should been created. On the other hand all weapons are based on oil fuel for mobility and chemical energy on fire power. For that reasons a second revolution in military affaires should happen.

## 3. THE SECOND REVOLUTION IN MILITARY AFFAIRS

Warship designers until now have used hydraulics, pressurized air, and steam to move large masses, such as aircraft catapults, aircraft elevators, and ship propulsion systems, yet new advances in high-power electronic devices may lead to all-electric power aboard surface vessels. The latter half of the past century saw nuclear power, computers, and precision-guided rocketry greatly increase the capabilities and killing power of naval warships. While those technologies improved through the decades, the next evolution in ship design is expected to alter naval maritime architectures so dramatically that it has been compared to the transition from sail – to steam – to nuclear power.

This next evolution, called advanced electrical power systems (AEPS), involves the conversion of virtually all shipboard systems to electric power – even the most demanding systems, such as propulsion and catapults aboard aircraft carriers.

AEPS, in short, will provide the foundation upon which to build fleets of all-electric ships – otherwise known as AESs. Ship designers are already working on all-electric ship concepts in programs such as:

- the U.S. Navy's next-generation destroyer, known as DDG 1000 Zumwalt;
- the British Royal Navy's Daring-class Type 45 destroyer;
- the French navy's Forbin-class Horizon future anti-air warfare frigate;
- the Italian navy's Bergamini-class Horizon frigate.

Also planned as an all-electric ship is the CVN-21 (CVN-X) next-generation U.S. Navy carrier, currently in Phase II design and scheduled for launch around 2011 to 2013 to replace the then half-century-old USS Enterprise (CVN 65). The CVN-21's new nuclear reactor not only will provide three times the electrical output of current carrier power plants, but also will use its integrated power system to run an electromagnetic aircraft launch system (EMALS) to replace the current steam-driven catapults. Combined with an electromagnetic aircraft recovery system (EARS), EMALS will enable the new carrier to conduct high-intensity aircraft launch and recovery operations consistently with minimal recovery or maintenance downtime.

The amount of power that an electric motor generates, stores and distributes throughout a vessel, in tandem with an integrated "fight-through" power (IFTP) system designed to function despite combat damage, is essential to the operation of the next generation of warships, due to the enormous amount of electrically powered components they will carry. These include computing systems for functions such as network-centric warfare and onboard automation; powerful surface and underwater sensors and dual-band radar units; "plug-and-play" modules that upgrade operational capabilities during the life of a ship; launch and guidance of conventional armaments such as the 155mm. Advanced Gun System and Tomahawk cruise missile; and new armaments such as directed-energy weapons and rail guns, which are still on the drawing board. An electric motor and the IFTP system also will manage energy more efficiently than the gas-turbine power plants, gearboxes and related mechanical components they replace. This is because software developed for use with the IFTP system regulates energy distribution to the propellers and elsewhere in the ship. Rather than having conventional turbine engines dedicated to propulsion and configured to deliver maximum power in anticipation of a rare command for flanking speed, energy will be channeled as needed to the propellers, computing systems, radar, sensors and weapons, as well as to the ship's "hotel loads" (i.e., electric lights, water-purification system, and cooking and cleaning appliances).

The efficient distribution of energy is one way that an electric propulsion system reduces fuel costs. Though the unit is still powered by gas turbines, the ability to adjust energy needs according to demand reduces fuel consumption.

There are other benefits, such as longer periods between refueling, which increase cruising range, and a reduced infrared signature due to lower emissions of exhaust gases. Moreover, since an electric propulsion system has fewer mechanical components than conventional turbine motors, it doesn't require as many personnel for operation and maintenance, which fits in with another goal of the DDG 1000 ships-reduced crew size (though this will largely be achieved by extensive automation). The Zumwalt is designed for a crew of 142; the Arleigh Burke-class destroyer, by contrast, has a crew of 341.

**Fig. 2** DDG 1000 design features and systems

In future conflicts, naval forces envision conducting ship-to-objective maneuvers as an integral part of the joint campaign. Joint ground elements will consist of increasingly light, highly maneuverable forces that will employ indigenous light, lethal fires from advanced ground combat vehicles while directing heavy joint fires that will be delivered increasingly from the air and sea. The integration of special operations forces and joint fires during

Operation Enduring Freedom was just a glimpse of how the relationship between ground forces, fires, and maneuver elements will transform future military operations. Naval forces must continue to extend their operational reach from the beach to 200 miles inland and beyond. Future operations will require the capability to engage thousands of targets a day, up from the current capability of sea-based missiles and carrier aviation to engage a few hundred targets in that time frame. To support the ground campaign, sea-based naval fires also must achieve performance equal to or greater than that currently available from shore-based artillery systems.

Constrained by physics and cost, conventional guns have reached their inherent limitations. The limits of gas expansion prohibit launching an unassisted projectile to velocities of greater than about 1.5 kilometers per second (km/sec) and ranges of more than 50 miles from a practical conventional gun system. Alternatively, the extended range guided munitions (ERGM) and advanced gun system (AGS) would launch rocket-assisted shells to extend the range of conventional guns, but tradeoffs between size, rocket fuel, and lethal payload requirements make these options prohibitively expensive beyond their expected ranges.

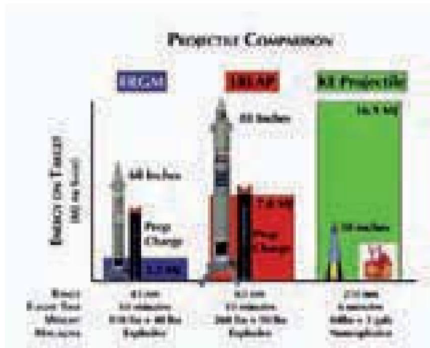


**Fig. 3** Projectile comparison

Electromagnetic rail gun technologies offer the most mature, unconventional, extended-range fire support solution. Increased muzzle velocity is the key to cost-effective increases in range, lethality, and responsiveness because it provides these benefits without onboard propellants or explosives. Rail guns are the only systems that have demonstrated a capability to launch projectiles to 4.4 km/sec, and recent technical developments have significantly reduced the technical barriers to fielding naval systems.

Developing rail gun technology would shift the possibilities for naval fire support to a new performance curve, allowing tremendous future growth potential in gun technology. To put things in perspective, current 5-inch gun has muzzle energy of 10 megajoules (MJ). ERGM will increase this to 18 MJ, and AGS will press the limits of conventional gun physics by attempting to achieve muzzle energy in excess of 33 MJ. In contrast, naval railguns will achieve muzzle energies from 60 to 300 MJ. Research indicates that a notional first-generation naval railgun with a 2.5-km/sec muzzle velocity could deliver a guided projectile with an impact velocity of Mach 5 to targets at ranges of 250 miles at a rate of greater than six rounds per minute. Mature rail gun technology is predicted to produce a much greater capability.[5]

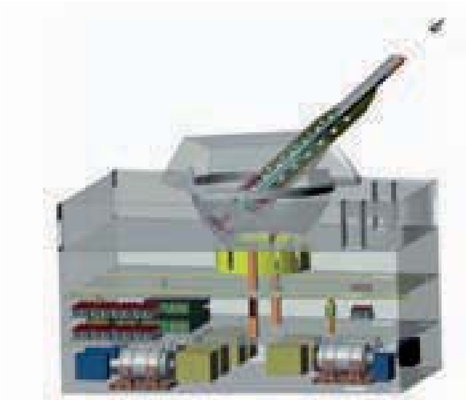

**Fig.4** Naval Railgun

An important advantage of rail guns is the ability to exploit the high kinetic energy (KE) stored in the projectile for extremely lethal effects. One test demonstrated that the release of the rail gun projectile's kinetic energy alone would create a 10-foot diameter crater, 10 feet deep in solid ground, and achieve projectile penetration to 40 feet. Hypervelocity projectiles provide deep penetration to destroy hardened targets that are extremely hard to kill by other methods. Nothing prohibits the use of explosives, but lethality studies suggest that rail gun KE projectile concepts will be sufficiently lethal-three to five times more deadly than current gun systems.

Compared with propellant guns, railguns can fire at higher velocities and do not require gun propellant but use ships' fuel. These features lead to important advantages, including shorter time of flight (important for ship defense), higher lethality on target (important for direct fire), and very extensive range capability (important for support of troops on shore). Such extended range capability also supports the sea-basing concept in which a forward deployed battle group is able to operate far enough off shore to be safe while providing a long reach for distant targets.

## 4. CONCLUSIONS

During the time the weapons was based by mechanical energy (bows, catapults) and chemical energy (guns, missiles). Now more and more weapons are designed using electromagnetic energy. Instead to accommodate new systems on old weapons the weapons designers are looking to integrate all systems in an electrical powered weapon. Despite the fact the speed of development are different, now we can see the two steps of revolution in military affair started at the end of industrialization age. First step was networking all the elements of the battle field sensors, platforms and decisions makers. Second step are in development and consist in building weapons based on electromagnetic energy. Both steps will create a stronger military body able to respond to future challenges.

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