CAMOUFLAGE COMBAT UNIFORM

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The development, testing, and fielding of combat uniforms for soldiers offer acquisition professionals an opportunity to analyze how programs progress through the U.S. defense acquisition system. This case centers on the U.S. Army's decision to change the camouflage patterns on combat uniforms and equipment for soldiers. The case is broadly applicable to project managers, business managers, engineers, testers, and logisticians involved in project management, while specifically targeting defense acquisition professionals. Emphasis is placed on the development of critical thinking and analysis skills in the areas of stakeholder management, resource management, and decision making in a complex environment. The case is developed in two distinct parts. Part I provides an analysis of the Army's development of a plan with an increased chance of success in meeting desired objectives. Part II analyzes how the Army decided to change the camouflage pattern on combat uniforms through an informed, knowledge-based process.

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Image designed by Michael Bubar-Krukowski

The Situation, October 2013

The Army Program Manager for Soldier Protection and Individual Equipment (PM SPIE) sat in his office at Fort Belvoir in total disbelief as he read an email from the contracting officer stating that a contract for the Army to purchase the camouflage pattern had never actually been accepted by the contractor. The email came after the PM asked the contracting officer to send a copy of the signed contract. The contracting officer's response was delayed by several weeks because Department of Defense (DoD) agencies were resuming normal operations after being shut down (October 1–16), with most federal employees furloughed, because neither an appropriations act nor a continuing resolution was enacted for Fiscal Year (FY) 2014. On the Friday afternoon before the shutdown, the contracting office reported the successful award of a contract to a commercial vendor for its camouflage pattern, commercially known as MultiCam©. Because of significant Army senior leader and congressional interest, notification of the contract award was documented in Significant Activity Reports to the Chief of Staff of the Army (CSA) and Secretary of the Army (SecArmy) levels.

Now, the PM faced the dilemma of how to notify Army senior leaders that the contract had not been awarded and that his team would have to develop options for the Army to consider going forward—both of these tasks were significant events considering the importance of the Army combat uniform (ACU) camouflage decision. The Army had completed the extensive combat uniform camouflage testing—testing that began in 2009 with reviews and a decision process that finally resulted in the selection of an acceptable camouflage pattern for ACUs. The PM started to consider all the information needed to help Army senior leaders make an informed decision: the importance of camouflage to soldier force protection and mission effectiveness, camouflage testing basics, the history of the testing program, the status of soldier combat uniforms, and the affordability aspects of the decision. First things first—the PM asked his deputy to immediately draft a notice to inform senior leaders that the previously announced award of the contract was premature.

Background

It's Only Camouflage—How Important Can It Be on the Modern Battlefield?

The protection of American soldiers in combat was a top priority for senior leaders in the U.S. Army, the DoD, and Congress. The DoD committed considerable resources and funding over the years to research and development, resulting in advanced materials and manufacturing processes. These investments increased the combat effectiveness of soldiers and their units. The force protection of soldiers was considered as a layered approach. The outer force protection layer for soldiers was situational awareness. The inner force protection layer was personal protective equipment, like helmets and ballistic vests with ceramic plate inserts. The middle force protection layer was concealment. Camouflage on combat uniforms remained the most important contribution to the overall concealment of individual soldiers on the battlefield.

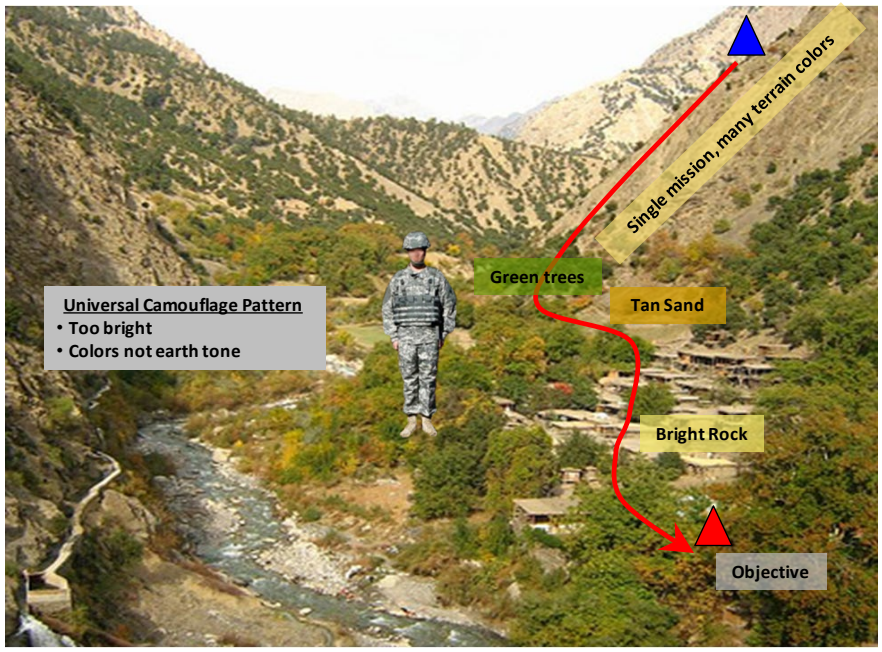
"Anecdotal evidence from soldiers on the importance of camouflage came from recounted combat missions in which they were close enough to the enemy to hear conversations without being seen—particularly during night operations.

Reinforcing the importance of camouflage was the result of postcombat surveys from soldiers deployed to Iraq and Afghanistan, in which the majority of soldiers indicated that better camouflage on combat uniforms contributed to increased combat effectiveness. Anecdotal evidence from soldiers on the importance of camouflage came from recounted combat missions in which they were close enough to the enemy to hear conversations without being seen—particularly during night operations. This contributed to the dominance of U.S. soldiers and the "we own the night" tactical advantage of U.S. forces. Basically, the enemy cannot kill what they cannot see. Effective combat uniform camouflage remained a significant combat multiplier for soldiers, thus increasing mission accomplishment.

Army soldiers in Afghanistan faced diverse battlefield operating environments in combat operations (Figure 1).[1] During a single mission, soldiers faced many different terrains across various environmental backgrounds. Each of these environmental backgrounds contained different earth-tone colors, which required different matching earth-tone colors

in the combat uniform to effectively conceal a soldier from detection or observation. Soldiers who wore combat uniforms and equipment with the universal camouflage pattern (UCP), a three-color digital pattern adopted by the Army in 2005, did not effectively blend into the diverse backgrounds typical during combat missions. The UCP colors were not earth-tone and were generally too bright—making soldiers easy to detect and providing ineffective concealment.

FIGURE 1. WHY THE U.S. ARMY NEEDED A DIFFERENT CAMOUFLAGE PATTERN

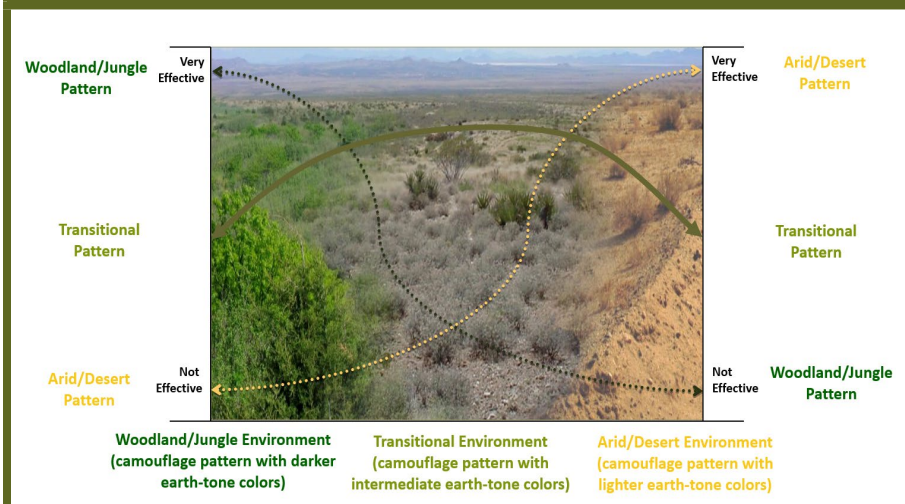


Note. Adapted from PM SPIE, personal communication, April 11, 2013.

The Army faced a critical question with respect to providing soldiers with effective camouflage on combat uniforms and equipment—how many camouflage patterns should be adopted? Soldiers operating in diverse operating environments had proven that the most effective camouflage pattern matches the colors of the background environment. A "chameleon" camouflage pattern eluded the Army due to low technological maturity level—basically, it was just not feasible to have a combat uniform with chameleon camouflage that would change color on its own to fit into its environment. Logistical and affordability considerations limited the Army from adopting a specific camouflage pattern for every combat environment. The Army settled on a strategy considering three camouflage patterns—one suited for the woodland/jungle environments, one suited for desert/arid environments, and a transitional pattern suited for most other environments.

In support of the combat uniform camouflage effort, the Army initiated an assessment of terrain throughout the globe. The Army Corps of Engineers classified the Army military operating environments across the combatant commands as 44% transitional, 37% woodland/jungle, and 19% desert/arid environments (PM SPIE, personal communication, April 11, 2013).[2] A woodland camouflage pattern would be very effective against backgrounds of darker brown and green colors and ineffective in dry arid regions (Figure 2).[3] On the other hand, a desert camouflage pattern would be very effective against backgrounds of lighter tan/sand colors and ineffective in woodland/jungle terrains. Finally, a transitional camouflage pattern would provide reasonable concealment against a broad range of environmental backgrounds. Seasonal considerations broke down the woodland/jungle and transitional backgrounds even further to dormant (without leaves on trees) and verdant (with leaves on trees) classifications.

FIGURE 2. EFFECTIVENESS OF CAMOUFLAGE PATTERNS IN DIFFERENT ENVIRONMENTS



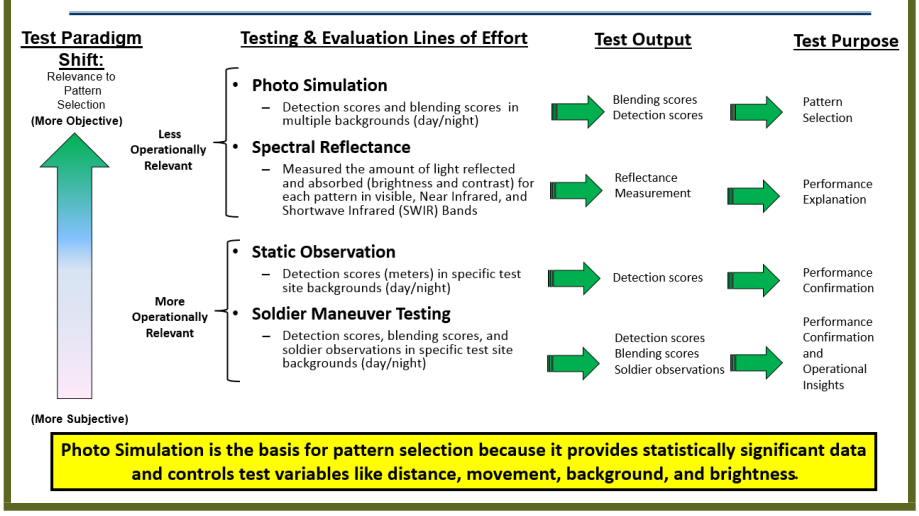
Note. Adapted from PM SPIE, personal communication, April 11, 2013.

Camouflage Testing Basics

The Army recognized that advancing the science of combat uniform camouflage testing was vitally important to enabling knowledge-based decisions on the most effective camouflage pattern. It further acknowledged that it was unaffordable to field-test various camouflage patterns in every possible environment and background. To gain a statistically robust data set to support decision making, the Army developed a test and evaluation strategy that involved a paradigm shift (Figure 3).[4] The strategy leveraged four mutually supporting lines of effort. Technical development testing

consisted of photo simulation for pattern selection and spectral reflectance measurements for performance insights. Operational field testing with soldiers consisted of static observation tests for pattern performance confirmation and maneuver tests for both pattern performance confirmation and operational insights.

FIGURE 3. CAMOUFLAGE TEST AND EVALUATION STRATEGY



Note. Adapted from PM SPIE, personal communication, April 11, 2013.

Normally, operationally realistic field testing carried the most weight in decision making over less operationally realistic developmental testing, which might rely on modeling and simulation. For camouflage testing, however, a much more extensive data set could be obtained if computer-based testing techniques were used in which soldiers observed photos of soldiers in camouflaged uniforms in many different backgrounds representing the Army's diverse military operating environments. The main effort for the test and evaluation strategy centered on the use of photo simulation to compare the effectiveness of camouflage patterns.

Two different criteria existed to compare the effectiveness of camouflage: detection and blending. Camouflage testing determined detection and blending scores for various camouflage patterns in relevant military operating environments. Detection is the ability to pick out the camouflage pattern measured at different distances, and blending is how well the camouflage pattern matches the background once detected at a specific range. Photo simulation evaluations allowed for collection of significant data in many backgrounds and controlled variables (such as distance,

movement, background, and brightness), so the difference in detection and blending scores could be attributable to different camouflage patterns (U.S. Army Natick Soldier Research, Development and Engineering Center [NSRDEC], 2009). The word "simulation" referred to the fact that the technique simulated soldiers being outside at the various sites by looking at computer screens displaying photos of soldiers in camouflage uniforms. Camouflage pattern selection criteria were based on both detection scores (at ranges up to 450 meters during the day and to 250 meters at night) and blending scores (at 50 meters during the day and at 25 meters during the night).[5] (Refer to Appendix A for a more detailed explanation of combat uniform testing basics.)

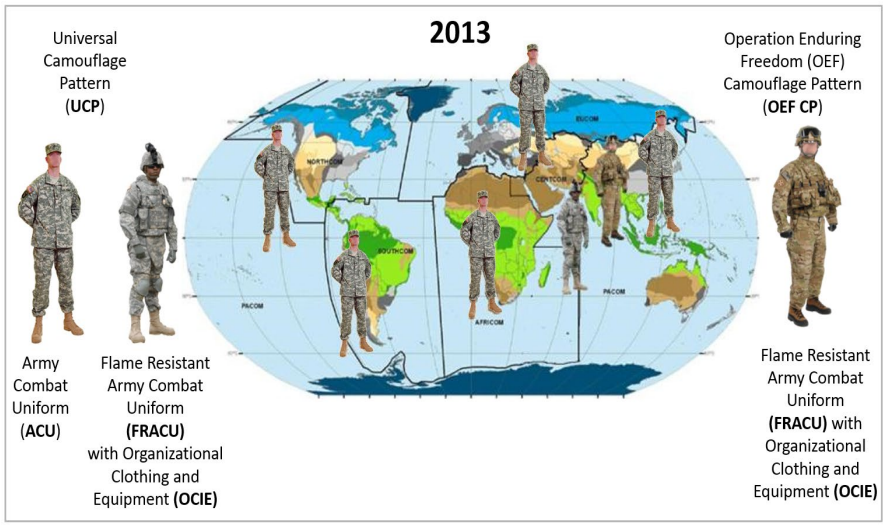
Basic Overview of Army Combat Camouflage Uniforms

After basic initial entry training, the Army issues uniforms and other essential combat equipment to soldiers. This was classified as organizational clothing and individual equipment (OCIE) and was generally referred to as the soldier's clothing bag. Part of this issue to soldiers was the ACU. The ACU was the uniform that soldiers wore in daily garrison operations when not deployed to combat operations. The ACU fabric was a 50-50 mix of cotton and nylon, and it came with the UCP, selling in the Military Clothing Store for about $90 for a coat and trouser set (PM SPIE, personal communication, July 15, 2014).[6] After their clothes wore out, soldiers used their clothing replacement allowance to buy new sets of uniforms. Examples of OCIE included the seven-layer, generation III extended cold weather clothing system (ECWCS), the field pack or rucksack (part of the modular lightweight load-carrying equipment [MOLLE]), and the ballistic vests (part of the improved outer tactical vest [IOTV])—all issued with the UCP.

Beginning in mid-2005, the Army recognized the importance of protecting soldiers from battlefield hazards and included specific uniform requirements for protection against insects (resulting in permethrin treatment) and fire (resulting in flame-resistant fabrics). When soldiers deployed to combat, the Army issued them the flame-resistant Army combat uniform (FRACU) with the UCP. The FRACU was made of 65% rayon, 25% para-aramid, and 10% nylon. The price of a FRACU set of coat and trousers averaged about $180 (PM SPIE, personal communication, July 15, 2014).[7] Additionally, soldiers received the flame-resistant environment ensemble (FREE)—the flame-resistant version of the ECWCS. Soldiers did not normally deploy with the clothing bag-issued ACU and ECWCS—those were for daily wear in garrison operations and in training. In 2011, the Army issued soldiers deploying to Afghanistan for Operation Enduring Freedom (OEF) the FRACUs and OCIE with the OEF camouflage pattern (OEF CP).

Figure 4[8] displays a pictorial representation of the uniforms soldiers would typically have worn in the summer of 2013 around the world. Soldiers wore the ACU with UCP in most regions of the world, except in the Middle East. Soldiers wore the FRACU with UCP when deployed to combat operations in Iraq and Kuwait, while soldiers supporting combat operations in OEF wore the FRACU in OEF CP.

FIGURE 4. COMMON OPERATION PICTURE FOR ARMY COMBAT UNIFORMS

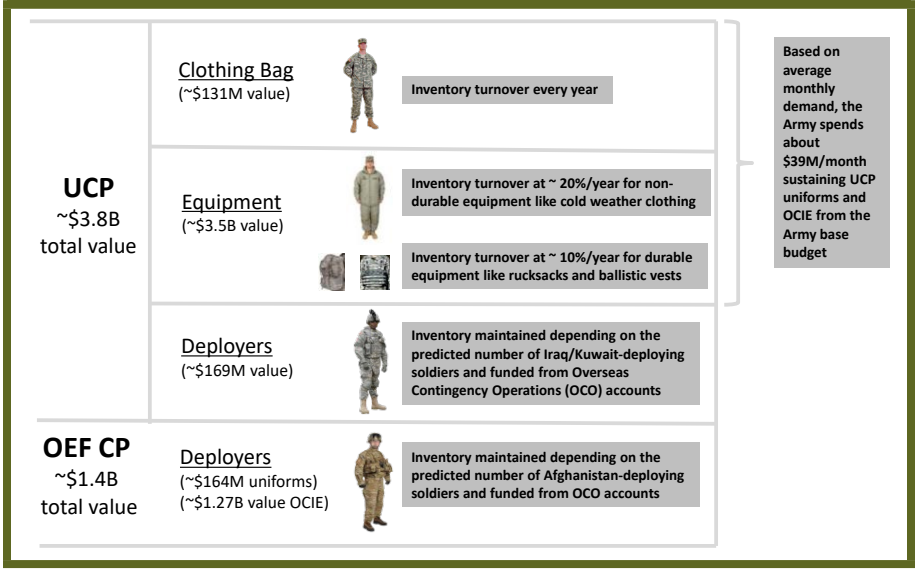


Note. Adapted from PM SPIE, personal communication, April 11, 2013.

The Army remained very cognizant of the value of the combat uniforms and OCIE worn by soldiers and in the inventory. For example, based on the number of active, reserve, and National Guard soldiers, both nondeployed and deployed, the ACUs worn by soldiers in their clothing bags are valued at about $131 million and turn over every year (PM SPIE, personal communication, May 2, 2014).[9] The value of OCIE worn by soldiers or in inventory with UCP totaled about $3.5 billion and turned over every 5 to 10 years, depending on the durability of the items (PM SPIE, personal communication, May 2, 2014).[10] Soldiers deploying to Iraq and Kuwait had another $170 million worth of UCP uniforms and OCIE (PM SPIE, personal communication, May 2, 2014).[11] Uniforms and OCIE with the UCP totaled over $3.8 billion in value (Figure 5).[12] To support soldiers deploying to Afghanistan, the Army maintained uniforms and OCIE with the OEF CP, with a value of about $1.4 billion. Based on the average monthly demand, the Army spent approximately $39 million per month sustaining UCP uniforms

and OCIE from the Army base operations and maintenance (O&M) budget for an Army of approximately 1 million soldiers (active, guard, and reserve components) (PM SPIE, personal communication, May 2, 2014).[13]

FIGURE 5. VALUE OF CAMOUFLAGE ARMY COMBAT UNIFORMS AND EQUIPMENT



Note. Adapted from PM SPIE, personal communication, May 2, 2014.

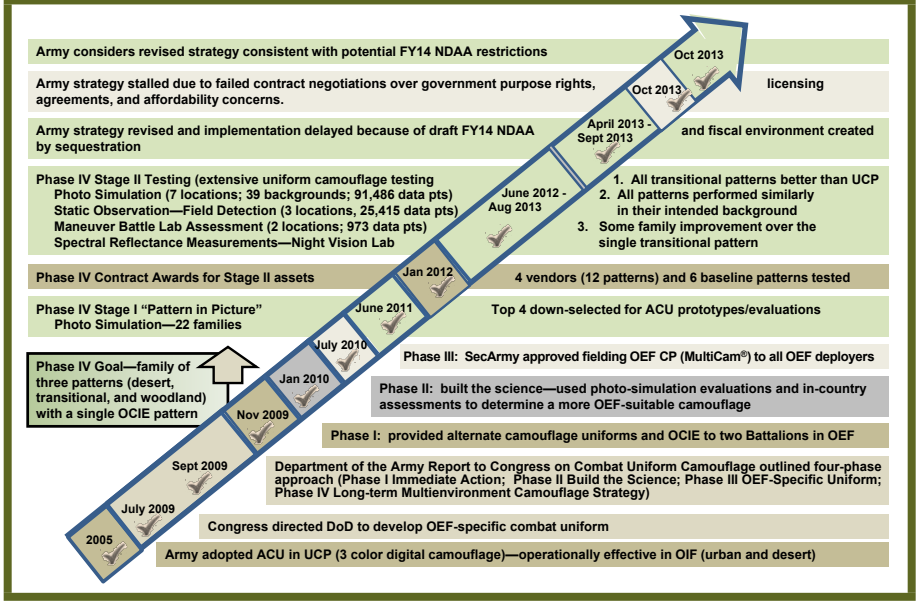
Army Combat Uniform Evolution

Figure 6[14] presents a brief recent history of ACUs since the adoption of the ACU with the UCP. In 2005, the Army adopted the ACU to replace the battle dress uniform (BDU) with the woodland camouflage pattern and desert camouflage uniform (DCU) with the desert camouflage pattern. The ACU was produced with the UCP—a digital pattern of three colors (urban gray, desert sand, and foliage green; U.S. Army NSRDEC, 2005). The Army wanted a single combat-uniform design with a single camouflage pattern. Field camouflage tests at Fort Lewis, Washington, the National Training Center at Fort Irwin, California, and the Joint Readiness Training Center at Fort Polk, Louisiana, confirmed the following (U.S. Army NSRDEC, 2004):

- In woodland environments, the ACU was equally effective as the BDU.
- In a desert environment, the ACU was as close to effective as the DCU.
- In an urban environment, the ACU was equally effective as the BDU or DCU.

Additionally, in camouflage blending tests (day and night) using photo simulation techniques, UCP provided the best average performance across desert, woodland, and urban environments compared to 10 other patterns. These patterns were the U.S. Marine Corps (USMC) marine pattern-desert (MARPAT-D), marine pattern-woodland (MARPAT-W), Scorpion (a pattern developed under a contract with the Army), desert brush, desert track, desert/urban track, standard desert (DCU), woodland track, standard woodland (BDU), and woodland brush (U.S. Army NSRDEC, 2004). The Army's decision to adopt a digital pattern (UCP) was influenced by the success of the USMC digital patterns—MARPAT-W and MARPAT-D. Ultimately, in testing, UCP provided better or equal concealment than other patterns in urban and desert terrains—obviously very important to the Army embroiled in combat operations in Iraq.

FIGURE 6. ARMY CAMOUFLAGE UNIFORM TIMELINE



Note. Adapted from PM SPIE, personal communication, April 16, 2013.

After the adoption of the ACU in 2005 and until 2009, the Army received overwhelmingly negative feedback from soldiers in combat operations in Afghanistan about the suitability of the FRACUs in UCP for the diverse Afghan backgrounds, terrains, and environments (Figure 1). As a result, in the FY 2009 Supplemental Appropriations Act, Congress directed the Army to take immediate action to provide effective camouflage for personnel deployed to Afghanistan (H.R. Rep. No. 111-151, 2009). In September 2009,

the Army submitted a Report to Congress on Combat Uniform Camouflage that outlined a four-phase approach: Phase I Immediate Action, Phase II Build the Science, Phase III OEF Specific Camouflage, and Phase IV Army Combat Uniform Decision for a Long-term Multienvironment Camouflage (Office of the SecArmy, 2009).

In November 2009, the Army completed Phase I by fielding two Army battalions (approximately 2,000 soldiers) with uniforms and OCIE in two different patterns. One camouflage pattern was universal camouflage pattern-Desert (UCP-D)—a variant of UCP with coyote brown color added and less sand color—and the other pattern was commercial camouflage called MultiCam©. MultiCam©—a seven-color pattern that was in use at the time with U.S. Special Forces in Afghanistan—was a variation of the original Scorpion pattern considered by the Army earlier in the UCP decision (U.S. Army NSRDEC, 2012).

From November 2009 to January 2010, the Army conducted Phase II, which involved soldier feedback of the two fielded patterns (MultiCam© and UCP-D), as well as photo simulation (pattern-in-picture) evaluations by soldiers of six camouflage patterns—UCP, MultiCam©, UCP-D, Mirage, Desert Brush, and a Navy pattern referred to as Area of Responsibility 2 (AOR2), which encompassed temperate/tropical forested terrain regions inserted into photographs of eight different OEF sites (U.S. Army NSRDEC, 2012). Soldiers overwhelmingly preferred both MultiCam© and UCP-D, with an edge in preference toward MultiCam©. The photo simulation involved assessments of both the detectability (range at which the pattern was detected) and blending performance (qualitative measure of how well the pattern blended into background). MultiCam© was harder to detect and blended slightly better than the other five camouflage patterns.

In February 2010, initiating Phase III, the Army selected MultiCam© as the pattern to be used on the FRACU and OCIE for deploying soldiers to Afghanistan. The Army named the commercially available MultiCam© pattern as the OEF CP. Because schedule and speed of delivery were critical, the Army encouraged separate licensing agreements between the MultiCam© commercial vendor and the companies that printed the OEF CP on fabric used for FRACUs and OCIE.

In July 2010, the Army began fielding uniforms and OCIE in the OEF CP to deploying OEF soldiers. The Army was not privy to the specifics of the licensing agreements. However, it ended up paying about a 10% premium on every uniform or piece of equipment that was camouflaged with OEF CP compared to every uniform or piece of equipment that was camouflaged with UCP (PM SPIE, personal communication, December 19, 2013).[15]

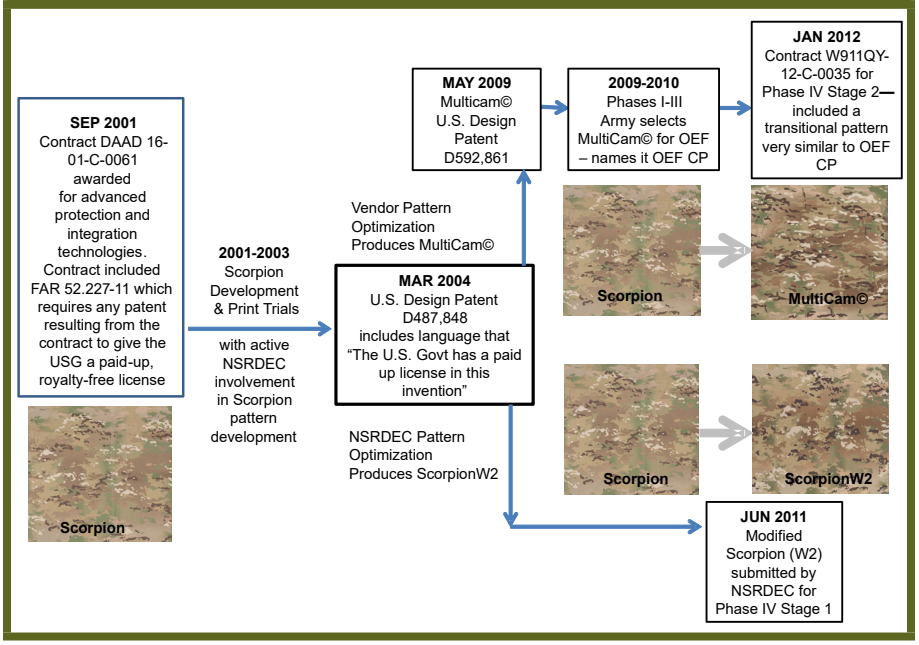
At the time, scheduling and the fielding of updated camouflaged uniforms and equipment as quickly as possible trumped affordability concerns, especially considering that uniforms for combat operations in Afghanistan were funded by overseas contingency operations (OCO) accounts without the restrictions contingent on the Army's base budget.

In December 2010, the Maneuver Center of Excellence (MCoE) outlined an 18-month-long competitive effort to lead a camouflage integrated product team through the Phase IV effort for the Army's selection of the long-term combat uniform and OCIE camouflage strategy to be effective in desert/arid, transitional, and woodland/jungle environments. The goal was to present the results to Army leadership in the fall of 2012 for a decision.

From January to June 2011, the Army scoped the Phase IV camouflage effort. Based on work performed by the NSRDEC and completed in 2009, the Army knew that environmentally specific camouflage patterns outperformed (meaning provided more effective concealment) than a single "universal" pattern (Hepfinger et al., 2010). The objective of Phase IV was to develop a "family" of three uniform camouflage patterns with a single coordinated pattern for OCIE to provide effective concealment across the globe in woodland/jungle, transitional, and desert/arid environments. A total of 22 family submissions from industry and the government competed in the first stage of Phase IV—18 family submissions were found to be technically acceptable (PM SPIE, personal communication, July 15, 2014).[16] These families of patterns were evaluated to determine blending scores using photo simulation techniques. The patterns were judged based on the best legacy patterns in the DoD inventory (desert versus a Navy pattern called Area of Responsibility 1, or AOR1 [desert/arid terrain regions], transitional versus OEF CP, and woodland versus a Navy pattern called AOR2), with family scores weighting the woodland, transitional, and desert environments.

Five families of patterns (four commercial vendors and one NSRDEC submission) performed as well as or better than the legacy family of patterns (PM SPIE, personal communication, July 15, 2014).[17] It is noteworthy that three patterns were visually similar in appearance: OEF CP (a baseline pattern), the transitional pattern proposed by one of the vendors, and the transitional pattern submitted by NSRDEC named ScorpionW2. Each of these patterns was developed, changed, and optimized independently from the same base pattern called Scorpion—a pattern developed by a commercial vendor in the early 2000s under contract with the U.S. Army. Figure 7[18] depicts relationships and differences between the Scorpion, MultiCam© (OEF CP), Phase IV transitional, and ScorpionW2 camouflage patterns.

FIGURE 7. TIMELINE OF SCORPION PATTERN DERIVATIVES



Note. Adapted from PM SPIE, personal communication, May 2, 2014. Govt = government; USG = U.S. Government.

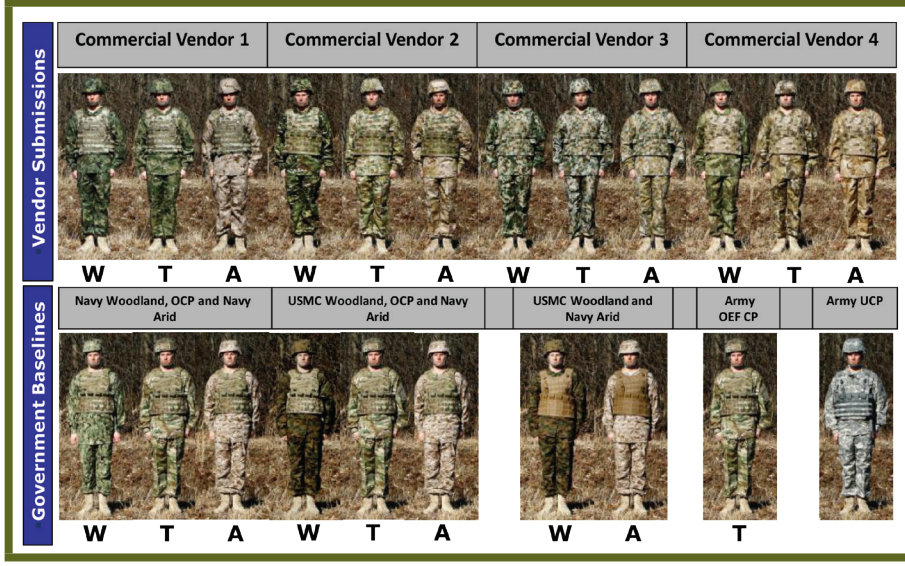
All three patterns performed similarly in testing, which served as a built-in, internal verification of the validity of the testing. At the time, even though the NSRDEC family performed well in source selection photo simulation testing, the Army decided not to continue to allow the NSRDEC family of patterns to participate in Stage II Phase IV testing. It was determined that the family of patterns lacked consistent matching geometric shapes—one of the Army criteria in the contracts with the four commercial vendors.

In January 2012, Phase IV contracts were awarded to the four down-selected vendors to produce fabric for test articles (both uniforms and OCIE) for the second stage of Phase IV. This stage included field testing, extensive photo simulation evaluations, and lab testing. Each of the four vendors had firm fixed price (FFP) contracts, with periods of performance not to exceed 30 months, to supply the Army with 1,000 yards of fabric. This would be used by the Army to fabricate test uniforms and OCIE under separate "cut & sew" contracts (U.S. Army Contracting Command, 2012a, 2012b, 2012c, 2012d). Included in the contracts were FFP options for the government to procure the nonexclusive license rights for each of the proposed camouflage patterns.

The competitive range to buy the license rights from the four vendors for a single camouflage pattern ranged from $25,000 to $2.1 million (U.S. Army Contracting Command, 2012a, 2012b, 2012c, 2012d). Each of the four vendors signed a nonexclusive license agreement that provided the Army the option to obtain (for a single lump sum) the rights to use the material for the production of patterns for printing on an unlimited number of uniforms, individual equipment, and unit-level equipment for U.S. Government purposes (i.e., Army, Navy, Marine Corps, Air Force, and Coast Guard, including their active and reserve components) excepting foreign military sales with successive renewable 10-year periods (U.S. Army Contracting Command, 2012a, 2012b, 2012c, 2012d).

From July 2012 to March 2013, the Army conducted the most extensive uniform camouflage testing ever undertaken. The 12 commercial vendors' patterns (each of the four vendors had a woodland, transitional, and desert pattern along with a matching transitional OCIE pattern) and six reference patterns (UCP, OEF CP, MARPAT-W, MARPAT-D, AOR1, and AOR2) were printed on fabric, and the fabric was assembled into uniforms and OCIE (Figure 8).[19]

FIGURE 8. PHASE IV CAMOUFLAGE PATTERNS TESTED



Note. **W** refers to woodland, **T** refers to transitional, and **A** refers to arid. Adapted from PM SPIE, personal communication, April 11, 2013.

The photo simulation evaluations collected 91,486 data points in detection and blending tests (both day and night) using 39 different backgrounds from seven global locations. Field tests for static observation detections were conducted at three different locations, resulting in the collection of an additional 25,415 data

points (Hanlin et al., 2013). Operational field tests with force-on-force soldiers were conducted at two locations, gathering another 973 data points. Finally, the spectral reflectance measurements were conducted by the U.S. Army Night Vision Laboratory (now the U.S. Army Night Vision and Electronic Sensors Directorate) to assess pattern "brightness" in visual, near infrared (NIR), and short wave infrared (SWIR) bands.

"From July 2012 to March 2013, the Army conducted the most extensive uniform camouflage testing ever undertaken.

The results of this extensive testing showed that all the vendor patterns in their intended backgrounds performed better than UCP—confirming the Army's intent to replace UCP (Mazz & Rowe, 2013). All the vendor patterns performed similarly in their intended backgrounds—this "tight shot" group gave the Army many options and confirmed that overall pattern colors and brightness were much more important than pattern design when assessing concealment effectiveness. Slight improvement was evident in the effectiveness of a family of patterns in their intended backgrounds over the performance of a single transitional pattern across the three background classes; however, the operational relevance of this improved performance proved difficult to quantify.

In May 2013, Army senior leaders approved the expanded use of OEF CP outside of OEF and the purchase of nonexclusive government license rights to one of the competing vendors' patterns (the transitional pattern that was very similar and visually indistinguishable from OEF CP), which was offered as an option in one of the Phase IV contracts. Because all of the vendor patterns performed similarly in testing, the decision was based on other considerations, primarily affordability—the Army could leverage existing inventories of OEF CP OCIE and reduce the overall implementation costs to the Army.

However, the announcement of the decision and implementation was delayed. Army senior leaders hesitated to announce a uniform change decision during a time of intense budget pressure and with the threat of sequestration looming. More importantly, the draft FY2014 National Defense Authorization Act (NDAA) was released, and it potentially limited the Army's camouflage flexibility by prohibiting any new camouflage patterns unless all Services adopted the new pattern. At the time, it was unclear whether the camouflage patterns tested in the Phase IV effort would potentially violate the NDAA restrictions.

In August 2013, to avoid the threat of protests by Phase IV vendors and subsequent lengthy contractual challenges, and to avoid potential violations of the new statutory restrictions in the pending NDAA, the Army changed its contracting strategy. Instead, it pursued a sole-source contract for the nonexclusive license rights (i.e., government purpose rights) to OEF CP and delayed exercising any remaining Phase IV contract options until the FY14 NDAA language was final. The vendor indicated to the Army that the price for OEF CP would be similar to the price offered to the Army for the transitional pattern nonexclusive license rights in the Phase IV contract (PM SPIE, personal communication, August 11, 2013).[20]

"The results of this extensive testing showed that all the vendor patterns in their intended backgrounds performed better than UCP—confirming the Army's intent to replace UCP (Mazz & Rowe, 2013).

In October 2013, the vendor balked at the terms of the contract proposed by the Army for OEF CP. The contract terms for the nonexclusive license rights were identical to the Phase IV contract option terms. The vendor now wanted considerably more money for its OEF CP transitional pattern than the terms specified in the Phase IV contract option.

Part I: Path Forward, Development of a Strategy, Fall 2013

All this information swirled around in the PM's head as he prepared to meet in the Pentagon with Army senior leaders. Fortunately for the PM, the CSA's office wanted the following points to be specifically addressed in the meeting scheduled for December 2013:

- How did this happen? What was the impact of the pending NDAA restrictions, and how would the Army keep Congress informed? What was the impact on the Phase IV contracts?
- What was the schedule and path toward an Army decision? What were the camouflage options, as well as key program and testing events, considering the performance, cost, and schedule implications?
- What were the risks associated with this camouflage decision?

Based on the guidance from leadership, the PM and his team put together some options for the Army to consider (PM SPIE, personal communication, January 29, 2014)[21]:

- Option 1: Continue to negotiate with the vendor for the nonexclusive rights for OEF CP. The initial price quoted started at $65 million, but it was later reduced to a lump sum of $24 million or 1% royalty on the price of each camouflaged uniform or piece of equipment.
- Option 2: Exercise the Phase IV contract option for nonexclusive rights to a transitional pattern.
- Option 3: Renegotiate all the Phase IV contract options for the nonexclusive rights for the patterns with all four vendors and try to select a pattern after the renegotiations.
- Option 4: Take a strategic pause and consider existing government patterns and patterns in which the government has license rights—for example, the NSRDEC pattern ScorpionW2.

The PM asked his team if there were any other options and what the decision criteria would be to compare these courses of action. Performance of the patterns remained the Army's most important criteria. However, cost/affordability was important, as well as schedule, congressional considerations (adherence to law), and litigation considerations such as the chance of protests and lawsuits challenging intellectual property rights to potential patent, copyright, and trademark issues.

The PM realized this would not be an easy set of meetings at the Pentagon. Despite the importance of combat uniform camouflage, efforts to change camouflage faced similar challenges that all programs within the DoD faced: a complex, bureaucratic, defense acquisition institution. (Refer to Appendix B for a description of the defense acquisition institution.) Any decision to change Army camouflage crossed multiple chains of command with different decision makers because it affected both uniforms and equipment. Uniform changes were approved by the CSA—and sometimes the SecArmy, if there was intense congressional, public, or media interest—after an approval recommendation from the Army Uniform Board. But camouflage also went on OCIE, and each piece of soldier kit (cold weather clothing, rucksacks, weapons, bags for night vision sights, etc.) had a different program decision maker—either a program executive officer (PEO) or the Army Acquisition Executive (AAE), depending on the acquisition category. The PM labored

over how to pull together this information to enable an informed decision and what recommendation he would make when invariably asked by Army senior leaders.

Analysis of the Army's Decision, Part I

The following section provides an analysis of how the Army made its decision. The discussion is framed by addressing key management considerations for the program management team as they prepared senior Army leaders to make the most informed decision possible.

In the general area of stakeholder management/engagement, identification of the key stakeholders and analysis of their concerns were essential. The following were the key stakeholders:

- Warfighters/Soldiers wanted camouflage uniforms to provide effective concealment in all military operating environments. Soldiers were not concerned with affordability at the Army level but were concerned about uniforms' costs when they must buy replacement uniforms. Performance was a critical decision criterion from the soldier perspective.

- Army Leadership/Decision Maker/CSA/SecArmy served as the decision authority and approved the path forward. Uniform changes must all be reviewed by the Army Uniform Board, which then made a recommendation to the CSA. In the case of uniform camouflage, the SecArmy was involved because of the sensitivity of this topic with Congress, the media, and the American public. The uniform was essentially the public face of the Army. The Army wanted to ensure that any uniform changes, particularly camouflage, were done for the right reasons, that is, to increase combat effectiveness and improve soldier protection; and that these uniform changes were executed in a fiscally responsible manner—especially at a time of budget austerity with the threat of sequestration looming. The perception of a frivolous uniform change would not pass the "*Washington Post* test" and could be a public affairs quagmire. This led to performance, cost/affordability, legal/contractual considerations, congressional considerations, and public perception considerations being important decision criteria.

- Congress wanted to support the warfighter with improved uniforms. Congress also supported the Army with resources (funding) but was concerned about the proliferation of different

combat camouflage uniforms across the Services—so much so that the NDAA restricted the adoption of new camouflage patterns unless all Services adopted the new pattern. The Army needed to ensure that Congress was well informed through required reports, hearings, and testimonies so that Congress could properly perform its crucial defense oversight mission.

- The PM ultimately was responsible for the uniform camouflage program cost, schedule, and performance. The PM had to remain neutral—trying not to advocate for any particular option so that the other stakeholders and, ultimately, senior Army leaders had ownership of the program, decision, and path forward. The PM was charged with delivering improved uniforms for soldiers as soon as possible within performance and cost constraints; and with acting as the key information source about consequences with respect to performance and cost/affordability, as well as the second-order effects of legal/contractual, public perception, and congressional implications.

The ultimate decision maker for the camouflage effort was unclear. A change in camouflage affected not only uniforms but all camouflaged soldier equipment across the Army. Typically, there would be a single decision authority for an acquisition program. For uniforms, the Army Uniform Board made a recommendation to the CSA for final approval; however, the SecArmy pulled the decision to his level. For each separate piece of equipment (that happened to be camouflaged), an assigned PM was responsible for cost, schedule, and performance. Those PMs reported to a PEO, who reported to the Assistant Secretary of the Army for Acquisition, Logistics and Technology. The bottom line is that the camouflage PM needed to get a decision from the highest levels of Army leadership and then coordinate that decision with multiple chains of command throughout the Army.

A paradigm shift required Army senior leaders to accept that the less realistic photo simulation testing was much more relevant for the selection of a camouflage pattern than more realistic field testing. It was counterintuitive, but necessary to recognize in this case. The performance of the camouflage patterns was measured in terms of detection and blending scores. These scores depended directly on important variables like the actual camouflage pattern (the colors and geometric shapes), distance, movement, lighting, and backgrounds. Field testing was extremely limited because it was nearly impossible to tightly control all the variables so that

the differences in detection and blending scores were attributed only to the change in the camouflage patterns and not to one of the other variables. Photo simulation allowed for testing in many backgrounds and tightly controlled other variables like movement, distance, and lighting, so that any change in blending or detection performance was attributed to the change in camouflage pattern. Photo simulation allowed testers to collect a statistically robust sample set.

Despite the logic in this strategy, senior Army leaders remained uncomfortable when the field testing from one specific site contradicted the photo simulation results. The PM had to build a foundation of trust so that senior leaders not only understood the strategy but accepted it and overcame the institutional barriers and cultural resistance to change.

The Army considered the following options (PM SPIE, personal communication, January 29, 2014)[22]:

- Option 1: Continue to negotiate for the nonexclusive rights for OEF CP.
- Option 2: Exercise the Phase IV contract option for nonexclusive rights for the transitional pattern.
- Option 3: Renegotiate all the Phase IV contract options for the nonexclusive rights for the patterns with all four vendors and try to select a pattern after the renegotiations.
- Option 4: Take a strategic pause and consider existing government patterns and patterns in which the government has license rights—for example, the NSRDEC pattern ScorpionW2.

To compare the options and ultimately decide on a path forward, the Army developed decision criteria. Unfortunately, PMs had no standard, formalized decision-making model or process to follow that was uniformly applied and accepted within the DoD. Some projects may be supported by a business case analysis or a cost-benefit analysis. But in this case, there was not enough information to perform these types of analyses because the benefits were qualitative and difficult to monetize. The decision was made by comparing (listing advantages and disadvantages) alternative options (or courses of action) against decision criteria. To fairly evaluate the various courses of action, discriminating decision criteria were defined. These criteria were derived from the constraints, considerations, and stakeholder concerns.

Clearly, the warfighter was most concerned with performance. However, all the options involved camouflage patterns that provided better performance than the current UCP in use, and all the camouflage patterns performed similarly. Therefore, a performance criterion was nondiscriminating. The Army decided the path forward based on the following: cost/affordability, schedule, adherence to the NDAA, and the potential for litigation. Using these criteria, the options were compared by listing the advantages and disadvantages of each option. Each criterion showed up as an advantage or disadvantage for each option. Table 1[23] lists the pros and cons of each option.

TABLE 1. PART I OPTION COMPARISON

Options	Pros	Cons
Option 1: Negotiate for nonexclusive rights for OEF CP ($24M or 1% royalty)	• Schedule (testing completed) • Adherence to the NDAA • Litigation risk is low/moderate (from contract protests)	• Cost/Affordability ($24M is above the competitive range established in the Phase IV contracts, and a 1% royalty would add a bill of $390K/month to the already overextended Army base budgets in perpetuity)
Option 2: Exercise existing Phase IV contract option for nonexclusive rights to transitional pattern ($200K)	• Schedule (testing completed)	• Cost/Affordability (less costly than Option 1 but unknown recurring license fees) • Adherence to the NDAA • Litigation risk is high (from contract protests)
Option 3: Readdress the Phase IV contracts of all four vendors with clarified contract clauses	• Litigation risk is low (from contract protests)	• Cost/Affordability (unknown) • Schedule (for contract negotiations) • Adherence to the NDAA
Option 4: Pursue existing government patterns to which the government has rights	• Cost/Affordability • Adherence to the NDAA	• Schedule (testing not completed) • Litigation risk is moderate (from intellectual property and patent challenges)

Note. Adapted from PM SPIE, personal communication, January 29, 2014.

Just using this comparison approach, the Army found it difficult to determine which option was best. Comparing the options using a decision criterion in a decision matrix allowed the options to be qualitatively ranked against one another. For each criterion, the options were ranked from best to worst with scores from 1 to 4 (1 being the best and 4 being the worst). An average score was used for options that scored the same for a criterion. Table 2 presents the decision matrix that helped the Army determine the path forward.

TABLE 2. PART I DECISION MATRIX

Decision Matrix (Qualitative Ranking of Options)						Option Scores (Lower is Better)	
Options / Criteria		Cost / Affordability	Schedule	NDAA Adherence	Litigation Risk	unweighted	weighted
	Criteria Weighting -->	3	1	2	1		
Negotiate for OEF CP rights	unweighted ranking -->	4	1.5	1.5	2	9	
	weighted ranking -->	12	1.5	3	2		18.5
Phase IV contract for transitional pattern	unweighted ranking -->	2	1.5	3.5	4	11	
	weighted ranking -->	6	1.5	7	2		16.5
Renegotiate Phase IV contracts	unweighted ranking -->	3	3	3.5	1	10.5	
	weighted ranking -->	9	3	7	1		20
Pursue existing Government patterns	unweighted ranking -->	1	4	1.5	3	9.5	
	weighted ranking -->	3	4	3	3		13

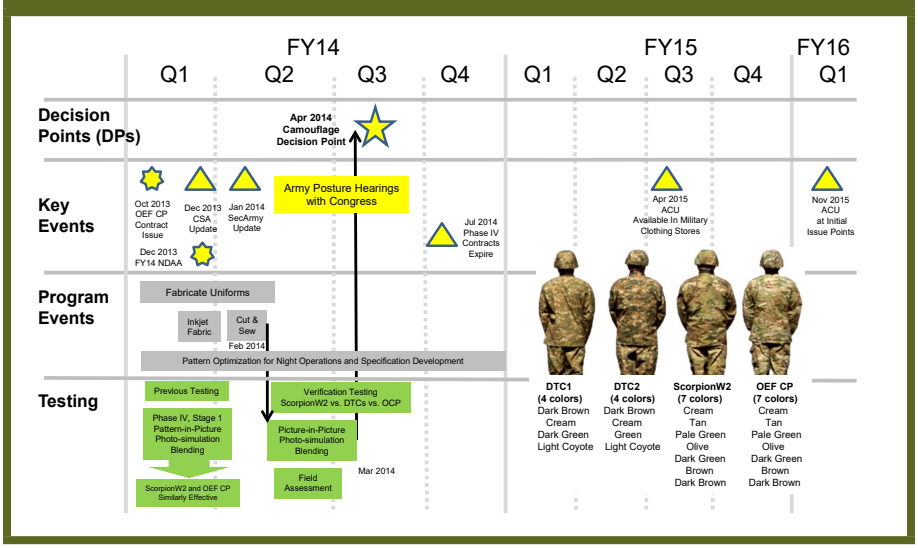
Using the criteria of cost/affordability, schedule, NDAA adherence, and litigation risk, the unweighted rankings of the options scored similarly (scores from 9 to 11)—making selection of a recommendation difficult and confirming the results from the comparison of advantages and disadvantages. Weighting of the criteria allowed the scores of the options to separate based on the importance of the criteria to the decision. For example, schedule and litigation risk were not as important in this decision as cost/affordability and NDAA adherence. When cost/affordability was weighted three times as important and NDAA adherence was weighted two times as important as schedule and litigation risk, the option scores separated. This analysis forced decision makers to critically think about why a certain option was favored over other options.

The Army chose Option 4 (take a strategic pause and consider existing government patterns and patterns in which the government has license rights); subsequently, a sensitivity analysis in which the weightings of the criteria were changed confirmed the Army's decision (PM SPIE, personal communication, January 29, 2014).[24] From this part of the case history, a key defense acquisition and program management lesson learned is not rushing to failure. The Army faced a complex and challenging problem but decided that it was best not to be schedule-driven and resolved against rushing a decision because the situation seemed urgent. In this part of the case, it was probably best for the Army to take a strategic pause to let the NDAA become final and allow time to test additional patterns for which the government had data rights.

Part II: Camouflage Decision, Winter 2013 to Spring 2014

Following a series of meetings in the Pentagon with Army senior leaders, the CSA issued the following guidance: delay any immediate decision, ensure that all options for the Army moving forward were rigorously tested, ensure that the options considered met the intent of the NDAA by pulsing congressional professional staff members, and provide an update to the SecArmy. The SecArmy subsequently approved the testing of transitional pattern alternatives for March 2014 with an anticipated decision pending successful and positive testing results in April 2014 (Figure 9).[25]

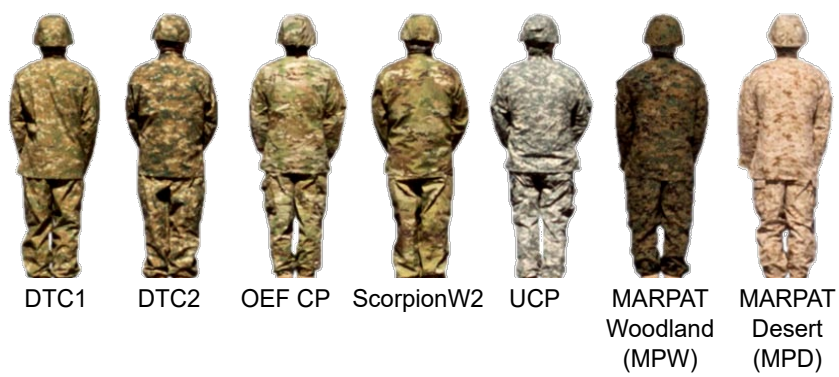
FIGURE 9. APPROVED REVISED ARMY PLAN



Note. Adapted from PM SPIE, personal communication, January 29, 2014.

After being reprimanded for lack of proper program oversight and damaging the reputation of Army acquisition leaders in the Pentagon, the PM led his team to execute another revised strategy for combat uniform camouflage testing. In December 2013, the FY14 NDAA became final and officially prohibited the Services from adopting new camouflage patterns unless all the Services adopted the new pattern (NDAA, FY 2014). This new law restricted the number of camouflage patterns considered going forward. The intent of the new strategy was to consider alternatives to OEF CP that provided equivalent or better performance, were affordable/fiscally responsible to implement, and complied with the FY14 NDAA. The testing included three baseline reference patterns (UCP, MARPAT-W, and MARPAT-D), OEF CP, and viable OEF CP alternatives. These alternatives were the ScorpionW2 pattern and two digital transitional camouflage patterns—referred to as DTC1 and DTC2—patterns based on USMCMARPAT but with four earth-tone-based colors (Figure 10).[26] The Army had a series of meetings with congressional members who sponsored the NDAA legislation and professional staff members who wrote the actual language to ensure the patterns considered were within the intent of the law. Congressional leaders considered the DTC1 and DTC2 patterns in a "gray area" of the new restrictions and were noncommittal regarding whether these patterns met the intent of the law. Nevertheless, the Army decided to test these patterns along with the other patterns.

FIGURE 10. PATTERNS TESTED BY THE ARMY AT FORT BENNING IN APRIL 2014



Note. Adapted from PM SPIE, personal communication, January 29, 2014.

In April 2014, the Army tested alternative transitional patterns at Fort Benning, Georgia, in operational field tests with U.S. Army Sniper School Cadre and in photo simulation assessments using soldiers from the 75th Ranger Regiment (Figures 11 and 12). The testing to support an Army

decision was rigorous and met the intent of the CSA. The testing used sniper experts to assess the operational relevance of the patterns in operational field tests and 106 soldiers as observers of the patterns in 46 separate backgrounds in photo simulation evaluations—collecting 19,474 data points (Lacey & Rogers, 2014; Mazz, 2014).

FIGURE 11. OPERATIONAL FIELD TEST RESULTS

Assessment Summary:

- 7 patterns, U.S. Army Sniper School cadre, 2 locations at Fort Benning, GA, on March 18, 2014
- Mostly dormant wooded and transitional terrains out to 695m
- Sensors included unaided eye and 10x binoculars—daytime visual only

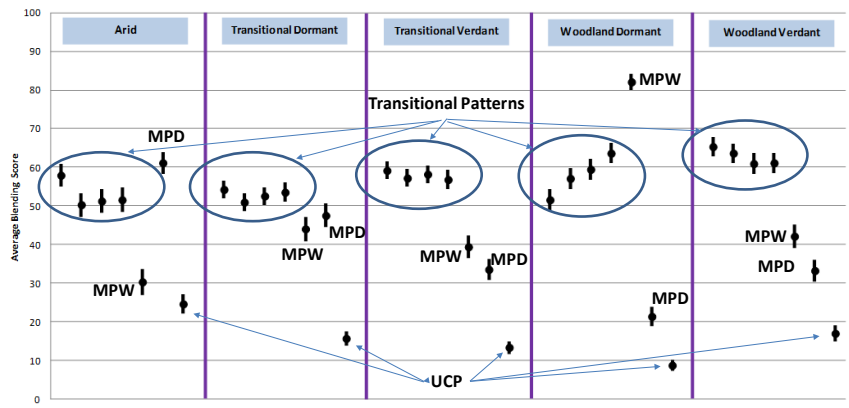
Observer Key Findings:

- After 300m, all the transitional patterns appeared the same with the naked eye. With binoculars, they were able to identify DTC2. This is mostly due to the color contrast in the pattern.
- DTC1, ScorpionW2, and OEF CP were said to be very similar; differences were difficult to detect.
- With binoculars, OEF CP, Scorpion, and DTC 1 rated higher than Woodland MARPAT and DTC2 at most stationary locations.

MARPAT Woodland (MPW)	MARPAT Desert (MPD)	UCP	DTC2	DTC1	ScorpionW2 (SCORP)	OEF CP
Performance was highly dependent on immediate background	Too bright throughout the assessment	Too bright throughout the assessment	High internal color contrast was evident more than others	Performance was similar to OEF CP and ScorpionW2	Performance was similar to OEF CP and DTC1	Performance was similar to DTC1 and ScorpionW2

Note. Adapted from Lacey & Rogers (2014); Mazz (2014).

FIGURE 12. PHOTO SIMULATION TEST RESULTS



Conclusions:

- ➢ UCP performed poorly in all five backgrounds.
- ➢ OEF CP, ScorpionW2, DTC1, and DTC2 scored similarly across all five backgrounds.
- ➢ USMC MARPAT Woodland performed well in the Woodland dormant backgrounds.
- ➢ USMC MARPAT Desert performed well in arid backgrounds.

DTC1 DTC2 OEF CP ScorpionW2 UCP MARPAT Woodland (MPW) MARPAT Desert (MPD)

Assessment Summary:

- Purpose: assess from a blending perspective the OEF CP, ScorpionW2, and DTC transitional uniform camouflage pattern candidates
- 7 patterns were assessed by 106 Soldiers from 3/75th Ranger Battalion Headquarters, Fort Benning March 30–April 2, 2014
- Pictures of Uniformed Individuals placed into 46 backgrounds; each photo viewed at least 57 times
- Total data points = 19,474

Note. Adapted from Lacey & Rogers (2014); Mazz (2014).

From the results shown in Figures 11 and 12, the Army came to the following conclusions: UCP performed poorly in all backgrounds (confirming prior results); OEF CP, ScorpionW2, DTC1, and DTC2 scored similarly across all background types; USMC MARPAT-W performed well in woodland dormant backgrounds; and USMC MARPAT-D performed well in arid environments. The results confirmed that there was a "tight shot" group for the effectiveness and performance of the transitional patterns. The Army decision came down to other considerations like affordability, cost, implementation and execution ease, schedule, contracting challenges, and intellectual property rights concerns (potential patent, trademark, and copyright challenges).

Again, the PM assembled his team to consider the following options for CSA and SecArmy to consider:

- Option 1: Do nothing. Make no decision at this time and continue the current situation of issuing soldiers UCP uniforms and equipment for all missions, except in Afghanistan where they would continue to get OEF CP uniforms and equipment.
- Option 2: Select OEF CP, accept the vendor's terms, and expand its use beyond Afghanistan as the standard pattern for all Army uniforms and equipment.
- Option 3: Select ScorpionW2 and replace worn-out UCP uniforms and equipment over time.
- Option 4: Select the DTC1 pattern and replace worn-out UCP uniforms and equipment over time.

The PM and his team considered these options the main courses of action for Army senior leaders. The team debated the following decision criteria to apply to these options: performance, schedule, affordability/cost, legal risk, and the perspectives of key stakeholders such as soldiers, Congress, the Marine Corps, and the media.

The PM prepared for another challenging set of meetings with Army senior leaders in the Pentagon. This would be the third time he attempted to get a decision on camouflage for Army uniforms and equipment. However, he knew that the decision was of utmost importance for soldiers in combat. Effective camouflage increases soldier combat effectiveness and improves force protection—saving soldiers' lives in battle. The PM thought about the decision in terms of return on investment (ROI). From 2009 to 2014 (over 6 years), the Army spent less than $10 million in the research, development, and testing of camouflage patterns, but a camouflage change would affect the purchase of $5.2 billion of uniforms and equipment over the next 5 to 10 years. The PM considered the research, development, and testing of camouflage patterns a wise investment for soldiers and for the American taxpayer.

Analysis of the Army's Decision, Part II

Countless Government Accountability Office (GAO) reports have documented waste of resources in the acquisition of particular DoD services and products. With respect to the combat camouflage uniforms specifically, a GAO Report entitled *Warfighter Support: DOD Should Improve Development of Camouflage Uniforms and Enhance Collaboration among the Services,*

highlighted the fragmented approach taken by the Army, Navy, Air Force, and Marine Corps to develop camouflage uniforms (GAO, 2012). The report stressed the potential for tens of millions of dollars of cost savings in the development, testing, logistics, and inventory control costs for combat uniforms. For the Army, the decision to change camouflage patterns on uniforms and equipment affected an approximate $5 billion inventory. The transition timeline involved up to 10 years as soldiers and the Army gradually replaced worn-out uniforms and equipment with the new camouflage uniforms and equipment. The appropriate question included the following: Is a $5 billion inventory change, over 10 years, worth a $10 million study over 6 years? What is the ROI? ($10 million/6 years)/($ 5,000 million/10 years) x 100% = ($1.67 million/year)/($500 million/year) x 100% = 0.334%. Would a private company spend less than 1% to get a significant financial decision correct? Obviously, this was not a typical ROI calculation because the future effort was used in place of a true "return," but it did put the $10 million research, development, and testing effort into perspective for its potential impact on a $5 billion decision.

Additionally, these types of calculations also did not account for the other benefits of improving camouflage, including increased mission effectiveness, improved force protection and safety, reduced casualties, and improved soldier confidence. Finally, the Army considered this question in terms of a project's total life-cycle costs (TLCC). For typical defense acquisition projects, the TLCC were about 10% in research, development, test, and evaluation (RDT&E) costs, 30% in procurement/production costs, and as much as 60% in operations and support (O&S) costs. For this camouflage effort, the TLCC split was <1% in RDT&E costs and >99% in combined procurement/production and O&S costs.

Within the DoD, soldier uniforms and equipment were procured with annual funding from Congress in the appropriations acts with what was called O&M dollars. These funds are appropriated annually and must be spent annually. The Army planned and submitted an annual budget request, which was approved by the Office of the Secretary of Defense and submitted to Congress as part of the President's budget. Congress used the President's budget request to write the annual appropriations act, which eventually was signed by the President and provided funding to the Army. This was all part of the Army's base budget, which remained fairly consistent over time. Separate from the base budget funding, Congress also appropriated OCO funds. These funds were not tracked as part of the DoD budget and were not subject to the constraints of sequestration or the Budget Control Act. This

funding was incredibly important because it funded war efforts around the globe, and it came with fewer strings attached and less oversight but also less transparency and accountability.

The Army decision to adopt OEF CP for Afghanistan operations was driven by performance and schedule. The Army needed to fix the camouflage issue as soon as possible. The soldier uniforms and equipment for Afghanistan operations came from OCO funds, which were plentiful. The Army accepted nearly 10% premiums for all camouflaged uniforms and equipment. Furthermore, only a subset of the entire Army force deployed to Afghanistan. On the other hand, the decision to change the camouflage pattern for all Army uniforms and equipment to be used in daily garrison operations must be funded through the base Army budget. The number of soldiers affected is 10 times higher, and adding an unfunded liability to the already strapped Army base budget was something that was studied to see if the benefits outweighed the costs.

Related to the source funding considerations was the fact that the Army was spending approximately $39 million per month to maintain the UCP inventory from its base budget (PM SPIE, personal communication, January 29, 2014).[27] If the Army were to expand the use of OEF CP beyond Afghanistan under the existing contractual and resulting fee arrangements, it would have added a $3.9 million monthly bill to the Army budget in perpetuity. Even a 1% fee of $390,000 per month was hard to justify in the base budget. From 2011 to 2014, the Army procured about $1.4 billion of OEF CP camouflaged uniforms and equipment. Moreover, it paid about $140 million in license fees for this inventory—a high number justified by the urgency of combat operations in Afghanistan and the availability of OCO funding. The OEF CP commercial vendor stated that it did not control the 10% premium paid by the Army. It further argued that other companies in the supply chain (prime contractors, fabric makers, "cut & sew" vendors) received most of the 10% premium. Eventually, the vendor guaranteed the Army a 1% royalty fee of camouflaged uniforms and equipment with OEF CP. However, if it did not control the fees the Army paid, it could not guarantee a 1% premium—an argument that didn't pass the common sense test for Army leaders (PM SPIE, personal communication, July 15, 2014).[28]

Important contractual and legal considerations complicated this decision as well. The Phase IV contracts were awarded by the Army in January 2012 and contained contract options that expired in July 2014 for the Army to purchase the nonexclusive license rights for each of the camouflage patterns (U.S. Army Contracting Command, 2012a, 2012b, 2012c, 2012d). The Army

thought that these options would allow the Army to print the patterns on an unlimited number of uniforms and equipment without paying licensing fees to the printers. However, the Army used nonstandard contract clauses and nonstandard licensing agreements in the Phase IV contracts, and legal reviews revealed that the contract options were not executable as written without a high risk of protests. Additionally, the FY2014 NDAA language prohibited the use of any of the Phase IV camouflage patterns unless all the Services adopted the new pattern, which was unlikely.

"Despite the logic in this strategy, senior Army leaders remained uncomfortable when the field testing from one specific site contradicted the photo simulation results.

The Army tried to buy the nonexclusive license rights to OEF CP in September 2013, using the same licensing agreement previously agreed upon for the similar Phase IV transition pattern. However, when vendors realized that they would no longer be getting the licensing fees, they balked at the terms of the agreement and eventually offered the Army the OEF CP pattern for a lump sum of $24 million or 1% end-product royalty fees (PM SPIE, personal communication, January 29, 2014).[29] This situation left the Army unsure about exactly what they were getting for their money.

The Army decision to reconsider the ScorpionW2 pattern presented intellectual property infringement concerns. In the early 2000s, the Scorpion pattern was developed under contract with the Army (U.S. Army NSRDEC, 2005). The vendor later received a patent for the Scorpion pattern. The Scorpion pattern was under consideration by the Army when UCP was adopted. UCP was favored because it was a digital pattern and performed particularly well in desert/arid and urban environments.

Independent from the Army, the same vendor produced the MultiCam© pattern from the Scorpion pattern and received a patent for MultiCam©—first used by some U.S. Special Forces in Afghanistan. In 2011, the Army adopted the MultiCam© pattern for all Army soldiers deploying to Afghanistan. The vendor then established licensing agreements with the camouflage printers of MultiCam©. The Army called MultiCam© the OEF CP. Subsequently, a similar pattern was submitted as a transitional pattern in the Phase IV contracts. In the Phase IV contracts, the vendor offered the Army nonexclusive license rights to the transition pattern for $200,000 (U.S. Army Contracting Command, 2012c). Independently, the U.S. Army

Research, Development and Engineering Center at the Natick Soldier Center produced a pattern called ScorpionW2 from the Scorpion pattern. ScorpionW2 was submitted as an Army, government-owned pattern for a transitional pattern in the Phase IV camouflage improvement effort. It is important to note that the OEF CP, the vendor Phase IV transitional pattern, and the ScorpionW2 pattern were all developed from the base Scorpion pattern, and all are visually indistinguishable. The testing showed that the patterns performed similarly. When the Army announced its decision to consider the ScorpionW2 pattern, its OEF CP vendor indicated potential issues with their existing licensing agreements with printers, as well as concerns with potential patent and copyright infringement—presenting the Army with high legal risk for the ScorpionW2 option.

The Army considered the following options:

- Option 1: Do nothing. Make no decision at this time and continue the current situation of issuing soldiers UCP uniforms and equipment for all missions, except in Afghanistan where they would continue to get OEF CP uniforms and equipment.
- Option 2: Select OEF CP, accept the vendor's terms, and expand its use beyond Afghanistan as the standard pattern of all Army uniforms and equipment.
- Option 3: Select ScorpionW2 and replace worn-out UCP uniforms and equipment over time.
- Option 4: Select a DTC1 pattern and replace worn-out UCP uniforms and equipment over time.

The Do Nothing option was considered to ensure the Army was not headed on the "Road to Abilene." The OEF CP, ScorpionW2, and DTC options were certainly viable. To be viable, the alternatives needed to be consistent with the Army camouflage improvement history and the general cost, schedule, and performance constraints. Options like restarting the competition were not considered because the Phase IV effort had just resulted in the best options that commercial industry had to offer. High-technology solutions like "chameleon" camouflage were not considered because these solutions were decades away from being mature.

For this decision, the Army compared the options using the following decision criteria: performance, schedule, cost/affordability, soldier/media perspective, congressional perspective, legal risk, and USMC perspective. Improving the concealment of soldiers remained a top priority for the Army,

which eliminated the Do Nothing option as a realistic option, and that option was subsequently eliminated from consideration. The remaining three options all had patterns that performed similarly in testing; therefore, the performance criterion was nondiscriminating. The remaining three options had similar implementation schedules; thus, schedule was also a nondiscriminating criterion.

The Army considered the advantages, disadvantages, and second-order implications of various courses of actions for the path forward. Table 3 summarizes the pro and cons of each of the three options. The OEF CP option had strong support from soldiers and the media and adhered to the NDAA constraints; the USMC had no issues with this option. With respect to disadvantages, this option had significant long-term unfunded liabilities and a high risk of legal battle. The ScorpionW2 option had advantages of affordability and low cost, adherence to the NDAA, and no USMC opposition. On the con side, soldier and media support was less than enthusiastic, and the legal risks were high. The DTC1 or DTC2 option was affordable with low cost and low legal risk as well. The cons of this option included negative reactions from soldiers and media still reeling from the UCP decision, an uncertain compliance with the intent of the NDAA, and strong USMC opposition.

TABLE 3. PART II OPTION COMPARISON

Options	Pros	Cons
Option 1: OEF CP	• Soldier/Media (strong support for OEF CP) • Congressional Perspective (adherence to the NDAA) • USMC perspective (no opinion)	• Affordability/Cost ($24M up-front cost or 1% royalty) • Legal risk is high (high likelihood and high win probability)
Option 2: ScorpionW2	• Affordability/Cost (no cost or royalty fees) • Congressional perspective (adherence to the NDAA) • USMC perspective (no opinion)	• Soldier/Media (lukewarm support because of the unknown) • Legal risk is high (high likelihood and high win probability)
Option 3: DTC1 or DTC2	• Affordability/Cost (no cost or royalty fees) • Legal risk is low (low likelihood and high win probability)	• Soldier/Media (negative because of the Army's UCP history) • Congressional perspective (adherence to the NDAA questionable) • USMC perspective (strong opposition)

From the comparison table alone, it remained unclear which option was preferred for the Army. To overcome this shortfall of a simple comparison listing advantages and disadvantages, the options were compared using

the decision criteria in a decision matrix. Table 4 presents the results of the Army decision matrix. Using the criteria of affordability/cost, soldier/media perspective, legal risk, congressional perspective, and USMC perspective, the unweighted rankings of the options indicated that the ScorpionW2 option was preferred, but the scores of the options were close. While affordability/cost was weighted three times as important, soldier/media perspective was weighted two times as important; congressional perspective was weighted two times more important than legal risk; and USMC perspective, the preferred option, remained the same. This type of analysis forced Army senior leaders to take an objective look at the comparison to either support their intuition or question why a particular option was preferred.

TABLE 4. PART II DECISION MATRIX

Decision Matrix (Qualitative Ranking of Options)							Option Scores (Lower is Better)	
Options \ Criteria		Affordability/ Cost	Soldier/Media Perspective	Legal Risk	Congressional Persepctive	USMC Perspective	unweighted	weighted
	Criteria Weighting -->	3	2	1	2	1		
OEF CP	unweighted ranking -->	3	1	2.5	1.5	1.5	9.5	
	weighted ranking -->	9	2	2.5	3	1.5		18
ScorpionW2	unweighted ranking -->	1.5	2	2.5	1.5	1.5	9	
	weighted ranking -->	4.5	4	2.5	3	1.5		15.5
DTC1 or DCT2	unweighted ranking -->	1.5	3	1	3	3	11.5	
	weighted ranking -->	4.5	6	1	6	3		20.5

The second part of this case emphasized some key program management lessons learned. Even though performance and schedule were important considerations, the preferred option for the path forward was decided by other criteria. PMs and acquisition professionals in general must bring together the information for the most informed decision possible. In this case, the PM had to understand the affordability/cost implications, legal risk, and the perspectives of key stakeholders including Congress, soldiers, the USMC, and the media.

Conclusions/Epilogue

"The rest of the story" as Paul Harvey would say, or what the Army actually did, is presented not as the "right answer" but to provide closure. Many paths can lead to similar end results for acquisition development programs. The case study provided the epilogue to the first key decision on how the Army proceeded when the strategy hit the contracting barrier. For the second key decision point, the Army selected the ScorpionW2 pattern and named it the Operational Camouflage Pattern (OCP) to emphasize that the pattern's reach extended beyond Afghanistan to other Army military operating environments (Figure 13).

FIGURE 13. PICTURES OF THE OPERATIONAL CAMOUFLAGE PATTERN (OCP) ON THE ARMY COMBAT UNIFORM (ACU)

Because the four transitional patterns all tested similarly, the decision came down to other considerations. The digital patterns that were based on the USMC MARPATs were never seriously considered because Army senior leaders were concerned about the following three things: strict literal compliance to the restrictions in the Fiscal Year 2014 NDAA, the backlash from the USMC leadership (who did not favor the Army leveraging the MARPATs), and the soldier/public perception of the Army choosing another "digital" pattern after the tepid response to the UCP adoption. Because of affordability concerns, the OEF CP pattern (commercially known as MultiCam©) was not chosen. The Army accepted the 10% licensing fees on all camouflaged uniforms and equipment for Afghanistan in OEF CP because funding for Afghanistan operations came from OCO accounts and not from the Army's base budget funding. Transitioning the entire Army to a different camouflage pattern for use in both garrison and deployments was a completely different effort (orders of magnitude larger in scale) than fielding uniforms and equipment to soldiers for one particular operation. The Army was spending approximately $39 million per month maintaining uniforms and equipment of approximately 1 million active duty, reserve, and National Guard soldiers. When buying camouflaged uniforms and equipment, perpetual monthly licensing fees were deemed unaffordable. Choosing OCP resulted in soldiers' benefiting from an effective camouflage pattern and the nation benefiting from the best use of limited resources. The Army has continued to work on improving the force protection and concealment of soldiers through more effective camouflage for uniforms and equipment. Specifically, the Army is considering camouflage tailored for woodland/jungle and desert/arid military operating environments.

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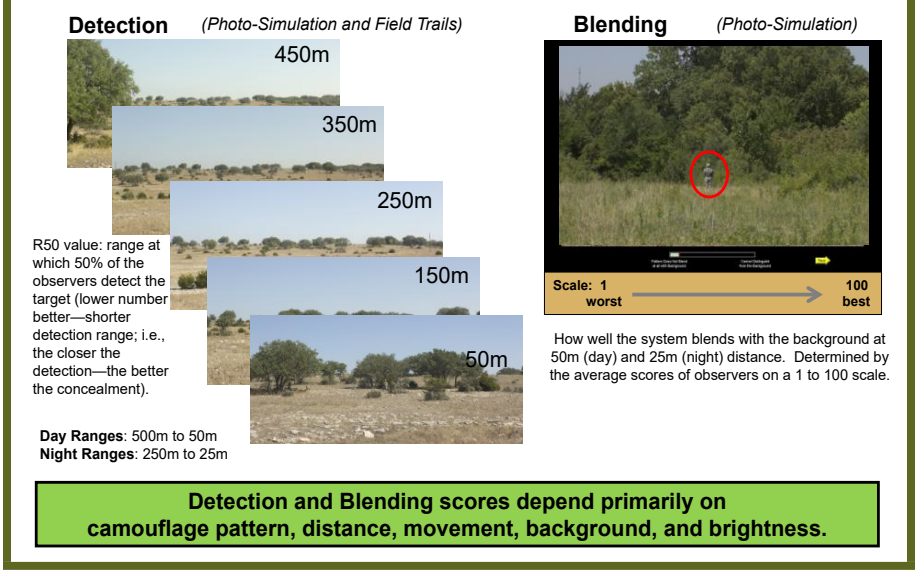
APPENDIX A

Camouflage Testing Basics

Pattern testing and selection criteria were based on both detection (ability to detect the pattern at ranges out to 450 meters day and 250 meters night) and blending (ability to match the background environment at 50 meters in daylight and 25 meters at night) (Hanlin et al., 2013). Detection is the ability to pick up the camouflage pattern measured at different distances, and blending is how well the camouflage pattern matches the background once detected at a specific close range (Figure A-1).[30]

FIGURE A-1. CAMOUFLAGE PATTERN TESTING CRITERIA

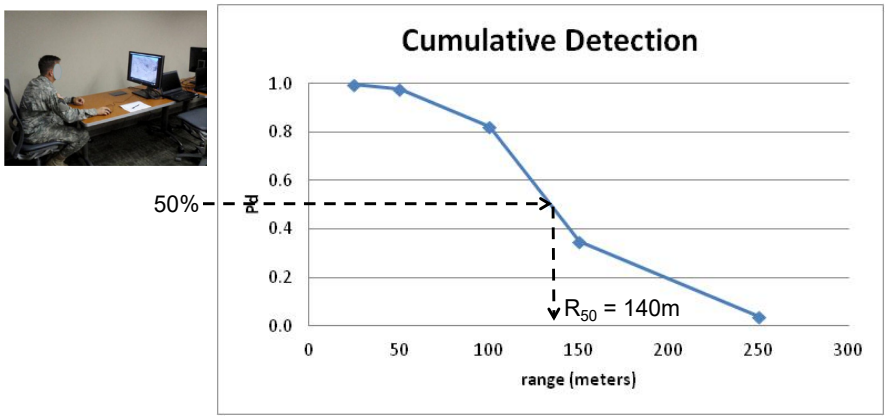


Note. Adapted from PM SPIE, personal communication, April 11, 2013.

Camouflage pattern testing used a combination of field trials and photo simulation evaluations. The field trials included day and night testing, squad-on-squad battle drill lanes, movement to contact drills, and individual soldier detection/acquisition at varying distances and varying soldier positions (prone, kneeling, and standing). The soldier photo simulation evaluations included feedback from soldiers who assessed the camouflage's detection and blending capability using calibrated images of uniformed individuals in arid, woodland, and transitional backgrounds. Photo simulation evaluations allowed for collection of significant data in many backgrounds. These evaluations also controlled variables (such as distance, movement, background, and brightness) so that change in detection and blending scores was only attributable to different camouflage patterns. The word *simulation* in this case really just means simulating soldiers being outside at the various sites by taking images of soldiers and

challenging other soldiers to detect them (Figure A-2).[31] Soldiers scored images of real camouflaged personnel in real outdoor scenes (day and night) on a computer monitor. Detection scores came in the form of R50 values, which is the range at which 50% of the observers detect the target (lower numbers are better, meaning shorter detection ranges—in other words, the closer the detection, the better the concealment) (U.S. Army NSRDEC, 2009).

FIGURE A-2. EXAMPLE PHOTO SIMULATION TEST AND TEST OUTPUT AND THE PROBABILITY OF DETECTION (PD) VS. DETECTION RANGE



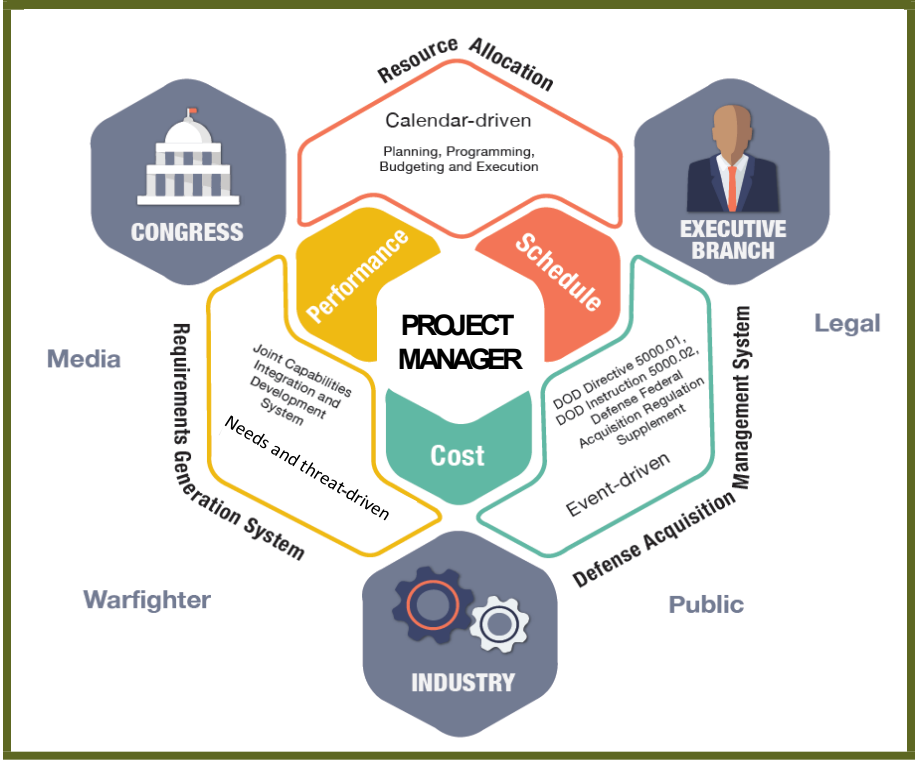
Note. Adapted from PM SPIE, personal communication, April 11, 2013.

APPENDIX B

U.S. Defense Acquisition Institution

Within the DoD, the development, testing, procurement, and fielding of capability for the warfighter operates within a complex decision-making framework. Within the private sector, similar frameworks exist. The U.S. defense acquisition institution has three fundamental support templates that provide requirements, funding, and management constraints. The executive branch, Congress, and industry work together to deliver capability, with the program manager (PM) as the central person responsible for cost, schedule, and performance. Figure B-1 depicts this framework.

FIGURE B-1. DEFENSE ACQUISITION INSTITUTION



Note. Adapted from Mortlock (2016).

The government PM is at the center of defense acquisition, which aims to deliver warfighter capability. The PM is responsible for cost, schedule, and performance (commonly referred to as the "triple constraint") of assigned projects—usually combat systems within the DoD. The executive branch of government provides the PM a formal chain of command in the DoD. The PM typically reports directly to a program executive officer, who reports to the Service Acquisition Executive (an

assistant secretary for that Service—either Army, Navy, or Air Force), who reports to the Defense Acquisition Executive (the Under Secretary of Defense for Acquisition and Sustainment). Depending on the program's visibility, importance, and/or funding levels, the program decision authority is assigned to the appropriate level of the chain of command.

Programs within defense acquisition require resources (for funding) and contracts (for execution of work) with industry. Congress provides the resources for the defense programs through the annual enactment of the Defense Authorization and Appropriations Acts, which become law and statutory requirements. The PM, through warranted contracting officers governed by the Federal Acquisition Regulation, enters into contracts with private companies within the defense industry. Other important stakeholders include actual warfighters, the American public, the media, and functional experts (like engineers, testers, logisticians, cost estimators, etc.), as well as fiscal and regulatory lawyers.

As a backdrop to this complicated organizational structure for defense PMs, there are three decision support templates: one for the generation of requirements, a second for the management of program milestones, and a third for the allocation of resources. Each of these decision support systems is fundamentally driven by different and often contradictory factors. The requirements generation system is driven primarily by a combination of capability needs and an adaptive, evolving threat. The resource allocation system is calendar-driven by Congress writing an appropriations bill—providing control of funding to Congress and transparency to the American public and media for taxpayer money. The defense acquisition management system is event-driven by milestones based on commercial industry best practices of knowledge points and off-ramps supported by the design, development, and testing of the systems as technology matures.

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