



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL REPORT

BARRIERS TO IMPLEMENTING A SINGLE JOINT COMBAT CAMOUFLAGE UNIFORM

December 2017

By: Robin J. Wharton

**Advisors: Robert F. Mortlock
Brad R. Naegle**

Approved for public release. Distribution is unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE December 2017	3. REPORT TYPE AND DATES COVERED MBA professional report		
4. TITLE AND SUBTITLE BARRIERS TO IMPLEMENTING A SINGLE JOINT COMBAT CAMOUFLAGE UNIFORM			5. FUNDING NUMBERS	
6. AUTHOR(S) Robin J. Wharton				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB number ___N/A___.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (maximum 200 words) The purpose of this thesis is to explore and understand the barriers that hinder the Department of Defense (DOD) from implementing a single joint camouflage combat uniform for the Armed Forces. Before 2002, the Armed Forces primarily relied on two camouflage uniforms: the woodland Battle Dress Uniform (BDU) and Desert Camouflage Uniform (DCU). In 2002, the Marine Corps began issuing its Marine pattern (MARPAT) camouflage uniforms in woodland and desert colors and the remaining three services quickly followed suit, resulting in ten different camouflage uniforms in the past 15 years. These separate designs cost billions of dollars, duplicate effort, and complicate logistics with no discernible effect of better-concealed combatants. The methodology applies strengths, weaknesses, opportunities, threats (SWOT), and political, economic, social, and technological (PEST) analyses; examines the requirements and role of each of the Armed Forces; and compares advantages and disadvantages to a single joint camouflage uniform. The literature review consists of reports from the Government Accountability Office, research results, and additional government-related feedback. The findings of this report indicate that implementing a single joint camouflage uniform for all services will result in cost savings, effective concealment for all services, and logistical simplicity.				
14. SUBJECT TERMS ground combat uniform, combat camouflage uniform history, combat camouflage uniform pattern, camouflage pattern testing			15. NUMBER OF PAGES 67	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

**BARRIERS TO IMPLEMENTING A SINGLE JOINT COMBAT
CAMOUFLAGE UNIFORM**

Robin J. Wharton, Captain, United States Army

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

**NAVAL POSTGRADUATE SCHOOL
December 2017**

Approved by: Robert F. Mortlock, Ph.D.

Brad R. Naegle

Keith Snider, Ph.D.
Academic Associate
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

BARRIERS TO IMPLEMENTING A SINGLE JOINT COMBAT CAMOUFLAGE UNIFORM

ABSTRACT

The purpose of this thesis is to explore and understand the barriers that hinder the Department of Defense (DOD) from implementing a single joint camouflage combat uniform for the Armed Forces. Before 2002, the Armed Forces primarily relied on two camouflage uniforms: the woodland Battle Dress Uniform (BDU) and Desert Camouflage Uniform (DCU). In 2002, the Marine Corps began issuing its Marine pattern (MARPAT) camouflage uniforms in woodland and desert colors and the remaining three services quickly followed suit, resulting in ten different camouflage uniforms in the past 15 years. These separate designs cost billions of dollars, duplicate effort, and complicate logistics with no discernible effect of better-concealed combatants. The methodology applies strengths, weaknesses, opportunities, threats (SWOT), and political, economic, social, and technological (PEST) analyses; examines the requirements and role of each of the Armed Forces; and compares advantages and disadvantages to a single joint camouflage uniform. The literature review consists of reports from the Government Accountability Office, research results, and additional government-related feedback. The findings of this report indicate that implementing a single joint camouflage uniform for all services will result in cost savings, effective concealment for all services, and logistical simplicity.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	RESEARCH PURPOSE.....	1
B.	RESEARCH QUESTIONS.....	1
C.	METHODOLOGY AND SCOPE	2
II.	BACKGROUND	3
A.	ORIGIN AND HISTORY OF THE CAMOUFLAGE UNIFORM.....	3
1.	United States.....	3
2.	Other Countries	5
B.	U.S. DOD BRANCH HISTORY	7
1.	USMC.....	8
2.	USA.....	9
3.	USAF	11
4.	USN.....	11
C.	CAMOUFLAGE PATTERN TESTING	12
D.	SUMMARY	19
III.	LITERATURE REVIEW	21
A.	PURPOSE.....	21
IV.	DATA ANALYSIS.....	27
A.	PEST ANALYSIS	27
1.	Political Factors.....	27
2.	Economic Factors.....	29
3.	Social Factors	30
B.	SWOT ANALYSIS	32
1.	Strengths	32
2.	Weaknesses	33
3.	Opportunities.....	34
4.	Threats	35
V.	COMPARATIVE ANALYSES.....	37
VI.	CONCLUSION AND RECOMMENDATIONS.....	41
	LIST OF REFERENCES.....	45
	INITIAL DISTRIBUTION LIST	49

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

Figure 1.	1960–1981 U.S. Armed Forces woodland camouflage patterns. Adapted from “USA” (n.d.).....	4
Figure 2.	U.S. Armed Forces arid camouflage patterns. Adapted from “USA” (n.d.).....	4
Figure 3.	German Flecktarn pattern. Adapted from “Germany” (n.d.).....	5
Figure 4.	British camouflage patterns. Adapted from “United Kingdom” (n.d.).....	6
Figure 5.	Canadian temperate and arid camouflage patterns. Adapted from “Canada” (n.d.).....	7
Figure 6.	Timeline of DOD camouflage uniform introductions. Adapted from Fahrenthold (2013).....	8
Figure 7.	Comparison of UCP and UCP-D. Adapted from Venezia and Peloquin (n.d.).....	10
Figure 8.	Photosimulation observer test setup. Adapted from NSRDEC (2009).....	14
Figure 9.	Army Camouflage Uniform Improvement Project, Phase IV uniform configuration. Source: Mazz (2015).	19
Figure 10.	DOD uniform design and development costs. Source: GAO (2010).....	22
Figure 11.	Depiction of image sequence. Adapted from Mazz (2009).	25
Figure 12.	Depiction of a blending analysis. Adapted from Mazz (2009).....	26
Figure 13.	Total uniform production and procurement costs by fiscal year. Source: GAO (2010).	38

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.	Ground combat uniform costs. Adapted from GAO (2010).	12
Table 2.	Photosimulation detection test environmental parameters. Adapted from NSRDEC (2009).	15
Table 3.	Ranking of patterns by scene. Adapted from NSRDEC (2009).	16
Table 4.	Ranking of patterns by environment. Adapted from NSRDEC (2009).	17
Table 5.	Patterns selected for final analysis. Adapted from NSRDEC (2009).	21
Table 6.	Camouflage uniform costs across the DOD. Source: GAO (2010).	23
Table 7.	Factors of the PEST analysis. Adapted from Shapiro (2013).	27
Table 8.	SWOT analysis. Adapted from Renault (2017).	32

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

ABU	Airman's Battle Uniform
ACE	Anchor, Constitution, Eagle
ACU	Army Combat Uniform
AMSAA	Army Materiel Systems Analysis Activity
BDU	Battle Dress Uniform
CADPAT	Canadian Disruptive Pattern Uniform (AR-Arid/WA-Winter-Arctic)
DCU	Desert Camouflage Uniform
DLA	Defense Logistics Agency
DLATS	Defense Logistics Agency Troop Support
DSCP	Defense Supply Center Philadelphia
DOD	Department of Defense
DPM	Disruptive Pattern Material
EGA	Eagle, Globe, Anchor
ERDL	Engineer Research and Development Laboratory
FFW	Future Force Warrior
FM	Field Manual
FRACU	Flame-Resistant Army Combat Uniform
FY	Fiscal Year
GAO	Government Accountability Office
MARPAT	Marine Pattern
MCCUU	Marine Corps Combat Utility Uniform
MOE	Military Operating Environment
MPD	Marine Corps Pattern—Desert
MPW	Marine Corps Pattern—Woodland
MTP	Multi Terrain Pattern
NDAA	National Defense Authorization Act
NIR	Near Infrared
NPW	Navy Pattern—Woodland
NSRDEC	Natick Soldier Research, Development, and Engineering Center

NWU	Navy Working Uniform
OCIE	Organizational Clothing and Individual Equipment
OCP	Operational Camouflage Pattern (Scorpion W2)
OEF CP	Operational Enduring Freedom Camouflage Pattern
OFW	Objective Force Warrior
PdM-SCIE	Product Manager - Soldier Clothing and Individual Equipment
PEST	Political, Economic, Social and Technological
SMMC	Sergeant Major of the Marine Corps
SWIR	Short-Wave Infrared
SWOT	Strengths, Weaknesses, Opportunities, Threats
UCP	Universal Camouflage Pattern
USA	United States Army
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy

ACKNOWLEDGMENTS

First and foremost, I want to thank God for the opportunity to attend the Naval Postgraduate School, and for sustaining me throughout these months. If not for His grace, I would have been lost.

God undoubtedly blessed me with my husband, Mark. Thank you for your patience and love, for being my sounding board, and for keeping me grounded.

Finally, I would like to thank my professors for their insight, guidance, and patience. Many of you have considerable expertise in your field and your ability to make your knowledge relatable greatly enhanced my understanding.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. RESEARCH PURPOSE

The purpose of this thesis is to explore and understand the barriers that hinder the Department of Defense (DOD) from implementing a single joint camouflage combat uniform for the Armed Forces. The Fiscal Year 2014 National Defense Authorization Act (NDAA) restricted the DOD Armed Forces from adopting new camouflage uniforms unless all the Services adopted the pattern, in stark contrast with the ten camouflage patterns now in use across the services. Prior to 2002, the Armed Forces primarily relied on two camouflage uniforms: the woodland and desert Battle Dress Uniforms and Desert Camouflage Uniform (BDU, DCU). In 2002, the Marine Corps began issuing its Marine pattern (MARPAT) pixelated camouflage uniforms in woodland and desert colors and the remaining three services quickly followed suit, resulting in ten different camouflage uniforms in the past 15 years. These separate efforts result in cost inefficiencies, duplicate efforts, complicate logistics, and do not provide all Service members with the same level of effective concealment.

B. RESEARCH QUESTIONS

This thesis attempts to answer these questions:

- What barriers hinder the DOD from implementing a single joint camouflage combat uniform?
- What are the Service histories for the camouflage combat uniform?
- What are the benefits and drawbacks of implementing a single joint camouflage combat uniform?
- What kind of testing is conducted for camouflage patterns?

- What do the PEST (Political, Economic, Social, and Technological) and SWOT (Strengths, Weaknesses, Opportunities, Threats) analyses provide to the development of acquisition strategies?

C. METHODOLOGY AND SCOPE

The intended objectives of this research are to explore the history of DOD Service component combat uniforms, the recent proliferation of Service-specific uniforms, and the barriers and challenges to implementing a single joint camouflage combat uniform across the DOD Armed Forces. This research includes a literature review of applicable DOD documents to develop an understanding of combat uniform development and implementation. The following analytical frameworks, to gain a comprehensive understanding of potential barriers, will be used:

- PEST Analysis—a tool used to help identify the macro-environmental influences that can have an impact on an organization and futures decisions
- SWOT Analysis—a methodology used to analyze the internal and external factors that would affect the implementation of a single joint camouflage uniform for the DOD Armed Forces

The research and data collected for this essay will aid in formulating a comparative analysis. Details from both the SWOT and PEST as well as the literary review will provide the reader with a non-biased summary. The concluding results will focus on addressing the barriers to implementing a joint camouflage uniform.

II. BACKGROUND

A. ORIGIN AND HISTORY OF THE CAMOUFLAGE UNIFORM

Although the use of camouflage by military forces dates back to the First World War, this research will address the history and testing of camouflage patterns since the Vietnam era. Most of the emphasis will address the American history, development, and testing of camouflage uniforms. A brief synopsis of three other countries' camouflage patterns is included for comparison. Of note is that the primary focus of this research is the camouflage patterns; the various uniforms also differ in types of fabrics used and in design functionality.

1. United States

In 1952 all U.S. Service branches utilized the olive-green utility uniform—itsself a variation of the World War II uniforms—which saw service in Korea and Vietnam. There were few modifications to this uniform, and it remained largely the same until the 80s. In 1963, however, tropical combat clothing was produced and issued to Soldiers serving in Vietnam. The first two patterns were in the olive-green shade 107 in a wind-resistant cotton fabric and were much the same, excepting that the second coat covered exposed buttons to reduce snagging in tropical terrain.

In 1967 a third pattern emerged in the form of the Engineer Research and Development Lab (ERDL) camouflage pattern. This uniform mixed tan, green, brown, and black colors in an effort to blend in with the various shades found in Vietnam. Descended from the ERDL was the 1981 adoption of the four-color woodland pattern M81 Battle Dress Uniform (BDU), the leading field uniform of the DOD's Armed Services (Brayley, 2009, p. 86). The BDU changed the uniform design and appearance with a different fabric, placement of pockets, and the camouflage pattern. All branches of the DOD wore these uniforms until 2002 and the patterns on these uniforms are displayed in Figure 1.

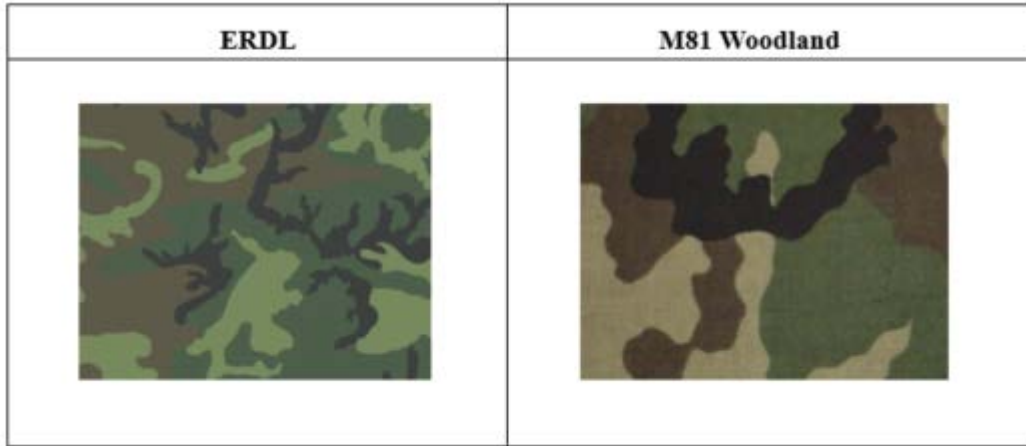


Figure 1. 1960–1981 U.S. Armed Forces woodland camouflage patterns.
Adapted from “USA” (n.d.).

The Desert Camouflage Uniform (DCU) was introduced at the same time as the woodland pattern BDU, but was issued only to Special Operations troops in the Middle East. The DCU was virtually identical to the BDU except for the tan, brown, and black colored pattern called “chocolate chip” by Service members. A new, three color DCU was issued in 1991 and stayed in use during Operation Enduring Freedom and Operation Iraqi Freedom until 2006. These camouflage patterns are displayed in Figure 2.

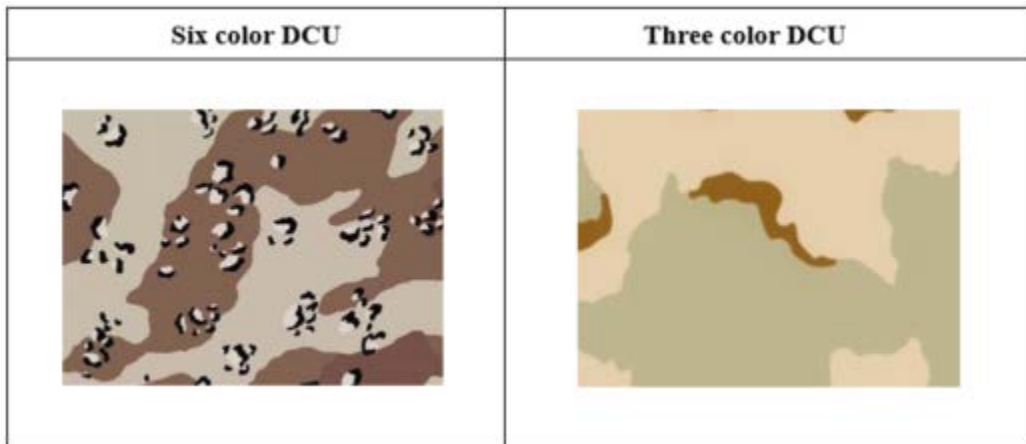


Figure 2. U.S. Armed Forces arid camouflage patterns.
Adapted from “USA” (n.d.).

2. Other Countries

a. Germany

Although Germany was one of the leading innovators of camouflage in WWII, there was not much effort made at camouflage pattern uniforms until the German Army Uniform trials of 1976. These trials produced the Sagezahnmuster (saw tooth), Punktmuster (dot pattern), and three Flecktarn (spot pattern) designs. The Flecktarn patterns were labeled A (small spots), B (large spots), and C (shadow). The Flecktarn B (Figure 3) pattern was determined to be the best of the six and was adopted into the German Army in the mid-1980s and called Flecktarnmuster, which was produced in tropical and desert colorations. Many experts regard German Flecktarn as among the best in the world (Brayley, p. 43, 2009), and the Germans still use these patterns.

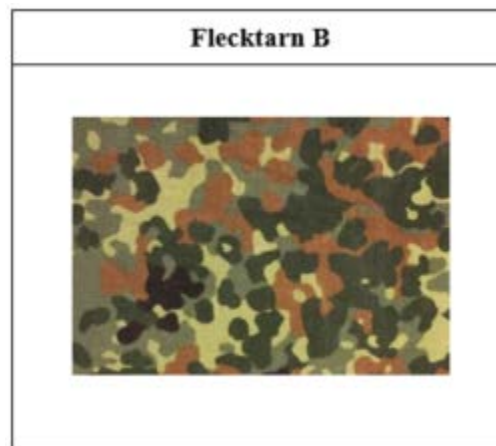


Figure 3. German Flecktarn pattern. Adapted from “Germany” (n.d.).

b. Britain

The standard uniform of the British Army until 1966 was khaki, which has a long history with British forces. At this point, Britain introduced the Disruptive Pattern Material (DPM) design, which used several earth-tone colors in a splotchy pattern, similar to the ERDL woodland uniform in use by U.S. forces (Brayley, p. 86 2009). The original DPM pattern was designated the P60, issued in 1966, and based on the previous khaki uniform design. The P60 was replaced with the P68, and then the P84, which

remained in service for the next ten years. The next significant change was the Soldier 95 uniform, introduced in 1995, which utilized lessons learned in the Falklands by making the uniform ensemble modular. The newest camouflage uniform to replace the Soldier 95 is the Multi Terrain Pattern (MTP), introduced in 2010 and based heavily on the American-made Crye Precision LLC MultiCam© pattern with DPM influences (Brayley, p. 45, 2009). The P68 pattern and the newer MTP are illustrated in Figure 4.

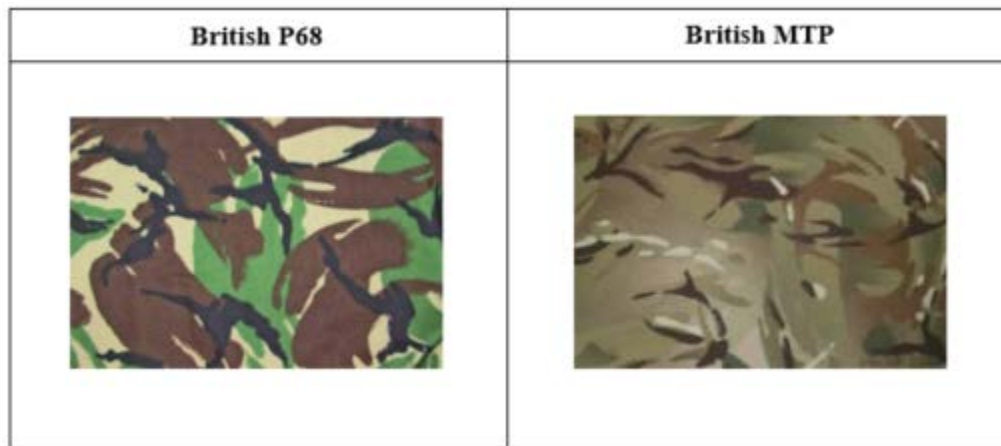


Figure 4. British camouflage patterns. Adapted from “United Kingdom” (n.d.).

c. Canada

The Canadian Armed Forces have an interesting history with camouflage uniforms since the Vietnam era. From the 1950s until 1996, the standard combat uniform was solid olive green, with a tan-colored version for arid environments. There were several camouflage-patterned DPM smocks and jackets issued from the 1970s, but these were intended only for garrison use (Brayley, 2009. p. 26). For deployments and field exercises, the olive-green uniform was used. Then, in 1996, the Canadian Disruptive Pattern (CADPAT) uniform was issued, and it remains as the standard combat uniform for the Canadian Armed Forces. There are two other versions in use, the CADPAT Arid Region (AR) and the Winter/Arctic (WA), shown in Figure 5. The CADPAT was one of

the first pixelated patterns used, and it greatly influenced branches of the U.S. Armed Forces (Cramer, n.d.).

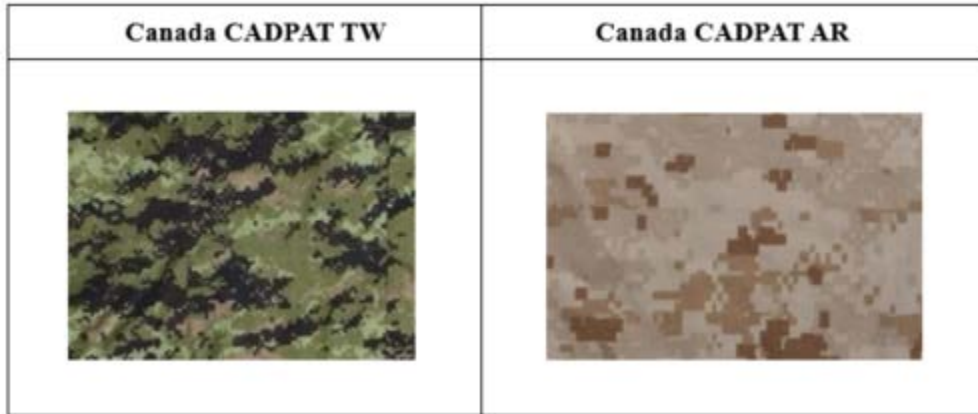


Figure 5. Canadian temperate and arid camouflage patterns.
Adapted from “Canada” (n.d.).

B. U.S. DOD BRANCH HISTORY

The U.S. military branches individually pursued camouflage uniform development beginning in the late 1990s. The USMC was interested in camouflage patterns that were potentially more effective than the existing BDU and DCU and that would provide them with a distinct appearance (Brown, 2013). The USA, USAF, and the USN followed suit; all four branches met with varying levels of success. The Government Accountability Office’s (GAO) report to Congress in report number 12–707 depicts that none of the Services collaborated with another in camouflage uniform development (Government Accountability Office [GAO], 2015). Figure 6 depicts the timeline of DOD uniform introduction.

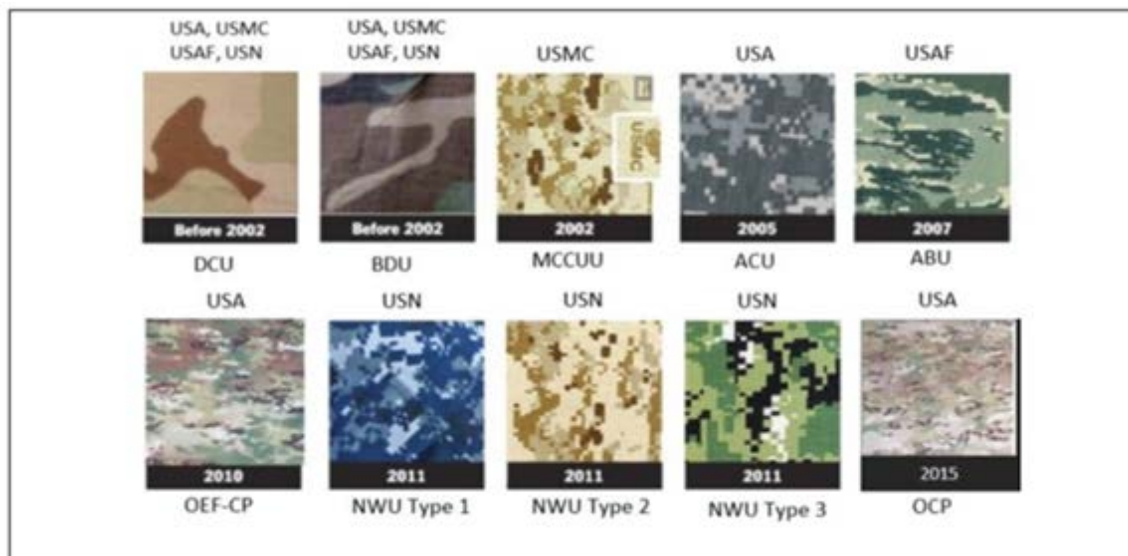


Figure 6. Timeline of DOD camouflage uniform introductions.
Adapted from Fahrenthold (2013).

1. USMC

The Marines, like all branches, wore the woodland pattern BDU and desert pattern DCU since the early 1980s. Following the success of Canada's CADPAT introduction in the late 90s, the USMC, with Canada's permission, began evaluating the disruptive pattern in order to develop the unique Marine Corps Combat Utility Uniform (MCCUU). Refinements of the CADPAT pattern were assessed against eight other patterns during testing at the USMC Scout Sniper Instructor School. The CADPAT derivative, called MARPAT (for Marine Pattern, displayed in Figure 6), was selected in both woodland and desert variations in 2002 and became the U.S. military's first uniform with a digital camouflage pattern (Brayley, 2002 p. 88). The MCCUU design differs from the BDU by removing the lower front bellow-type pockets, changing the upper chest pockets by slanting them and adding Velcro closures, and the fabric is a fire-resistant nylon blend; these changes were implemented to add utility, comfort, and protection while wearing body armor. The USMC uses a single, coyote brown color for Organizational Clothing and Individual Equipment (OCIE) that complements both variations and reduced production costs. It is worth noting that the USMC have patented

their design and embedded a small Eagle, Globe, and Anchor (EGA) emblem to the pattern every few feet (Brown, 2013) to discourage other branches from using the design.

2. USA

In 2004, following the Marines' example, the Army adopted nearly the same digital pattern (using different colors) into the Universal Camouflage Pattern (UCP). The intent was to design a single combat uniform ensemble capable of performing in any environment, reducing the need to issue specialized camouflage clothing for deployments to different geographical areas. Adopting the UCP pattern was only one change in creating the Army Combat Uniform (ACU); the design of this uniform was completely new and added slanted breast pockets, vertical shoulder and lower-leg pockets, and Velcro closures all around. Initial testing reported in TR09/021L (2009) concluded that UCP provided the best average performance of 10 other patterns across three areas—desert, woodland, and urban—but did not test as well as environment-specific patterns in their intended environment (U.S. Army Natick Soldier Research, Development, and Engineering Center [NSRDEC], 2009).

Sydney Freedberg (2012) asserts that Soldiers deployed to Afghanistan soon discovered that the UCP not only failed to blend in with the terrain but the pale, green colors were somewhat noticeable in most areas of the region. Indeed, as both Brayley (2009, p. 7) and the Army's FM 21-75 *Combat Skills of the Soldier* (1984) point out, no single camouflage pattern will be suitable for all environments. Brayley (p. 12) further contends that the cost savings from the Army's sole pattern perhaps outweighed the reduced effectiveness of individual concealment. Army leadership would have to carefully weigh the cost savings against the possible detection of Soldiers on the battlefield.

In 2009, Congress directed the DOD to take immediate action to provide Soldiers with a camouflage pattern suitable for that environment (GAO, 2015). The Army responded, and in 2010 concluded that UCP failed to meet concealment needs for the multiple regions in Afghanistan. The Camouflage Improvement Effort began with the objective to find a replacement uniform suitable for operational environments. The

testing was a phased approach with the immediate objective of Phases I-III to determine the best short-term solution (Hepfinger et al., 2010). Two contenders were evaluated: Crye Manufacturing's MultiCam© pattern, which was in use by Special Forces at the time, and the UCP-D, which was a variant of UCP with darker colors (illustrated in Figure 7). Evaluations from Phase II resulted in the selection and implementation of MultiCam© in Phase III. This pattern was named the Operational Enduring Freedom Camouflage Pattern (OEF-CP). The OEF-CP was issued to Soldiers deploying to Afghanistan on the Flame-Resistant Army Combat Uniform (FRACU), a uniform the same functionality as the ACU but made from a flame-resistant mix of fabrics as opposed to the ACU made from a 50–50 nylon cotton fabric mix.

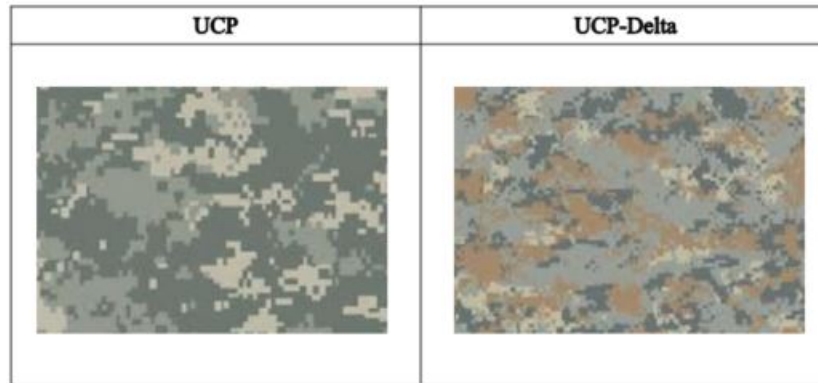


Figure 7. Comparison of UCP and UCP-D. Adapted from Venezia and Peloquin (n.d.).

Phase IV's goal was to determine a uniform decision for a long-term, multi-environment camouflage pattern. The objective was to develop a three-pattern family (woodland, arid, and transitional) with a single pattern for OCIE. Selection of patterns began in 2011 with 22 entrants being reduced to four families of patterns for additional evaluation in the next stage. The testing in this portion indicated that all of the tested patterns performed similarly to the OEF-CP in their intended environments (Cole & Sloane, 2010).

The National Defense Authorization Act of 2014 (NDAA, 2014), however, banned funding for development and fielding of any new camouflage patterns unless it was for all Services to use (H.R. 3304, 2013). The NDAA stipulations ruled out the previous four vendor patterns, so the Army began investigating the possibility of using OEF CP as the transitional pattern and using existing patterns from the other Services as woodland and arid variations. Author John Mazz (2015) reported that licensing fees for the use of MultiCam© caused the Army to choose a similar pattern called Scorpion W2 as its replacement for the UCP, and named it the Operational Camouflage Pattern (OCP) to emphasize that its reach extended beyond Afghanistan. The Scorpion W2 pattern can be traced to 2002 when Crye Precision LLC, under contract with the U.S. Army Natick Soldier Research, Development and Engineering Center created the original version as part of the Future Force Warrior (FFW) program of 2002 (Cox, 2015).

3. USAF

In 2006, the USAF elected to join the USMC and the USA by selecting its own unique uniform design in a digitized tiger stripe pattern. The first pattern was colored blue and was eventually discontinued and replaced with the same pattern in colors found in the UCP. The USAF uniform was dubbed the Airman's Battle Uniform (ABU) and it suffered from the same inadequacy of blending with terrain found in operational areas as the UCP. Airmen also complained of the heavy weight of the material, which led to the 2012 release of the Improved Airman Battle Uniform with a lighter-weight 50/50 cotton-nylon blend. Still, USAF leaders determined that the ABU was not suitable for operations in Afghanistan and subsequently directed Airmen in that theater would wear the Army's FRACU in OEF-CP. Testing data from the USAF was not available at the time of this writing (GAO, 2010).

4. USN

The Navy Working Uniform (NWU) was the result of a fleet-wide survey conducted in 2003 and again in 2005. There were four final patterns in digital and woodland camouflage, with the dominant blue color in a MARPAT pattern being selected and named the Navy Working Uniform (NWU) Type I (Brown, 2013). Sailors

affectionately call this uniform “blueberries” or “aquaflage” due to being the same color as ships and the seas in which they operate. The NWU Type I was designed in a four-color, 50–50 nylon-cotton twill fabric; it was not designed to disguise Sailors against the backdrop of a ship and was never intended for a tactical setting. Brayley adds that the NWU Type I replaced seven previous uniforms issued to Sailors (p. 90, 2009). However, the colors of the uniform do not blend with the surroundings in an operational environment, so the NWU Type II (also known as AOR 1 for Area of Responsibility) tactical uniform was created for USN Special Operations personnel. This pattern is slightly darker overall than the desert MARPAT with different color shades; it is made of the same 50–50 nylon-cotton twill fabric. In August of 2016, the Navy announced that it is replacing the NWU Type I with the NWU Type III (also known as AOR 2) uniforms, which are colored with more browns than the woodland MARPAT. The objective of designing a single working uniform for wear aboard ship and when ashore was not met by the Type I uniform. The NWU also bears the Navy Anchor, Constitution, and Eagle (ACE) symbol embedded in the pattern, much like the Marines’ EGA on the MARPAT (Blakemore, 2016). The total cost of all branch’s efforts are represented in Table 1.

Table 1. Ground combat uniform costs. Adapted from GAO (2010).

	Design and Development Service Data (FY 2001-2010)	Production and Procurement DSCP obligations (FY 2005-2010)	Distribution and Storage Commercial and DSCP (FY 2005-2010)
USAF	\$3,164,000	\$198,731,403	\$7,727,376
USA	\$6,640,000	\$1,241,602,034	\$4,823,664
USMC	\$319,000	\$173,796,280	\$1,409,088
USN	\$8,386,000	\$105,623,784	\$369,456
DSCP	—	—	\$52,317,751
Totals by Phase	\$18,509,000	\$1,719,753,501	\$66,647,335

C. CAMOUFLAGE PATTERN TESTING

The Army Combat Uniform (ACU) development began in 2003 with the intent to provide Soldiers with an improved uniform capable of providing effective camouflage in all environments. The Universal Camouflage Pattern (UCP) was selected, but Army officials failed to make available to Congress any testing and evaluation data that

supported this decision. Furthermore, no performance reports nor explanations were provided regarding the development of the UCP (GAO, 2012, p. 17–18).

Thus, the focus of this section will primarily rely on the U.S. Army's camouflage pattern testing conducted by the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) from March 2007 through March 2009 and during the Phase IV portion of the Camouflage Improvement Effort. These evaluations contained an incredible amount of data on camouflage pattern effectiveness. Most of the information has been gleaned from the Natick Technical Report TR-09/021L and the Army Materiel Systems Analysis Activity (AMSAA) Technical Report TR-2015-19 respectively. Both of these reports focused on camouflage patterns and their effectiveness in varying environments rather than uniform design and are further described in the Literature Review section of this paper.

The Photosimulation Camouflage Detection Test, detailed in TR-09/021L, was conducted between March 2007 through March 2009 in order to test the effectiveness of the UCP-D and the MultiCam© pattern used by Special Forces in Afghanistan against UCP. UCP was proving ineffective in the various terrain found there and an alternative was needed.

Phase IV of the Army's Camouflage Uniform Improvement Effort, detailed in TR-2015-19, was conducted from 2011–2014 to determine the Army's long-term strategy for its uniform requirements for the future. A U.S. Army Corps of Engineers study found that the Army's operating environment consisted of 19% arid, 37% woodland, and 44% transitional environments (Mortlock, 2017). The objective was to determine which patterns worked best in these environments in order to find a three-pattern family of camouflage patterns to augment operational reach around the globe.

The NSRDEC test, performed from 2007–2009, was conducted to quantify the effectiveness of varied camouflage patterns in different environments (NSRDEC, 2009). NSRDEC, in conjunction with the U.S. Army's Aberdeen Test Center, developed a computerized photo simulation evaluation for testing camouflage effectiveness shown in Figure 8. This method uses photographs of subjects wearing various camouflage

uniforms in varying terrain under relatively similar conditions, and it allows field data to be taken to observers rather than the costly method of putting observers in the field.



Figure 8. Photosimulation observer test setup. Adapted from NSRDEC (2009).

Eighteen camouflage patterns worn by test personnel in various terrains were evaluated through obtaining visual ranges of detection by over 900 observers (NSRDEC, 2009) to determine which patterns performed well in different environments. Three environments were of interest; desert, urban, and woodland. Each environment was imaged in various CONUS locations and contained three scenes at multiple ranges illustrated in Table 2:

Table 2. Photosimulation detection test environmental parameters.
Adapted from NSRDEC (2009).

Environment	Scenes			Dates	Distance (m)
Woodland (Devens, MA)	Woodland Shade	Woodland Partial Shade	Woodland Bright Sun	7-10 March 2007 15-17 July 2008	25, 50, 75, 100, 125, 150, 175, 200, 250, 300, 400
Urban (Ft. Campbell, KY)	Urban Door	Urban Small Building	Urban Corner	30 Sep-5 Oct 2007	125, 150, 175, 200, 250, 300, 400
Desert (Ft. Irwin, CA)	Desert Rock	Desert Sage	Desert Sand	17-20 Mar 2008	25, 50, 75, 100, 125, 150, 175, 200, 250, 300, 400

Camouflage patterns included Universal Camouflage Pattern (UCP), woodland and desert MARPAT, MultiCam©, and patterns from other countries. Five of the patterns were eliminated from the final analysis due to availability or poor performance (NSRDEC, 2009). Final rankings by scene are displayed in Table 3; it is noteworthy that some patterns that ranked highly in one setting did not perform as well in other scenes within that environment.

Table 3. Ranking of patterns by scene. Adapted from NSRDEC (2009).

Ranking of Patterns by Scene									
	Desert			Urban			Woodland		
	Rock	Sage	Sand	Door	Small Bldg	Corner	Bright Sun	Shade	Partial Shade
Best ↑ ↓ Worst	Desert Brush	MultiCamB	Desert British	Desert MARPAT	Desert Brush	Desert Brush	China	China	China
	Desert British	Natural Gear	Syria	Natural Gear	Woodland MARPAT	Desert MARPAT	Mossy Oak	Woodland MARPAT	Syria
	Syria	Syria	Desert MARPAT	Desert British	Syria	Desert British	Iraq	French	Iraq
	Desert MARPAT	Desert Brush	Desert Brush	MultiCamB	Bulldog	Syria	Woodland MARPAT	Mossy Oak	Woodland MARPAT
	Natural Gear	Desert British	Bulldog	Iraq	Iraq	MultiCamB	French	Iraq	Mossy Oak
	Bulldog	Desert MARPAT	MultiCamB	China	UCP	UCP	Bulldog	Syria	French
	MultiCamB	Mossy Oak	China	Desert Brush	Desert MARPAT	Bulldog	Natural Gear	MultiCamB	Natural Gear
	Woodland MARPAT	Bulldog	Natural Gear	Mossy Oak	MultiCamB	Iraq	Desert British	Desert Brush	MultiCamB
	French	China	UCP	French	Desert British	Natural Gear	Desert MARPAT	Desert MARPAT	Desert Brush
	UCP	French	Mossy Oak	UCP	China	French	MultiCamB	Bulldog	Bulldog
	Iraq	Woodland MARPAT	Woodland MARPAT	Syria	Natural Gear	China	Syria	Natural Gear	Desert MARPAT
	Mossy Oak	Iraq	French	Bulldog	Mossy Oak	Mossy Oak	Desert Brush	UCP	Desert British
	China	UCP	Iraq	Woodland MARPAT	French	Woodland MARPAT	UCP	Desert British	UCP

The ranking of patterns by scene highlight the poor performance of UCP in desert and woodland settings; indeed, the only scenes that UCP ranked tolerably were in two of the Urban settings. Both MARPAT patterns ranked highly in their respective backgrounds and the OEF-CP pattern outperformed UCP in every scene except Urban Small Building. This testing confirmed the Army’s desire to find a replacement camouflage pattern for UCP.

Expanding from specific scenes into overall backgrounds reveals similar results as the data were averaged from the three scenes within the environment. Table 3 illustrates ranking of patterns by the environment, which primarily generates a general overview rather than the scene-specific rating as depicted in Table 4.

Table 4. Ranking of patterns by environment. Adapted from NSRDEC (2009).

Ranking of Patterns by Environment			
	Desert	Urban	Woodland
Best ↑ ↓ Worst	Desert British	Desert MARPAT	China
	Syria	Desert Brush	Woodland MARPAT
	Desert MARPAT	Desert British	Mossy Oak
	Desert Brush	MultiCam®	French
	Bulldog	Syria	Iraq
	MultiCam®	Natural Gear	MultiCam®
	Natural Gear	Iraq	Syria
	Mossy Oak	UCP	Bulldog
	UCP	Bulldog	Natural Gear
	French	China	Desert Brush
	Woodland MARPAT	Mossy Oak	Desert MARPAT
	China	Woodland MARPAT	UCP
	Iraq	French	Desert British

As Table 4 illustrates, environment-specific patterns performed well in their intended environments and fared poorly in other environments. Several patterns ranked significantly higher than UCP, including OEF-CP and MARPAT.

Testing for the Army’s Camouflage Uniform Improvement Project Phase IV began in 2011 and used similar methodologies. The purpose of this phase was to determine the Army’s long-term, three-pattern family of uniforms using a single Organizational Clothing and Individual Equipment (OCIE) pattern. Testing primarily relied on photosimulation detection and operational testing, with nearly 200 observers evaluating the former and 120 for the latter. Eighteen camouflage pattern families were evaluated for Stage 1 and four families were tested further in Stage 2. Provisions in the National Defense Authorization Act (NDAA) of 2014 (H.R. 3304, 2013) prohibited funding for new patterns, which ruled out the four patterns tested in Stage 2 (NSRDEC, 2009). To comply with the provisions, the Product Manager - Soldier Clothing and Individual Equipment (PdM-SCIE) investigated using the alternative Scorpion W2 (now

called the Operational Camouflage Pattern, or OCP) as a transitional pattern and existing DOD patterns for arid and woodland environments. The following uniforms were tested:

- OCP: Operational Camouflage Pattern (Scorpion W2)
- MPD: Marine Corps Pattern - Desert
- MPW: Marine Corps Pattern—Woodland
- NPW: Navy Pattern—Woodland
- DCU: Desert Camouflage Uniform
- BDU: Battle Dress Uniform

There are three suffixes concerning the use of Organizational Clothing and Individual Equipment (OCIE) with the above patterns:

- O: OCP OCIE (OCP camouflage pattern)
- C: Coyote OCIE (USMC and USN solid color)
- N: No OCIE worn

As noted in the report, OCP is a transitional pattern, MPD and DCU are arid patterns, and MPW, BDU, and NPW are woodland patterns. The eight uniform/OCIE configurations are shown in Figure 9.



Figure 9. Army Camouflage Uniform Improvement Project, Phase IV uniform configuration. Source: Mazz (2015).

The evaluations did not focus on Coyote OCIE, but data results have caused the Army to reconsider the affordability constraint that mandated a single OCIE pattern. The DLA Troop Support Clothing and Textiles Supply Chain report a cost of approximately \$4,000 in OCIE expenses per Soldier (Berteau, 2011). The evaluation shows that the performance of the DCU-N is significantly better than the DCU-O for example.

The results of the arid pattern assessment in the arid environment are clear. Arid camouflage patterns with OCP OCIE (MPD-O and DCU-O) perform significantly better than OCP-O. There are indications that, with matching OCIE, the arid patterns could substantially better their performance. MPD-O and DCU-O perform equally well (Mazz, 2015, p. 18).

The results of the woodland pattern assessment in the woodland environment are mixed. Woodland camouflage pattern with OCP OCIE (MPW-O and BDU-O) perform significantly better than OCP-O in sunlit, dormant conditions but not in sunlit, verdant (green or covered in green vegetation) conditions. Under woodland twilight verdant conditions, the woodland patterns perform significantly better the OCP-O.

D. SUMMARY

Prior to 2002, all four military branches of the U.S. were utilizing the BDU and DCU. Since then, each Service branch has developed new camouflage uniforms specific to that branch. However, the DOD Services employed a fragmented approach in

designing, developing, and implementing these uniforms. Collaboration between the Services was ignored due to uniform development efforts being implemented individually.

The GAO, in report 12–707, found that only one Service followed the DOD’s acquisition guidance found in the 5000-Series (GAO, 2012). The USMC complied with specific, required reports and information documentation to support its decision-making in five distinct categories: acquisition strategy, acquisition program baseline, risk assessment, cost estimate for the program’s life cycle, and a test and evaluation master plan. Comprehensive testing was performed that narrowed the original pool of more than 60 patterns down to eight, then to three.

The Army failed to follow the 5000-Series guidance nor did they use an acquisition strategy that would have provided a blueprint for research and development, testing, and fielding (GAO, 2012). The selection of the UCP was not supported with information on the results of testing, performance evaluations, or risks to the program. The pattern also proved to be ineffective in Afghanistan and non-urban areas in Iraq, prompting Congress to direct the Army to provide suitable camouflage uniforms to deployed Soldiers immediately (GAO, 2012).

The Air Force, like the Army, was lacking an acquisition strategy in selecting the ABU. The GAO concludes that Air Force testing processes were incomplete as they failed to test different patterns and fabrics before choosing the tiger stripe pattern. USAF officials argued that ABU development was intended only for use on bases and, as such, did not fall under acquisition guidance provided in the 5000-Series (GAO, 2012).

The USN uniform development efforts are not included in GAO Report 12–707 due to the Navy adopting uniforms developed within their Special Warfare Command.

III. LITERATURE REVIEW

A. PURPOSE

These reports are presented in chronological order to provide the reader a sound understanding of the DOD camouflage uniform development since 2007. By this time, the USMC had developed and introduced the MARPAT in two color schemes, and the USA was undergoing Congressional scrutiny of the ACU and FRACU with UCP. Furthermore, these reports focus on camouflage pattern effectiveness rather than uniform design and material.

The first report, issued by the U.S. Army Natick Soldier RD&E Center and labeled TR-09/021L (NSRDEC, 2009), describes and documents in detail the technical methodology and results from photosimulation evaluations of various camouflage patterns across multiple environments. Overall, there were over 90,000 data points collected using 39 different backgrounds from several locations: the Cassidy MOU site at Ft. Campbell, KY; Ft. Irwin, CA; and Devens, MA. Camouflage patterns included UCP, Desert Brush, Desert MARPAT, MultiCam©, and Syria. These patterns are displayed in Table 5.

Table 5. Patterns selected for final analysis. Adapted from NSRDEC (2009).



The four latter patterns demonstrated a significant visual detection performance advantage over the UCP in most environments. The report concludes with several recommendations, such as pattern color and brightness are more important than design; environment-specific patterns provide the most effective camouflage in their respective environments; and defined requirements are necessary for the DOD to successfully implement any future camouflage patterns (NSRDEC, 2009).

The next report, GAO-10-669R (GAO, 2010), evaluates the DOD's combat uniforms utilized by the Armed Forces by assessing four specific objectives, methodologies used, and the findings. Objective 1 assessed the extent of performance standards by which camouflage uniforms were judged.

The GAO found that, although the Services have performance criteria, camouflage effectiveness is not among them. The focus of Objective 2 was to determine the costs and logistics requirements of developing and implementing Service-specific uniforms. The authors present a graph representing design and development costs in Figure 10.

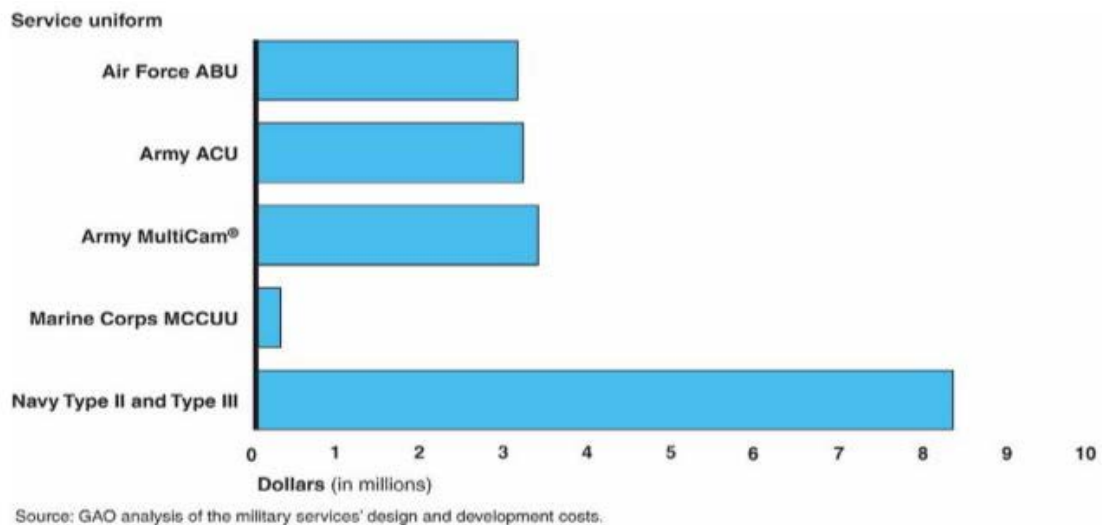


Figure 10. DOD uniform design and development costs. Source: GAO (2010).

Exact figures from the report are displayed in Table 6:

Table 6. Camouflage uniform costs across the DOD. Source: GAO (2010).

	Design and development Service data (FY 2001-2010)	Production and procurement DSCP Obligations (FY 2005-2010)	Distribution and storage Commercial and DSCP (FY 2005-2010)
Air Force	\$ 3,164,000	\$198,731,403	\$7,727,376
Army	6,640,000	1,241,602,034	4,823,664
Marine Corps	319,000	173,796,280	1,409,088
Navy	8,386,000	105,623,784	369,456
DSCP			52,317,751
Totals by Phase	18,509,000	1,719,753,501	66,647,335

Additionally, this report finds that production costs have increased from \$223 million in FY05 to \$422 million in FY09. Furthermore, DOD officials claim that fielding multiple uniforms in a combat theater does not require additional logistics support; this additional support, however, is displaced to U.S. based storage costs (GAO, 2010). Objective 3 evaluated the impact of patents on sharing uniform design across the Services. The authors determined that government-owned patents do not present a barrier to allowing other Services to adopt the same camouflage pattern. Lastly, Objective 4 assessed any risks or challenges to Service members operating in tactical environments where separate camouflage uniforms are used. The authors report that no data has been collected by the DOD that would enable such an assessment (GAO, 2010).

GAO Report 12-707 (GAO, 2012) addresses the DOD's fragmented approach to uniform development. The report also identifies two elements that are fundamental for producing successful outcomes in acquisitions: using clear policies and procedures that are consistently implemented; and obtaining effective, reliable information to make decisions (GAO, 2012). This report determined that the USMC was the only branch to follow these elements, and thereby developed a uniform that met its requirements. Field testing of the MCCUU involved almost 300 Marines from Expeditionary Forces over 22 days evaluating fit and comfort, durability, appearance, and mission suitability (GAO, 2012). The USA and USAF did not follow these essential elements; the report found that both Services developed uniforms that did not meet mission requirements and subsequently had to be replaced. Test and evaluation results for both the UCP and the

ABU were not made available. The report concludes that although the DOD provided acquisition guidance through the 5000-Series policies, all Services did not follow said guidance. The GAO report recommended that the Secretary of Defense take action in four areas: ensure that the military Services have and use clear policies and a knowledge-based approach in acquisitions, develop and issue joint criteria for uniforms, develop a policy to ensure that uniforms provide equivalent levels of protection and performance, and to take advantage of pursuing partnerships for the joint development and implementation of uniforms (GAO, 2012).

GAO report 13–279SP (GAO, 2013) addresses fragmentation and duplication within the DOD. In this report to Congress, the GAO points out programs and activities within the DOD that are fragmented, overlapping, or duplicative that, if addressed, could reduce the cost of government operations. The report is divided into two categories: Section I presents 17 areas that apply to the former, and Section II summarizes 14 additional opportunities for the latter. Section I addresses combat uniforms and the DOD’s fragmented and costly approach in their development and acquisition processes. This GAO report determined that the military Services and the DOD have not collaborated in setting criteria for the uniforms and that the DOD has failed to take steps to ensure equivalent protection and performance levels for combat uniforms, potentially exposing our Service members to increased risk. This fragmented approach resulted in numerous inventories of uniforms and an increased cost to the logistics chain. Lastly, the report recommends that the Secretary of Defense should direct the following three actions: identify and implement steps to develop and issue joint criteria for uniforms, develop a policy to ensure future uniforms provide equivalent levels of protection and performance, and that the military departments shall actively pursue partnerships to minimize fragmentation, reduce inventory, and reduce overall procurement costs (GAO, 2013).

The last report analyzed is from the Army Materiel Systems Analysis Activity (AMSAA) evaluation of the U.S. Army’s Camouflage Uniform Improvement Project, Phase IV. In this technical report, labeled TR-2015-19, author John Mazz (2015) begins with an overview of Phase IV testing. The objective of this phase is to determine a long-

range camouflage uniform strategy for the Army's future needs. A family of three patterns (woodland, transitional, and arid) with an Organizational Clothing and Individual Equipment (OCIE) pattern was desired by the USA. In 2014, the Army selected the Scorpion W2 pattern as the OCP transitional pattern for uniforms and OCIE. The author continues by describing the design of the study and providing analysis from photosimulation and operational testing of woodland and arid patterns in their respective backgrounds. Figure 11 illustrates an image sequence for the photosimulation detection analysis while Figure 12 represents depiction of a blending study.

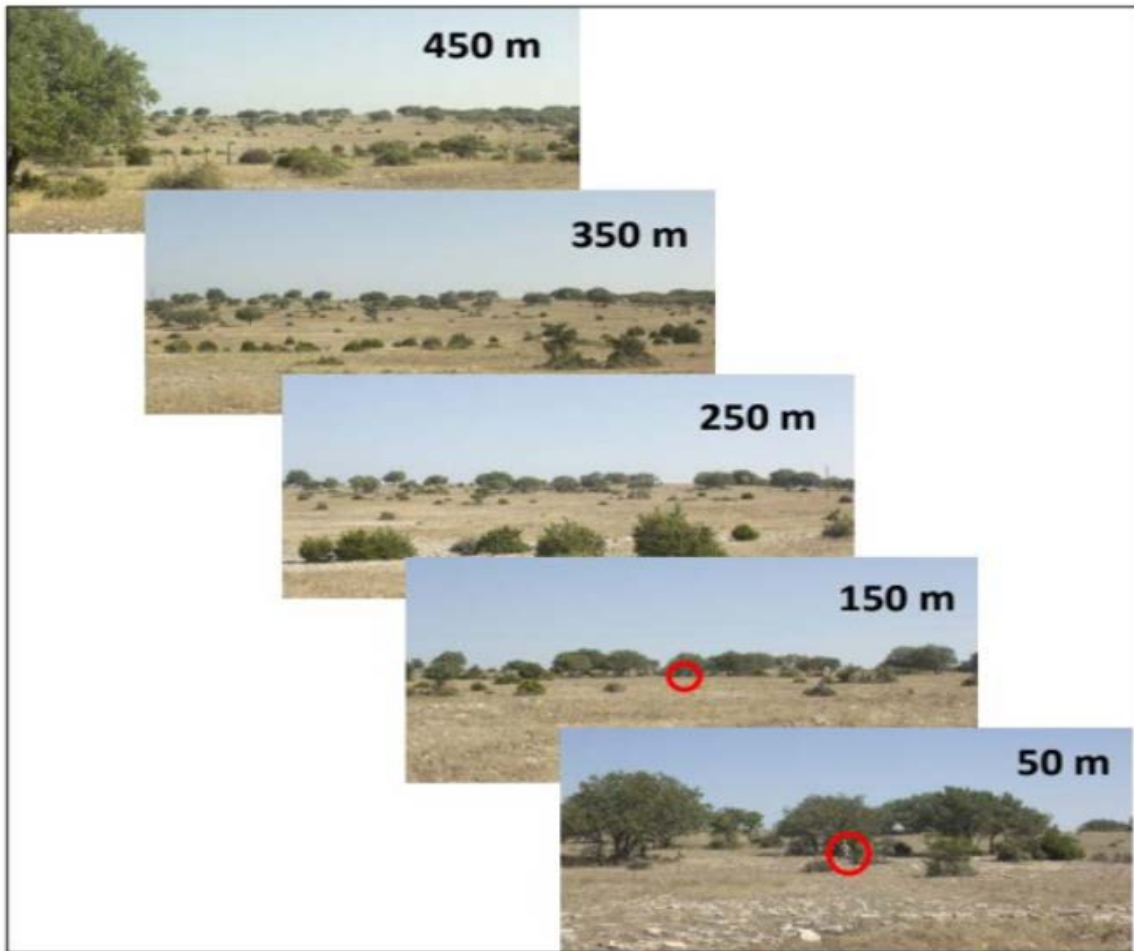


Figure 11. Depiction of image sequence. Adapted from Mazz (2009).



Figure 12. Depiction of a blending analysis. Adapted from Mazz (2009).

Mazz concludes that the arid patterns perform far better than the OCP in both day and night arid environments and the woodland camouflage patterns perform significantly better than the OCP in specific woodland environments, thus supporting the Army's desire for a family of uniforms.

IV. DATA ANALYSIS

The following data analysis will use a PEST (Political, Economic, Social, Technological) and SWOT (Strengths, Weaknesses, Opportunities, Threats) framework to examine external and internal factors affecting camouflage uniform development within the DOD. This section of the thesis will focus on two propositions: maintaining the current status quo of service-specific camouflage uniforms, and implementing a single joint camouflage combat uniform across all branches.

A. PEST ANALYSIS

The PEST analysis provides a tool to evaluate the macro-environmental (external) factors of a business or organization (Shapiro, 2013). In the following PEST analysis, each factor will examine benefits and drawbacks of implementing a joint camouflage uniform in order to allow a better understanding of each dimension. Common PEST analysis factors are found in Table 7. Each factor will evaluate the benefits and drawbacks of the options of Service-specific uniforms and joint camouflage uniforms.

Table 7. Factors of the PEST analysis. Adapted from Shapiro (2013).

Political	Economic	Social/Cultural	Technological
Infrastructure	Business cycle	Cultural	Communications
Regulations	Labor costs	norms/trends	Emerging tech
Fiscal policy	Growth rate	Demographics	R&D efforts
Legislation	Industry factors	Ethical issues	Awareness

1. Political Factors

These factors relate to how the government intervenes with an activity and to what degree. Political factors include:

- Congressional influence
- Infrastructure

- Regulations
- Fiscal policy
- Legislation

Since the military Service branches belong to the DOD—itsself a branch of the U.S. Government—political factors cannot be ignored. Congress dramatically influences decisions made by the DOD as evidenced by the provisions in the NDAA 2014. Section 352 of H.R. 3304, Public Law 113–66 quotes:

It is the policy of the United States that the Secretary of Defense shall take steps to reduce the separate development and fielding of service-specific combat and camouflage utility uniforms, in order to collectively adopt and field the same combat and camouflage utility uniforms for use by all members of the Armed Forces to the maximum extent practicable (H.R. 3304, 2013).

As of the time of this writing, the NDAA 2015 has not stricken this requirement. Of note is that the DOD does not have a single office for uniform procurement; this has traditionally been Service-driven. There is, however, a Joint Clothing and Textile Governance Board (JCTGB) that may share some of this burden (Senate Bill 2943, 2016).

The NDAA requirement will affect the Secretary of Defense, the three Service Secretaries, and the Commandant of the Marine Corps. At least one of the Service chiefs, Secretary of the Navy Ray Mabus, has spoken in favor of this requirement. Author Paul Shinkman (2013) quotes Mabus saying “The notion that we [have] all [this] camouflage doesn’t make a lot of sense to me,” he also states “It’s worthwhile to see if we can shrink the numbers. Whether you go to one, or two or three, that’s still progress” (Shinkman, 2013). However, it may be unreasonable to expect political leaders to agree with this stance. Some may favor the distinctive look that Service-specific uniforms provide, regardless of effectiveness.

The current array of Service-specific uniforms results in a higher number of uniform production contracts than a single uniform might entail. Reversing this trend of

unique uniforms for every branch to a joint camouflage combat uniform for use by all Services may result in an unfavorable impact on commercial providers. Politicians represent these businesses and may resist this change in commerce.

2. Economic Factors

Economic factors have a significant impact on how an organization does business. Factors of this category include:

- Fiscal responsibility
- Additional logistics requirements vs. reduced inventory costs
- Possible reduction in commercial providers
- Business cycle
- Labor costs
- Industry factors

Fiscal responsibility is owed to the taxpayers, and the military branches should not be excused from this. The previously referenced GAO-10-669R report concludes that the total of Service-specific uniform design and development cost exceed \$18 million; production and procurement cost is approximately \$1.7 billion (GAO, 2010).

These are funds that have already been expended and, some might say, is a reason to stay with Service-specific uniforms. However, the cost in additional logistics requirements for the variety of uniforms now in service has increased and will be a continuing expenditure. Moving to a joint uniform would reduce inventory costs in the supply chain and should ease logistics requirements by cutting the additional storage costs incurred from Service-specific uniforms. However, this potential change in commercial providers could limit competition and cause some businesses financial distress. Moreover, there may be additional costs incurred from modifying or terminating existing contracts.

3. Social Factors

Social factors involve areas that contain the beliefs and attitudes of a population—in our case, the Service members of the military. Factors in this case are:

- Distinct appearance of uniforms
- Shifting military culture to inclusiveness
- Unequal camouflage effectiveness

The current array of Service-specific uniforms has resulted in a distinctive look for each branch, and some Service members—as well as top officials—want to maintain their unique uniforms to distinguish themselves from other branches (Seck, 2013). Seck quotes the Commandant of the Marine Corps as saying that the Marines are “sticking with the MARPAT like a hobo on a ham sandwich.” The same article quotes the Sergeant Major of the Marine Corps (SMMC) Michael Barrett saying that the MCCUU “is a visible indicator of our identity as United States Marines” (Seck, 2013). These distinctive uniforms may also serve as an enticement to potential recruits that wish to serve their country with an additional measure of uniqueness found in Service-specific uniforms.

Service-specific uniform individuality, however, is at odds with the changing military paradigm of exclusive elitism to an inclusive whole. Recent legislation that allows females to serve in traditionally male combat roles and homosexuals to serve openly in the military are both indicators that the military is shifting to an inclusive, “all are welcome” stance. The following quote is an excerpt from USAF LTC Dunivan’s Air War College thesis:

If America expects its military to reflect society, it is imperative that the military adopts an inclusionary paradigm of culture. The success or failure of a paradigm shift rests with the military. Together its leaders and members are the catalysts for permanent social change—they are the paradigm pioneers who can institutionalize a cultural paradigm characterized by an inclusive whole rather than a paradigm personified by an exclusive few (Dunivin, 1997).

Furthermore, there is an ethical aspect to Service-specific uniform design. The SMMC has said that the USMC has the best camouflage pattern in the world (Seck, 2013), and this infers that the other branch's patterns are somewhat deficient in camouflage effectiveness. If our military Service members are all on the same team, in the same battle space, then logic dictates that our Service members should wear the same uniform with the same level of concealment.

4. Technological

Technology changes constantly and considerably influence the way an organization functions. Technological factors include:

- Uniform performance
- Impact on development and testing
- Emerging technology
- Research and development efforts
- Awareness

The technology that goes into camouflage uniform development consists of patterns, colors, visibility in the visible, Near Infrared (NIR), and Short-Wave Infrared (SWIR) spectrums, durability, and insect and flame resistance. Continuing advances in technology could yield improved concealment and protection for Service members.

Additionally, technology has accorded alternative methods of testing camouflage effectiveness, such as producing high-quality digital images of various patterns in different backgrounds under relatively controlled environments. Observers are then able to evaluate uniforms at computer terminals. This method of testing is much less expensive and time-consuming than traditional methods of bringing observers into the field (NSRDEC, 2009).

Extensive camouflage pattern testing has been carried out by the Army in the recent Camouflage Improvement Effort, one of the most intensive studies ever

undertaken in the field of camouflage effectiveness (Vergun, 2014). Data were collected and evaluated on existing and experimental patterns—as well as those in use by different nations—in 46 daylight conditions and 18 nighttime background types (Mazz, 2015).

Continuing improvements in research and development are made possible by technological advancements. For example, NSRDEC reports advances in fiber science resulting in enhanced strength and flame resistance as well as being environmentally-friendly and sustainable (Lafontaine, 2016). Technology can advance exponentially; it would be immensely beneficial to increase awareness of these advances for future use.

B. SWOT ANALYSIS

SWOT is an acronym that stands for strengths, weaknesses, opportunities, and threats (Renault, 2017). A SWOT analysis is a framework that allows an organization to develop a full awareness of factors involved in strategic planning and decision-making. The following SWOT analysis is made using the findings of the previously addressed PEST analysis and will focus on the proposition to introduce a joint camouflage uniform across all branches. Table 8 notes the factors of the SWOT analysis.

Table 8. SWOT analysis. Adapted from Renault (2017).

	Helpful to the objective	Harmful to the objective
Internal	Strengths	Weaknesses
External	Opportunities	Threats

1. Strengths

These factors are internal to the organization and consist of knowledge, experiences, and resources—human, physical, and financial—available. As they pertain to this paper, the strength factors are:

- All branches report to the Secretary of Defense
- Extensive test data gathered
- The proven effectiveness of some patterns

A primary advantage within the Armed Forces is that all branches fall under the purview of the Secretary of Defense. Any policy implemented at this level should be followed by all Services. A structured hierarchy is typically a practical avenue for policy execution.

There has been extensive testing conducted on the effectiveness of various camouflage uniforms, enough to determine what patterns and colors work best in woodland, transitional, and arid environments. The USMC developed, tested, and fielded an effective pair of woodland and arid uniforms by following DOD guidance. The USA took a longer, more expensive route and, after following NDAA 2014 guidance, produced an effective transitional pattern. The U.S. Military has an extensive amount of knowledge, experience, and data available in camouflage pattern effectiveness that should present enough information to make decisions regarding uniform implementation.

The effects of the various Service-specific camouflage patterns on core branch activities is difficult to assess. The MARPAT MCCUU has proven effective in joint battle spaces, as has the Army's OEF-CP and OCP in Afghanistan. The USN NWU Type 1 and the Air Force's ABU were not suitable for joint battle spaces; the effects of these uniforms in service-specific environments has not been published to date.

2. Weaknesses

Weaknesses are also internal to the organization and consist of many of the same factors listed under strengths, with a few additions below:

- Distinct uniforms could be a source of pride
- Funds previously expended on development
- Possible effects within the commercial uniform industry
- Military branches emphasize uniqueness rather than effectiveness
- Not all branches followed DOD acquisition guidance

However, weaknesses place limitations and restrictions on the objective. If the aim is to implement a joint camouflage uniform, then the status quo of Service-specific uniforms must be changed. There appears to be a degree of individualism perceived by each branch wearing its own uniform, which may be difficult to overcome. The Economist (E.B., 2014) quotes Timothy O’Neill, a retired LTC and expert in camouflage, as saying “Objectively speaking, it would be better for everyone to wear the same uniforms. But the Marines don’t want to look like the Army, the Army doesn’t want to look like Marines, and no one wants to look like the Navy” (E.B., 2014).

An additional disadvantage of implementing a joint camouflage uniform will be the money already expended on uniforms that are not selected for joint use. These funds will essentially become wasted taxpayer dollars, which are unpopular in political domains.

3. Opportunities

Opportunities are external conditions that may assist in achieving an objective. Several opportunities have become evident thus far:

- Enhance collaboration
- Reduced storage costs
- Streamlined logistics
- Joint uniform may reinforce paradigm shift
- Establishment of a joint procurement office
- Potential cost savings
- Maximizing proven effectiveness across all branches

The first opportunity is one of collaboration between the Services. Thus, far, none of the branches have worked with another to share the knowledge and experience gained

in combat camouflage. Collaboration between branches has the potential to produce the best camouflage pattern for all Service members in joint battle spaces.

Reducing the number of Service-specific patterns to a single joint camouflage uniform would reduce storage costs within the supply chain (GAO, 2010) and streamline logistics promoting effective cost savings by storing one uniform pattern rather than multiple Service-specific patterns. Furthermore, a joint camouflage pattern would provide the same level of camouflage effectiveness across all branches in joint battle spaces, thus maximizing proven effectiveness for all warfighters.

Implementing a joint combat uniform would result in reinforcing the military's paradigm shift to inclusiveness as a whole. If the military is genuinely interested in pursuing a policy of equality as a whole, then the Armed Forces' choice of uniforms should reflect that position.

A further potential opportunity lies in establishing a joint uniform procurement office at the DOD level. This would also enhance Service collaboration by providing equal representation by each branch. Additionally, the implementation of a joint camouflage uniform would eliminate the fractured approach taken over the last 15 years and would result in universal performance standards for combat uniforms.

4. Threats

Threat factors are external and may hinder objectives. Strengths and opportunities are often used to avoid or mitigate risks as listed below:

- Worldwide threats and operations
- Service-specific uniforms may degrade joint cooperation
- Resistance to joint uniforms from stakeholders

A prevalent threat in this analysis is continuing or emerging international unrest. The DOD Armed Forces are conducting operations worldwide, in a variety of environments, each with differing vegetation and terrain. Many of these operations are

conducted jointly, and each branch may be called upon to operate in several environments.

Continuation of Service-specific uniform development without collaboration may degrade inter-service cooperation. Moreover, this will not be beneficial in the current joint operating environment. In addition, as previously mentioned, there may be some political resistance, or opposition from other stakeholders, in implementing a joint camouflage uniform.

V. COMPARATIVE ANALYSES

To summarize the analyses of this report, the barriers to implementing a joint camouflage uniform are:

- Costs of terminating Service-specific uniform contracts
- Resistance from stakeholders

There are two propositions at hand: maintaining the status quo of Service-specific uniforms, and implementing a joint camouflage uniform—or family of uniforms—for use by all DOD branches. The following comparative analysis will focus on the relevant points of each potential barrier and how these difficulties can be mitigated.

(1) Costs of terminating Service-specific uniform contracts

This is a two-fold category that relates to the probable cost to commercial providers and the potential costs to the military of terminating existing uniform contracts. The Defense Logistics Agency (DLA) supplies clothing to all Services through various agreements. The U.S. Military branches submit an order and pay a fee to DLA to procure their uniforms (Defense Logistics Agency, n.d.).

According to GAO report 10–669, Defense Supply Center Philadelphia’s (DSCP) cost to produce and procure ground combat uniforms have increased from \$223 million in FY05 to \$422 million in FY09 (GAO, 2010). This period reflects the introduction of several Service-specific camouflage uniforms. There was an increase in the number of ACUs, ABUs, and flame-resistant uniforms issued which contributed to a spike in FY06. Aside from that year, DSCs logistics costs have steadily climbed as represented in Figure 13.

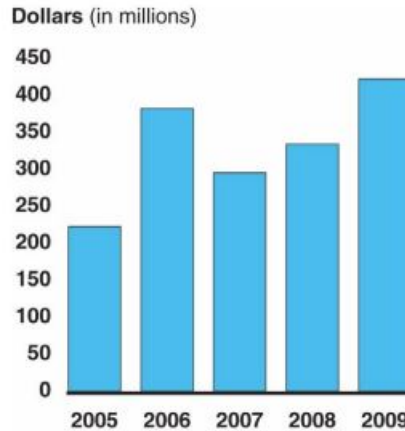


Figure 13. Total uniform production and procurement costs by fiscal year.
Source: GAO (2010).

Much of this cost could be negated by implementing a joint camouflage uniform for all Services. GAO report 12-707 found that the Armed Forces have collectively spent approximately \$12.5 million for uniform development since 2000 (GAO, 2012).

Procurement of military uniforms is managed by the Defense Logistics Agency Troop Support (DLATS) through various commercial providers (Defense Logistics Agency, n.d.). The current status quo of Service-specific uniforms results in a higher number of contracts for production; however, a single joint camouflage uniform for all Services would significantly lower the number of contracts. This action may adversely affect commercial providers due to the reduced number of contracts needed; however, the DOD would benefit from the cost savings. Terminating or modifying existing contracts may also result in an additional financial cost to the military.

(2) Resistance from stakeholders

There are several stakeholders regarding uniforms in the military. Service members, Service leaders, politicians, and commercial providers are all affected by the selection of camouflage uniforms. Discontinuing the procurement of Service-specific uniforms in favor of a joint pattern would potentially affect commercial providers the greatest. There may be political and commercial resistance due to this change. There is likely to be resistance from certain Service Members or Service leaders as well. The

USMC seem to be especially proud of their MARPAT MCCUU and rightly so; they spent the least amount of money of any branch and produced an effective set of camouflage patterns that met the stated objectives of providing greater effectiveness than the BDU/DCU.

If the DOD were to implement a camouflage pattern for all Services to use then some Service's uniforms would conceivably not be selected. This decision may lead to dissatisfaction from some parties such as politicians or Service leaders. However, if the Army's desire for a three-pattern family were implemented jointly, the three patterns could, for example, use a combination of patterns from across the Services, resulting in a compromise that all branches could accept. Additionally, the money saved on uniform procurement and streamlined logistics should more than offset any such resistance by way of cost savings across the DOD.

Extensive camouflage pattern evaluations have definitively shown which patterns work best in a given environment. Of the approximately \$12.5 million spent on uniform development by military branches since 2000 (GAO, 2012), the DOD has acquired three effective patterns. Both of the MARPAT versions have tested well, as has the Army's OCP and OEF-CP. The USAF ABU, IABU, and the USN NWU Type I were not developed for camouflage effectiveness, but rather branch individuality. The USAF has been directed to use the USA's OCP FRACU in Afghanistan, and the USN wear either the DCU or the new NWU Type III, which is a woodland pattern.

If the DOD were to implement a joint camouflage uniform, or family of uniforms, based off testing results, then all Service Members would have the same level of camouflage effectiveness in joint battle spaces.

The following section will revisit the research questions and briefly summarize the answers gleaned from the research.

- What barriers hinder the DOD from implementing a single joint camouflage combat uniform?

There are two primary barriers that could affect implementation of a joint camouflage combat uniform; resistance from stakeholders and the cost of terminating Service-specific uniform contracts.

- What are the Service histories for the camouflage combat uniform?

Each Service began with the use of the BDU and DCU. The USMC debuted the first U.S. Military digital camouflage patterns followed by the USA, USAF, and USN; each uniform was distinct to that branch. Unfortunately, none of the Services collaborated on uniform development, which created duplication and additional funding for the separate development efforts.

- What are the benefits and drawbacks of implementing a single joint camouflage combat uniform?

The benefits include equal camouflage effectiveness across all Services, reduced cost of development and storage, and emphasis placed on effectiveness and performance instead of uniqueness. The primary drawbacks are the potential resistance from stakeholders and a possible change to industry providers.

- What kind of testing is conducted for camouflage patterns?

Testing has been conducted in the visual and non-visual spectrums, performance, durability, and pattern effectiveness in different environments.

- What do the PEST and SWOT analyses provide to the development of acquisition strategies?

These analyses have highlighted the lack of collaboration between Services in uniform procurement. Additionally, there appears to be a lack of commitment from some Services in following DOD acquisition guidance. And, perhaps most importantly, camouflage effectiveness was not among the criteria for performance standards.

VI. CONCLUSION AND RECOMMENDATIONS

There seems to be a prevailing military culture that values wearing distinctive camouflage uniforms, even if many of these uniforms do not provide effective concealment in battle spaces. This paradigm, however, has cost millions of dollars and complicated logistics at the DOD level. Testing has found that the Army's OCP works well as a transitional pattern and that the MARPAT designs perform well in their intended environment.

Logistics costs in procurement and storage would be reduced if the DOD were to implement a joint camouflage uniform for use by all Services. Finally, all Service members would have the same level of camouflage effectiveness regardless of branch.

The U.S. military branches have employed ten different camouflage uniforms in the last 15 years in Iraq, Afghanistan, and other operational environments. None of the Branches collaborated with another branch but instead used a fractured approach to uniform development. This methodology resulted in several unfavorable consequences, such as millions of dollars in extra spending, additional logistics requirements, compromised camouflage protection for Service members, and at least three uniforms that did not meet branch objectives.

The 2014–2015 NDAA contained provisions to stop the development of Service-specific camouflage patterns in order to adopt a joint pattern or family of patterns. This author has found that there are some potential barriers to implementing this proposal; however, there are some recommendations that may promote such a transition.

Recommendation 1: Create a joint office for uniform development and procurement at the Office of the Secretary of Defense (OSD) level. The DOD currently issues guidance for acquisition practices under the DOD Directive 5000-Series. Initially, only the USMC followed this directive and subsequently introduced a uniform that met its stated objectives. The other three branches failed to follow this guidance, resulting in uniforms that had to be replaced. A joint uniform procurement

office would promote collaborative opportunities and reduced overall development costs. An organization along this vein has recently been created in the Joint Clothing and Textile Governance Board (JCTGB), which may accomplish this recommendation. However, it seems that this board has only met four times since 2010 and may not have the requisite program management expertise to develop the joint uniform (Senate Bill 2943, Sec. 332, 2016).

Recommendation 2: Begin development of a three-pattern family of camouflage uniforms. Extensive testing and evaluation have been conducted in the arena of camouflage pattern effectiveness. A family of patterns including woodland, transitional, and arid uniforms would allow combatant commanders to operate efficiently in joint battle spaces. One such family could include the Army's OCP for transitional environments, the Marine's MARPAT desert pattern for arid or urban environments, and the Navy's NWU Type III for woodland environments.

Recommendation 3: Conduct a cost-benefit analysis to determine OCIE pattern or patterns. Testing has determined that camouflage uniform effectiveness could be significantly increased with the addition of environment-specific OCIE. However, procuring multiple OCIE patterns will increase the overall cost as well as growing logistics requirements by requiring DLA to procure and store additional OCIE sets in three patterns rather than one. The DLA Troop Support Clothing and Textiles Supply Chain report a cost of approximately \$4,000 in OCIE expenses per Soldier, although this number would decrease with a standard complement of boots, helmet, and eyewear for example (Berteau, 2011).

Recommendation 4: Continue to pursue technological advancements in uniform design and production. NSRDEC reports advances in fiber science resulting in enhanced strength and flame resistance as well as being environmentally friendly and sustainable (Lafontaine, 2016). There have also been recent advances in ink jet printing that could result in environment-specific patterns being produced—in small quantities—in a matter of hours instead of the weeks or months it has traditionally taken (ROTHTEC, n.d.).

Lastly, the prevailing military culture of utilizing distinctive camouflage uniforms does not reflect the current changing paradigm shift from exclusiveness to inclusiveness. Recent policies and practices that emphasize inclusion are perhaps degraded by distinctive uniform wear. Our Service members deserve the most effective camouflage uniforms available, regardless of branch.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

- Blakemore, E. (2016, August 5). Navy Bids Goodbye to “Blueberry” Uniform. *Smithsonian*. Retrieved from <https://www.smithsonianmag.com/smart-news/navy-bids-goodbye-blueberry-uniform-180960039/>
- Berteau, D. J. (2011, June 28). *DLA troop support clothing & textiles supply chain*. Presented at Ohio Procurement Technical Assistance Center, Columbus, OH. Retrieved from <https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2011/DLA/TuesdayDLATroopSupportClothingTextiles.pdf>
- Brayley, M. J. (2009). *Camouflage uniforms: International combat dress 1940–2010*. Marlborough, Wiltshire: The Crowood Press.
- Brown, D. (2013). Why is the Marine Corps fighting with the Navy over a camouflage pattern? *The Atlantic*. Retrieved October 17, 2017 from <https://www.theatlantic.com/national/archive/2013/01/why-is-the-marine-corps-fighting-with-the-navy-over-a-camouflage-pattern/267232/>
- Canada. (n.d.). In *Camopedia*. Retrieved September 02, 2017, from <http://camopedia.org/index.php?title=Canada>
- Cole, W. E., & Sloane, M. E. (2010). Operation Enduring Freedom Camouflage Pattern: A Rapid Response to a Complex Need. *Army AL&T*. Retrieved from [http://ciehub.info/References/asc.army.mil/docs/pubs/alt/2010/4_OctNovDec/articles/12_Operation_Enduring_Freedom_Camouflage_Pattern\\$A_Rapid_Response_to_a_Complex_Need_201004.pdf](http://ciehub.info/References/asc.army.mil/docs/pubs/alt/2010/4_OctNovDec/articles/12_Operation_Enduring_Freedom_Camouflage_Pattern$A_Rapid_Response_to_a_Complex_Need_201004.pdf)
- Cox, M. (2015, January 05). Army Chief adds to confusion over new camouflage pattern. Kit Up! News. Retrieved from <https://kitup.military.com/2015/01/army-chief-adds-confusion-camouflage.html>
- Department of the Army. (1984). *Combat Skills of the Soldier* (FM 21–75). Washington, DC: Author. Retrieved from http://pdf.textfiles.com/manuals/MILITARY/united_states_army_fm_21-75%20-%203_august_1984.pdf
- Cramer, G. (n.d.). Digital camouflage history: Who did it first, Canada or the US? Camouflage or MARPAT camouflage. Retrieved September 14, 2017, from <http://www.hyperstealth.com/CADPAT-MARPAT.htm>
- Dunivin, K. O. (1997). *Military culture: A paradigm shift?* (Doctoral dissertation). Retrieved from <http://www.au.af.mil/au/awc/awcgate/maxwell/mp10.pdf>

- E.B. (2014, June 03). Why America's armed forces have so many camouflage patterns. *The Economist*. Retrieved from <https://www.economist.com/blogs/economist-explains/2014/06/economist-explains-0>
- Fahrenthold, D. A. (2013, May 08). With 10 patterns, U.S. military branches out on camouflage front. *The Washington Post*. Retrieved from https://www.washingtonpost.com/politics/us-military-has-10-kinds-of-camouflage-uniforms-government-duplication-at-its-finest/2013/05/08/58f2fe4e-b67c-11e2-bd07-b6e0e6152528_story.html?utm_term=.ee45580eb1df
- Freedberg, S. J. Jr. (2012, June 25). Army drops universal camouflage after spending billions. *Breakingdefense.com*. Retrieved from <https://breakingdefense.com/2012/06/army-drops-universal-camouflage-after-spending-billions/>
- Germany. (n.d.). In *Camopedia*. Retrieved September 02, 2017, from <http://camopedia.org/index.php?title=Germany>
- Government Accountability Office (GAO). (2010). Warfighter support: Observations on DOD's ground combat uniforms (GAO-10-669R). Retrieved from <http://www.gao.gov/assets/100/96770.pdf>
- Government Accountability Office (GAO). (2013). 2013 Annual report: Actions needed to reduce fragmentation, overlap, and duplication and achieve other financial benefits (GAO-13-279SP) (2013). Retrieved from <http://www.gao.gov/assets/660/653604.pdf>
- Government Accountability Office (GAO). (2012). Warfighter support: DOD should improve development of camouflage uniforms and enhance collaboration among the Services (GAO-12-707). Retrieved from <http://www.gao.gov/assets/650/648951.pdf>
- Government Accountability Office (GAO). (2016). 2016 Annual Report: Additional opportunities to reduce fragmentation, overlap, and duplication and achieve other financial benefits (GAO-16-375SP). Retrieved from <http://www.gao.gov/assets/680/676473.pdf>
- H.R. 3304, 113rd Cong (2013). Retrieved from <https://www.govtrack.us/congress/bills/113/hr3304>
- Lafontaine, D. (2016, November 23). Soldiers, researchers test prototype uniforms during Combined Resolve VII. *Army.mil*. Retrieved from https://www.army.mil/article/178691/soldiers_researchers_test_prototype_uniforms_during_combined_resolve_vii
- Mazz, J. (2015). *Data Analysis for the Army Camouflage Uniform Improvement Project: Phase IV, Bookend Pattern Assessment* (Report No TR-2015-19). Army Materiel Systems Analysis Activity.

- Mortlock, R. F. (2017). *Army camouflage pattern test sufficiency* [Lecture]. Retrieved from <https://cle.nps.edu>
- National Defense Authorization Act for Fiscal Year 2017, Pub. L. No. 114–328, Stat. 2943 (2016). Retrieved from <https://www.congress.gov/bill/114th-congress/senate-bill/2943>
- Renault, V. (2017). *SWOT Analysis: Strengths, Weaknesses, Opportunities, and Threats* [Lecture]. Retrieved from <http://ctb.ku.edu/en/table-of-contents/assessment/assessing-community-needs-and-resources/swot-analysis/main>
- ROTHTEC. (n.d.). Digital camouflage printing. Retrieved September 09, 2017, from <https://www.rothtec.com/digital-textiles/digital-camouflage-printing>
- Seck, H. H. (2013, July 22). Amos: Marines sticking to their MARPAT “like a hobo on a ham sandwich.” *Marine Corps Times*. Retrieved from <http://battlerattle.marinecorpstimes.com/2013/07/22/amos-marines-sticking-to-their-marpat-like-a-hobo-on-a-ham-sandwich/>
- Shapiro, A. (2013, May 29). PEST to PESTLE [Blog Post]. Retrieved from <https://www.trainingindustry.com/blog/leadership/pest-to-pestle/>
- Shinkman, P. (2013, June 13). Navy Secretary Slams “Blueberry” Camouflage. *U.S. News & World Report*. Retrieved from <https://www.usnews.com/news/articles/2013/06/13/navy-secretary-criticizes-blueberry-camouflage-uniforms>
- Venezia, J. & Peloquin, A. Natick Soldier Research, Development and Engineering Center. (n.d.). *Using a Constructive Simulation to Select a Camouflage Pattern for use in OEF*. Natick, MA: NSRDEC
- Vergun, D. (2014, March 31). Army testing combat boots, camouflage patterns. Retrieved from https://www.army.mil/article/121866/Army_testing_combat_boots__camouflage_patterns/
- United Kingdom. (n.d.). In *Camopedia*. Retrieved September 02, 2017, from http://camopedia.org/index.php?title=United_Kingdom
- U.S. Army Natick Soldier Research, Development, and Engineering Center. (2009). *Photosimulation Camouflage Detection Test* (Report No. TR-09/021L). Natick, MA:
- USA. (n.d.). In *Camopedia*. Retrieved September 02, 2017, from <http://camopedia.org/index.php?title=USA>

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California