NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

IMPROVING MILITARY TEAM BUILDING UTILIZING MATCHMAKING ALGORITHMS

by

Robert B. Thompson Jr. and David N. Schnaak

December 2018

Thesis Advisor:	Bradley J. Strawser
Second Reader:	Robert E. Burks

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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 2018		**3. REPORT TYPE AND DATES COVERED** Master's thesis	
4. TITLE AND SUBTITLE IMPROVING MILITARY TEAM BUILDING UTILIZING MATCHMAKING ALGORITHMS				**5. FUNDING NUMBERS**
6. AUTHOR(S) Robert B. Thompson Jr. and David N. Schnaak				
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.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.				**12b. DISTRIBUTION CODE** A

13. ABSTRACT (maximum 200 words)

Professional leaders across all industries, including the Army, seek to create teams that not only work well together, but are also highly successful. As the Army continues to structure its teams using an archaic and rudimentary system that relies heavily on intuition, the civilian sector has found great success by leveraging matchmaking technology to assist in team development. In continuation of previous research, our work discusses the current state of the Army's talent management system and the gap between it an its civilian counterpart, and urges the use of technology as a possible solution. We begin by establishing a base understanding of human chemistry. We discuss why human judgment and intuition are no longer sufficient tools for successful talent management, and highlight how current matchmaking technology is being used. Last, we present areas within the military that could benefit from the application of this technology and examine two hypothetical tests that could act as a proof of concept for our claims.

14. SUBJECT TERMS talent management, team building, matchmaking, algorithms, intuition, decision-making			**15. NUMBER OF PAGES** 63
			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

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. 239-18

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Robert B. Thompson Jr.
Major, United States Army
BA, Virginia Military Institute, 2007

David N. Schnaak
Major, United States Army
BA, Furman University, 2007

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN DEFENSE ANALYSIS (IRREGULAR WARFARE)

from the

NAVAL POSTGRADUATE SCHOOL
December 2018

Approved by: Bradley J. Strawser
Advisor

Robert E. Burks
Second Reader

John J. Arquilla
Chair, Department of Defense Analysis

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ABSTRACT

Professional leaders across all industries, including the Army, seek to create teams that not only work well together, but are also highly successful. As the Army continues to structure its teams using an archaic and rudimentary system that relies heavily on intuition, the civilian sector has found great success by leveraging matchmaking technology to assist in team development. In continuation of previous research, our work discusses the current state of the Army's talent management system and the gap between it and its civilian counterpart, and urges the use of technology as a possible solution. We begin by establishing a base understanding of human chemistry. We discuss why human judgment and intuition are no longer sufficient tools for successful talent management, and highlight how current matchmaking technology is being used. Last, we present areas within the military that could benefit from the application of this technology and examine two hypothetical tests that could act as a proof of concept for our claims.

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LIST OF ACRONYMS AND ABBREVIATIONS

1st SFC(A)	1st Special Forces Command (Airborne)
AI	artificial intelligence
ARSOF	Army special operations forces
AWCFT	Algorithmic Warfare Cross-Functional Team
AWS	Amazon Web Servers
CAQC	Civil Affairs Qualification Course
CPP	Consulting Psychologists Press
DARPA	Defense Advanced Research Projects Agency
DIUx	Defense Innovation Unit Experimental
DoD	Department of Defense
FFM	Five-Factor Model
FMV	Mid-Altitude Full-Motion Video
GDPR	General Data Protection Regulation
HASC	House Arms Services Committee
IO	information operations
IO/PSYOPS	information operations and psychological operation
IRB	Institutional Review Board
IT	information technology
KSAO	knowledge, skill, ability, and other personal characteristics
LOGSA	Logistics Support Activity
MBTI	Myers-Briggs Type Indicator
MFP-11	Major Force Program 11
MFP-2	Major Force Program 2
MOS	military occupation specialty
OER/NCOER	Officer/Non-Commissioned Officer Evaluation Reports
ORB/ERB	Officer/Enlisted Record Briefs
PED	processing, exploitation, and dissemination
PII	personally identifiable information
SFODA	Special Forces Operational Detachments–Alpha

SOCFWD0	Special Operations Command Forward
SOF	special operations forces
TMTF	Talent Management Task Force
TUAS	tactical unmanned aerial systems
USAJFKSWCS	U.S. Army John F. Kennedy Special Warfare Center and School
USASOC	U.S. Army Special Operations Command

ACKNOWLEDGMENTS

I want to thank my incredible wife, Jamie, for her love, patience, and candor. I also want to thank my twin boys, Owen and Drew, for being my greatest source of joy, laughter, and inspiration. Last, I also want to thank Rob for jumping on this crazy train with me and for keeping us organized and on schedule throughout this adventure in thesis writing.

—David N. Schnaak

I'd like to thank my wife, Anne, for her support, encouragement, and patience during graduate school, and my kids, Virginia Grey and Ainsley Kathleen, for bringing immeasurable joy to this world and consistently reminding me what truly matters. Last, I'd like to thank my thesis partner, Dave, whose steadfast optimism and common sense helped make this process much less painful.

—Robert B. P. Thompson Jr.

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I. INTRODUCTION AND BACKGROUND

A. INTRODUCING THE STUDY

Professional leaders across all industries seek to create groups of individuals—teams—that not only work well together but are also highly successful in accomplishing their assigned tasks or missions. The U.S. Army is no different. In fact, given the high stakes involved in the military profession, one could argue that effective teamwork is more important here than in nearly any other profession. Yet despite the importance the Army places on its human dimension, it still continues to structure its teams using an archaic and rudimentary system that relies heavily on human intuition. The results of such an approach are unsurprisingly suboptimal and cause some to call for a redesign of the system.[1] Meanwhile, in the private sector, many Fortune 500 companies have begun to leverage matchmaking technology to assist in team development and have found great success. Given the state of the current technology, the success rates experienced in the private sector, and the importance the Army places on human/team performance, the successful application of this same technology may have the potential to develop the Army's team concept and dramatically improve how its leaders manage talent.

In a continuation of previous research done by Ian McGregor and Jared Tomberlin, this work seeks to build on their findings by first discussing the current state of the Army's talent management system and the gap between this system and its counterpart in the private sector. Second, we then develop a base understanding of human chemistry and use that knowledge to discuss how current information technology (IT) is assisting decision-making. In particular, we examine the role of IT in team-building and talent management, and why, in the 21st century, human judgment and intuition may no longer be sufficient decision-making tools. Once this case has been made, we next identify a London-based IT company, Saberr, whose matchmaking software has the potential for immediate application

[1] David Barno and Nora Bensahel, "Can the U.S. Military Halt Its Brain Drain?," *The Atlantic*, November 5, 2015, https://www.theatlantic.com/politics/archive/2015/11/us-military-tries-halt-brain-drain/413965/; Tim Kane, *Bleeding Talent: How the U.S. Military Mismanages Great Leaders and Why It's Time for a Revolution* (New York: Palgrave Macmillan, 2012), 5–8.

in a military setting and discuss which areas within the military could benefit from the software. Finally, we propose two hypothetical test cases that could serve as a significant proof of concept. These cases test the software's application within a controlled military setting and thereby give a sense of its ability to influence military team building positively.

In the remainder of this chapter, we briefly describe the Army's current approach to talent management and highlight an area where decision-based algorithm technology could benefit not only the Army as an organization but also the individual warfighter—the Soldier—as well. Following that, we conclude this chapter by discussing human chemistry at a basic level. These concepts set the stage for the discussion in Chapter II of how rapid advances in technology have furthered our decision-making processes and are primed to assist in creating more cohesive and effective teams.

B. ARMY TALENT MANAGEMENT/TEAM BUILDING

The U.S. Army has access to the most up-to-date technological advances on the battlefield, yet wisely recognizes that it is the American Soldier, not the technology, that ensures its superiority. Thus, the U.S. Army continues to invest significantly in the human dimension to maximize individual and team performance, ensuring the American Soldier and the U.S. Army remain the most discriminately lethal and superior force in the world.[2] In fact, General Raymond T. Odierno, the 38th Army chief of staff, has stated that "the squad will remain the foundation and cornerstone of the Army,"[3] and Army doctrine reinforces that claim, stating, "individuals within the squad must excel at teamwork."[4]

Currently, the Army Talent Management System creates these squads by relying almost exclusively on highly subjective performance and experience reports such as the Officer/Non-Commissioned Officer Evaluation Reports (OER/NCOER) and the Officer/

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[2] "Human Dimension," Army Capabilities Integration Center, accessed March 20, 2018, http://www.arcic.army.mil/Initiatives/HumanDimension.

[3] Raymond T. Odierno, "Chief of Staff of the Army Remarks at AUSA Institute of Land Warfare Breakfast," www.army.mil, February 25, 2012, https://www.army.mil/article/72513/jan_25_2012_csa_remarks_at_ausa_institute_of_land_warfare_breakfast.

[4] Department of the Army, *The U.S. Army Human Dimension Concept* TRADOC PAM 525-3-7 (Washington, DC: U.S. Army Training and Doctrine Command, 2014), 9, www.tradoc.army.mil/tpubs/pams/tp525-3-7.pdf.

Enlisted Record Briefs (ORB/ERB). These reports, along with a leader's intuition, are then used to place individual soldiers into squads, platoons, staffs, and other teams with the aim of creating highly cohesive units. Although many Special Operations Forces (SOF), like the Army Special Operations Forces (ARSOF), recognize the value of psychological profiling and have utilized it to assist with assessment and selection when placing individuals into teams, ARSOF leaders continue to use the same subjective method as the rest of the Army.[5] Due to these factors, some argue that the Army's Talent Management System is archaic, leads to a loss in talent and readiness, and requires a redesign that meets the needs of the millennial generation of soldiers.[6] As the private sector has begun to exploit IT to its advantage—finding success by leveraging matchmaking algorithms to assist in developing project teams—the Army's Talent Management System has not kept pace. Instead, the Army continues to rely upon the highly subjective performance and experience reports with no indication that it plans to change. In a 2017 study, Ian McGregor and Jared Tomberlin found that within the Army, limited-to-no resources are available to assist with placement of an individual in a team once they have been selected.[7] Additionally, they found that the Army's Talent Management Task Force (TMTF) Defense Advanced Research Projects Agency (DARPA), and Defense Innovation Unit Experimental (DIUx) "indicate that there are no efforts underway to explore the use of matchmaking algorithms for team building."[8]

C. IDENTIFYING THE GAP

As the Army continues to emphasize individual and team performance as its cornerstones, and given the investment it places on the human dimension, any advantages in augmenting leaders' ability to form cohesive, successful teams should be evaluated.

[5] "Ranger Assessment and Selection," U.S. Army, accessed February 11, 2018, http://www.goarmy.com/ranger/join-the-rangers/ranger-assessment-and-selection.html.

[6] Kane, *Bleeding Talent*, 5–8; Barno and Bensahel, "Can the U.S. Military Halt Its Brain Drain?"

[7] Ian B. MacGregor and Jared D. Tomberlin, "TeamHarmony: Employing Matchmaking Algorithms to Team-Building" (Master's thesis, Naval Postgraduate School, 2017), 23, http://hdl.handle.net/10945/56760.

[8] MacGregor and Tomberlin, 52.

Psychologists have conducted a significant amount of research aimed at grouping specific individual qualities or traits as well as identifying and categorizing specific group dynamics, highlighting those that take a problematic form. However, useful, such studies into identifying what enables *positive* group chemistry have revealed no single superior form. Filling this void however, IT professionals have developed matchmaking algorithms proven to explain up to 20%–30% of overall team performance.[9] By using this same technology as a tool, not as an end-all solution, Army leaders may be able to maximize individual and team performance, improving how they conduct personnel placement and talent management, thus ensuring that "the American Soldier remains the most discriminately lethal force on the battlefield."[10]

D. HUMAN CHEMISTRY

In order to discuss team-building and how technology can assist with decision-making, one must first have an understanding of how human chemistry is categorized and tested and how the results of such tests are used in the creation of teams. This section provides an overview of that chemistry at the individual, pair, and group levels, discussing both the positive and negative outcomes such chemistry can create.

1. The Individual

When discussing the placement of individuals into a specific job, organization, or group, many psychologists start by focusing their analysis on the individual. Here, they draw on specific groupings of *qualities* or *traits* that an individual possesses and then, based on those qualities and traits, attempt to place them into groups of likeminded individuals or balanced teams. One of the more popular groupings that assesses the *qualities* of an individual is nicknamed KSAO, or "knowledge, skill, ability, and other personal

[9] Jennifer Robertson, "The Benefits of Assessing Team Fit First," *Saberr* (blog), February 9, 2017, https://blog.saberr.com/assessing-team-fit-first-the-benefits-7500fe970230.

[10] Army Capabilities Integration Center, "Human Dimension."

characteristics."[11] The five-factor model (FFM), or Big 5, on the other hand, assesses an individual's personality *traits* of openness to experience, conscientiousness, extroversion, agreeableness, and neuroticism.[12] Like the Big 5, the Myers-Briggs Type Indicator (MBTI) also assesses an individual's personality *traits*; however, as psychologists continue to refine the Big 5 model, many argue that the "MBTI is little more than pseudo-science."[13] Additionally, the president of the company that owns the MBTI test, Consulting Psychologists Press (CPP), confessed that the MBTI "was never intended to be predictive, and should never be used for hiring, screening, or to dictate life decisions."[14] Another more recent theory that has gained traction and is used to categorize individuals is Shalom Schwartz's theory of human values. Here he defines values as "desirable, trans-situational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity."[15] Originally, Schwartz identified 10 human values—benevolence, universalism, self-direction, stimulation, hedonism, achievement, power, security, conformity, and tradition—but additional research continuing Schwartz's work have posited that there could be as many as 15 discrete human values.[16]

2. Pair Chemistry

Pair chemistry is the relationship between two individuals. Although pair chemistry is usually used to refer to a relationship between individuals that is romantic or sexual in

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[11] M. Wisecarver, R. Schneider, H. Foldes, M. Cullen, and M. Zbylut, *Knowledge, Skills, and Abilities for Military Leader Influence.* (Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, 2011) 1.

[12] Courtney Ackerman, "The Big Five Personality Theory: The 5 Factor Model Explained (+PDF)," Positive Psychology Program, June 23, 2017, https://positivepsychologyprogram.com/big-five-personality-theory/.

[13] Adam Grant, "Goodbye to MBTI, the Fad That Won't Die," *Psychology Today,* September 18, 2013, http://www.psychologytoday.com/blog/give-and-take/201309/goodbye-mbti-the-fad-won-t-die; MacGregor and Tomberlin., "TeamHarmony," 13.

[14] Anthony Zurcher, "Debunking the Myers-Briggs Personality Test," BBC News, July 15, 2014, sec. Echo Chambers, http://www.bbc.com/news/blogs-echochambers-28315137. For additional information regarding the individual, see MacGregor and Tomberlin, "TeamHarmony," 11–13.

[15] Willem E Saris, Desiree Knoppen, and Shalom H Schwartz, "Operationalizing the Theory of Human Values: Balancing Homogeneity of Reflective Items and Theoretical Coverage," *Journal of the European Survey Research Association,* 7, no. 1 (2013): 29.

[16] Saris, Knoppen, and Schwartz, 31, 39–40.

nature, it can also be used to describe relationships such as friendships, family, or professional and is based on the relational context and expectations that the two individuals have of each other.[17] The importance of these types of relationships has been illustrated in Maslow's hierarchy of needs, specifically the need for love and belonging.[18]

These types of relationships are usually investigated in two different fields: personality psychology and social psychology.[19] Personality psychologists are largely concerned with isolating specific personality traits or qualities, like those identified in the KSAO, Big 5, or MBTI, then using those traits or qualities to infer certain characteristics of behavior toward others, introversion and extroversion being two outstanding examples.[20] Social psychologists, on the other hand, study how an individual's behaviors are influenced by others and examine what factors or conditions exist that cause these behaviors to occur.[21] One such psychologist, George Levinger, developed a model that describes the stages through which all interpersonal relationships develop—acquaintance, buildup, continuation, deterioration, and ending—and is often cited as being one of the most influential models of interpersonal relationships.[22]

3. Group Chemistry

Another area for analysis focuses not on the individual or a pair of individuals but on groups of three or more individuals and the factors that bind them together—their cohesion. When analyzing groups, sports psychology literature often employs two main concepts: social cohesion and task cohesion. According to Gregory Herek, these terms are defined as follows:

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[17] Lakshmi Sravanti, "Interpersonal Relationships: Building Blocks of a Society," *Indian Journal of Psychiatry* 59, no. 1 (2017): 123, https://doi.org/10.4103/psychiatry.IndianJPsychiatry_70_17.

[18] Abraham H Maslow, *A Theory of Human Motivation* (Eastwood, CT: Martino Fine Books, 2013).

[19] Fritz Heider, *The Psychology of Interpersonal Relations* (Hillsdale, NJ: Erlbaum, 1958), 3.

[20] Heider, 3.Mac

[21] G.W. Allport, "The Historical Background of Modern Social Psychology," Lindzey Gardner and Elliot Aronson, *The Handbook of Social Psychology* (Mahwah, NJ: Lawrence Erlbaum Associates Inc., 1985), 5.

[22] George Levinger, "Toward the Analysis of Close Relationships," *Journal of Experimental Social Psychology* 16, no. 6 (November 1980): 510–44, https://doi.org/10.1016/0022-1031(80)90056-6.

- ***Social cohesion*** refers to the nature and quality of the emotional bonds of friendship liking, caring, and closeness among group members. A group displays high social cohesion to the extent that its members like each other, prefer to spend their social time together, enjoy each other's company, and feel emotionally close to one another.

- ***Task cohesion*** refers to the shared commitment among members to achieving a goal that requires the collective efforts of the group. A group with high task cohesion is composed of members who share a common goal and who are motivated to coordinate their efforts as a team to achieve that goal.[23]

The existence or lack of social and/or task cohesion affects group chemistry, which can take both positive and negative forms. Problematic chemistry like human *toxicity*, "demotivational behavior that negatively impacts unit morale and climate";[24] *lookism*, "prejudice or discrimination based on physical appearance especially believed to fall short of societal notions of beauty";[25] and *groupthink*, "the desire for group harmony that supersedes the ability provide effective counsel or think critically"[26] can ultimately result in a group's failure. Likewise, positive chemistry within a group can foster success; however, few if any discrete classes of prominent positive chemistry exist. In fact, Laurie Buchanan found that research into team composition shows that there is no single factor

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[23] Gregory M. Herek, "Unit Cohesion and the Military Mission," UC Davis: Psychology, 2012, accessed February 11, 2018, http://psychology.ucdavis.edu/rainbow/html/military_cohesion.html.

[24] George E. Reed, *Tarnished: Toxic Leadership in the U.S. Military* (Lincoln, NE: Potomac Books 2015), http://muse.jhu.edu/book/41613.

[25] *Merriam-Webster*, s.v., "lookism" accessed February 11, 2018, https://www.merriam-webster.com/dictionary/lookism.

[26] "Groupthink," *Psychology Today,* accessed February 11, 2018, https://www.psychologytoday.com/basics/groupthink; Irving Lester Janis, *Victims of Groupthink: A Psychological Study of Foreign-Policy Decisions and Fiascoes* (Boston: Houghton Mifflin, 1972), 9, https://www.jstor.org/stable/3791464?seq=1#page_scan_tab_contents.

consistently correlated with positive group chemistry.[27] It is in light of such findings, that we turn to the IT industry to determine what they have found to be effective.

[27] Laurie Birch Buchanan, "The Impact of Big Five Personality Characteristics on Group Cohesion and Creative Task Performance" (PhD diss., Virginia Tech, 1998), https://vtechworks.lib.vt.edu/handle/10919/30415.

II. INFORMATION TECHNOLOGY

A. OVERVIEW

Since their inception, computers have played a vital role in the world economy by exponentially increasing the output of individuals and greatly economizing time spent on certain tasks. As the capabilities of computers have increased predictably according to Moore's Law, which states that computing power will roughly double every two years, businesses and agencies in both the public and private sectors have struggled to keep pace with the innovation.[28] As one might predict, businesses in the private sector have led much of this progress, developing new approaches and models to fully realize the latent potential that exists with burgeoning technology. Government agencies, the Department of Defense (DoD) in particular, have generally been slow to act, preferring to adopt a wait-and-see approach to the acquisition of new systems and technology until it is fully proven in the private sector.

Although this conservative approach has many benefits, including ensuring that investments in unproven technology are not made without substantial testing, it also has considerable consequences. The realm of technology is one in which early adopters are often rewarded with disproportionate returns and are able to dominate within certain arenas, if only for a short time. In the DoD, new technology and processes are often subjected to the same type of testing and selection that weapons and other military hardware must go through. The key distinction is that, unlike technology, military hardware, once tested, selected, and approved through the acquisition process, has a very long service life. One example is the M16 rifle, which has proved itself to be a reliable weapon for soldiers since it entered service in the early 1960s.[29] Any replacement weapon system will likely have updated ergonomics and components that will promise to increase reliability, accuracy, and user friendliness, but will provide the same basic function—

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[28] Dean Takahashi, "Forty Years of Moore's Law," *Seattle Times,* April 18, 2005, https://www.seattletimes.com/business/forty-years-of-moores-law/.

[29] Edward Clinton Ezell, *Small Arms of the World: A Basic Manual of Small Arms*, 11th rev. ed. (Harrisburg, PA.: Stackpole Books, 1977), 46–47.

allowing the user to fire projectiles at enemy forces. Technology and computer software, however, differ significantly due to the fact that they evolve or become obsolete much sooner than other types of acquisitions, thanks again to Moore's Law. By using the same acquisition process for both hardware and technology, the DoD all but ensures that any advantage achieved by adopting the new technology will be nullified by the time it is implemented.

In the world of business, global politics, and warfare, failing to innovate or adopt new processes as they become available leaves untapped potential on the table and provides an opportunity for competitors or adversaries to gain a distinct advantage. In this chapter, we explain current trends regarding the use of technology in the private sector, specifically algorithms and data-driven decision-making, and argue for greater utilization of this technology within the military.

B. THE COMPUTER-HUMAN PARTNERSHIP

The relationship or division of labor between humans and computers came about toward the end of the 20th century as the potential of computers began to be realized. While computers could be used for computations, bookkeeping, data storage, and transmission, humans would continue to make use of their creativity and intuition in order to make decisions and render judgments while working with one another to solve problems.[30] This standard partnership was a revolution that did away with a lot of paperwork, leaving mundane and repetitive tasks to computers while freeing people to do more of the types of activities that they enjoyed.

The advent of enterprise systems and the World Wide Web further automated processes throughout the private sector and has facilitated more productivity by enabling instant communication and allowing a network of computers separated by vast distances to do routine tasks automatically.[31] These tasks include tracking account balances and transactions, determining the quantity and timing of commodity orders, managing payroll

[30] Andrew McAfee and Erik Brynjolfsson, *Machine, Platform, Crowd: Harnessing Our Digital Future*, 1st ed. (New York: W. W. Norton & Company, 2017), 31.

[31] McAfee and Brynjolfsson, 34.

for employees, and providing customers a virtual storefront purchase products.[32] The military has followed suit, and for the past two decades, computers and web-based systems have done away with a tremendous amount of paperwork and facilitated more productivity by digitizing and automating certain systems within and across the different branches of service.

This new situation that attempts to increase productivity in workforce by combining computers and humans then raises the question of how to do it well. Michael Hammer and James Champy were the first to provide an answer as how employees should be best utilized following the proliferation of enterprise systems and the World Wide Web in their best-selling book, *Reengineering the Corporation*. The entire process of human cooperation is reengineered through the incorporation of machines to take over the mundane tasks. Meanwhile, according to Hammer and Champy "people working in a reengineered process are, of necessity, empowered. As process team workers they are both permitted and required to think, interact, use judgement, and make decisions."[33] This partnership between humans and computers should provide for an ideal division of labor, assuming that both partners are competent within their respective areas of expertise. However, while computers and algorithms are exceptional at handling and manipulating data, humans are not holding up their end of the bargain.

C. INSUFFICIENCIES OF HUMAN JUDGMENT AND INTUITION: THE CASE FOR ALGORITHMS

As technology continues to progress, there has been great interest in examining how humans think and make decisions as well as conducting research into building algorithms that enable technology to make these same decisions and predictions more effectively than humans. Hammer and Champy's argument for a partnership between humans and computers is convincing, and it served as a foundation at the beginning of the digital age.[34]

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[32] McAfee and Brynjolfsson, 34.

[33] Michael Hammer and James Champy, *Reengineering the Corporation: A Manifesto for Business Revolution*, (London: Nicholas Brealey, 1995), 69–70.

[34] McAfee and Brynjolfsson, *Machine, Platform, Crowd*, 37.

However, it turns out that human judgment, even by the most experienced professionals and experts in their field, can be, and often is, flawed and inefficient.

According to Nobel Prize winner Daniel Kahneman, humans reason in two distinct ways: fast and slow. Kahneman developed the notion of a two-system approach to judgment and choice that he simply labelled System 1 and System 2:

- ***System 1*** operates automatically and quickly, with little or no effort and no sense of voluntary control.

- ***System 2*** allocates attention to the effortful mental activities that demand it, including complex computations. The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration.[35]

System 1 for example, is the gut feeling or intuition a seasoned soldier develops after numerous missions conducted during a deployment and can alert him or her to the presence of an improvised explosive device or a potential enemy ambush before it happens. System 2 is the series of complex calculations that a pilot makes prior to a mission to determine how certain atmospheric conditions will impact fuel consumption and flight times. Kahneman explains that major issues with human thought and reasoning arise because "System 1 operates automatically and cannot be turned off at will, [so] errors of intuitive thought are often difficult to prevent. Biases cannot always be avoided, because System 2 may have no clue to the error."[36] In other words, the gut feelings and intuition developed in System 1 can unconsciously cloud a person's System 2 processes and create biases and other flaws in reasoning that impact their ability to make sound decisions.

There are numerous examples of the limitations of human judgment and intuition. In one notable experiment, law professors Ted Ruger and Pauline Kim conducted a test along with political scientists Andrew Martin and Kevin Quinn to determine whether a

[35] Daniel Kahneman, *Thinking, Fast and Slow*, 1st ed. (New York: Farrar, Straus and Giroux, 2011), 21–22.

[36] Kahneman, 28.

multivariable algorithm could accurately predict U.S. Supreme Court rulings by specific Supreme Court justices in 2002. The algorithm was pitted against a panel of renowned legal experts, law professors, and individuals who had previously worked with Supreme Court justices. The results were impressive, with the algorithm making accurate predictions 75% of the time while the experts were right only 59% of the time.[37] In another case, a meta-analysis study conducted by a team led by psychologist William Grove surveyed the results of 136 peer-reviewed human health and behavior studies in order to determine the accuracy of clinical (professional) judgment versus mechanical predictions (algorithms). They found that, "on average mechanical-prediction techniques were about 10% more accurate than clinical predictions. Depending upon the specific analysis, mechanical prediction substantially outperformed clinical prediction in 33–47% of studies examined. Although clinical predictions were often as accurate as mechanical predictions, in only a few studies (6%–16%) were they substantially more accurate."[38] In another notable study, political scientist Philip Tetlock and his colleagues conducted an expansive decades-long meta-analysis that involved more than 82,000 forecasts that sought to evaluate the accuracy of predictions made by both humans and algorithms in many fields, such as politics, economics, and international affairs, and according to McAfee and Brynjolfsson, they "found that 'humanity barely bests [a] chimp'[39] throwing darts at the possible outcomes."[40]

Given human limitations and the complexities of processing data through a blend of System 1 and System 2, each of the preceding examples provides evidence that relying on human decisions alone may not be the most effective. Given the computer's superior ability to process overwhelming amounts of data to make System 2 decisions, evidence

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[37] Theodore W. Ruger et al., "The Supreme Court Forecasting Project: Legal and Political Science Approaches to Predicting Supreme Court Decisionmaking," *Columbia Law Review* 104, no. 4 (2004): 1150–1210, https://doi.org/10.2307/4099370.

[38] W. Grove et al., "Clinical Versus Mechanical Prediction: A Meta-Analysis," *Psychological Assessment* 12, no. 1 (March 2000):19–30, https://insights.ovid.com/plast/200003000/00012030-200003000-00003.

[39] Philip Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?* (Princeton, NJ. Princeton University Press, 2006), 52.

[40] McAfee and Brynjolfsson, *Machine, Platform, Crowd*, 59.

suggests there is much to be gained from handing at least some predictions and decision-making responsibility over to computers. As McAfee and Brynjolfsson put it, "It's not that our decisions and judgement are worthless; it's that they can be improved on."[41] That said, while the potential benefits of handing off more decisions to computers are many, there are also numerous drawbacks that need to be considered.

D. POTENTIAL DRAWBACKS OF ALGORITHM-BASED DECISION-MAKING

Despite the abundance of studies that have shown the superior decision-making and predictive abilities of properly constructed algorithms, there are numerous instances in recent years of algorithms that have produced undesirable results due to their inability to filter input data. One example is an instance where the algorithm that determines passenger fares for the taxi booking firm Uber mistakenly raised fares during a hostage crisis in Sydney, Australia, causing significant public relations fallout. According to a *BBC* article in December 2014, Uber's algorithm "raised fares by as much as four times its normal rate when demand shot up during the siege that left three people dead."[42] The algorithm could not determine the context for the sudden uptick in demand for rides in the vicinity of the hostage crisis and merely reacted to data that showed a sudden demand for rides in that specific area. It responded by raising fare prices in order to provide incentive for drivers to pick up all of the passengers in that part of the city.

This incident illustrates McAfee and Brynjolfsson observation that,

> while it's true that we have biases that computers don't, we also have strengths that they don't. For one, we take in an absolutely huge amount of data all the time from our senses, and we don't preselect it; we just take it all in as it comes. We have difficulty trying to hear only certain sounds or see certain things, even for a short time. Computers are exactly the opposite; they have great difficulty gathering more or different data from what their builders and programmers allowed.[43]

[41] McAfee and Brynjolfsson, 58.

[42] "Uber Sorry for Sydney Siege Prices," BBC News, December 24, 2014, sec. Technology, https://www.bbc.co.uk/news/technology-30595406.

[43] McAfee and Brynjolfsson, *Machine, Platform, Crowd*, 53.

For all of the capabilities that computers and algorithms have, they do not possess common sense. There is and will continue to be a need for human oversight and the ability to override the decisions made by computers.

Caution, however, must be taken when trying to implement this type of approach. According to McAfee and Brynjolfsson, "we humans are so fond of our own judgement, and so overconfident in it, many of us, if not most, will be too quick to override computers, even when their answer is better."[44] In fact, McAfee and Brynjolfsson go on to recommend keeping score to "track the accuracy of algorithmic decisions versus human decisions over time. If the human overrides do better than the baseline algorithm, things are working as they should. If not, things need to change and the first step is to make people aware of their true success rate."[45]

E. THE CASE FOR APPLICATION WITHIN THE DEPARTMENT OF DEFENSE

Keeping all these caveats in mind, as the capabilities of computers continue to advance at an exponential rate, the partnership between humans and computers needs to advance as well. Although poorly constructed algorithms and the computers' inability to display human qualities like common sense can produce negative results, the advances in artificial intelligence (AI) makes it seem that computers are not too far behind.

Within the private sector, the growing trend to turn many decisions and predictions currently made by humans over to their computer partners has provided overwhelming evidence that, whenever possible, relying on data and algorithms alone usually leads to better decisions and predictions than human judgment, even those made by experts in their field. Such successes make a substantial case that branches and agencies within the DoD follow suit, pursuing options that harness the predictive and decision-making capabilities of computer-based algorithms.

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44 McAfee and Brynjolfsson, 55.

45 McAfee and Brynjolfsson, 56.

In the increasingly digital world, failure to adapt and a continued over-reliance on humans to predict outcomes and make decisions could cause the DoD to suffer an unnecessary handicap when faster, more efficient, and more reliable means exist. As the implementation of technology increasingly rewards early adopters with disproportionate returns and domination of certain arenas, the implementation of computerized decision-making technology within the U.S. military should be rapidly exploited, thus increasing national security and ensuring that we maintain our superiority over our adversaries by remaining the dominant force on the battlefield.

III. ALGORITHM-BASED DECISION-MAKING IN THE MILITARY

A. BROAD OPPORTUNITIES

As discussed in the previous chapter, the exponential growth rate of technology in recent years, combined with the efficiencies of algorithm-based decision-making, yields great opportunities for the DoD. In recognition of these opportunities, in 2017, then–Deputy Secretary of Defense Robert O. Work established the Algorithmic Warfare Cross-Functional Team (AWCFT), more commonly known as Project Maven.[46] AWCFT was initially tasked with reducing the analysis burden on humans by augmenting and automating the processing, exploitation, and dissemination (PED) for Tactical Unmanned Aerial Systems (TUAS) and Mid-Altitude Full-Motion Video (FMV). AWCFT was also established to integrate algorithm-based technology into the DoD by developing, acquiring, and/or modifying algorithms to accomplish key military tasks and to establish the field infrastructure that would make it possible.[47] In addition to using these algorithms to assist with the PED of TUAS and FMV, other possible applications of this same technology include using it to support war games, support tired planners in headquarters at different levels, solve logistics issues, develop successful information operations and psychological operation (IO/PSYOPS) campaigns, or using it to transform the very way the military conducts talent management.[48]

Thus, much in the way that UPS and Amazon have revolutionized the logistics world by relying on algorithms to analyze large amounts of data, enabling them to optimize routes and automate warehouses and the supply chain at large, the U.S. military has begun

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[46] Mick Ryan, "Integrating Humans and Machines," The Strategy Bridge, January 2, 2018, https://thestrategybridge.org/the-bridge/2018/1/2/integrating-humans-and-machines.

[47] Robert Work, "Establishment of an Algorithmic Warfare Cross-Functional Team (Project Maven)" (official memorandum, Washington, DC: Office of the Deputy Secretary of Defense, April 26, 2017).

[48] Robert W. Button, "Artificial Intelligence and the Military," September 7, 2017, *RAND* (blog), https://www.rand.org/blog/2017/09/artificial-intelligence-and-the-military.html; Ryan, "Integrating Humans and Machines."

to implement algorithms to help solve its own logistics issues.[49] In 2017, the Army's Logistics Support Activity (LOGSA) partnered with IBM to see if their supercomputer, Watson, which combines AI and analytical algorithm-based software, could assist with their logistics chains. Using Watson, the Army was able to save hundreds of millions of dollars when it analyzed the data generated by 17 transmission sensors in the Army's Stryker Vehicle, correlated it with millions of other data points, and identified a previously unknown issue with the Stryker's transmission.[50] In another scenario, LOGSA turned to Watson for help in better understanding the way the Army transports spare parts; although the LOGSA analysts were able to audit about 10% of all transportation requests and re-route these materials through less expensive nodes, saving about $100 million a year, Watson has the potential to audit 100% of the requests and do it much faster.[51]

Another way that algorithm-based decision-making could make a difference is though the employment of advanced marketing algorithms like those currently being used by Google and Amazon. These marketing algorithms could be used to assist the military in a number of ways, both on the battlefield and at home. Although advertising agencies have long offered targeted ad campaigns to their clients, in recent years, campaigns using algorithms to analyze large amounts of data have been developed that are significantly more successful. Not only can campaigns be produced based on words or search terms that are being used globally or in a specific geographic area, but individual ads can be produced and delivered directly to a hyper-specific consumer, automatically.[52] Using these same algorithms, the military could develop themes and messages that resonate with specific audiences and identify the optimal medium to distribute them, yielding maximum results. This technique could not only be used to recruit applicants for service within the United

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[49] Mona Lebied, "5 Examples of How Big Data in Logistics Transforms The Supply Chain," *Datapine* (blog), April 5, 2017, https://www.datapine.com/blog/how-big-data-logistics-transform-supply-chain/; Adam Stone, "Army Logistics Integrating New AI, Cloud Capabilities," C4ISRNET, September 14, 2017, https://www.c4isrnet.com/home/2017/09/07/army-logistics-integrating-new-ai-cloud-capabilities/.

[50] Stone.

[51] Stone.

[52] "Google Trends," Google, accessed August 23, 2018, https://trends.google.com/trends/?geo=US; Lynn Wu and Erik Brynjolfsson, "The Future of Prediction: How Google Searches Foreshadow Housing Prices and Sales," *Economic Analysis of the Digital Economy*, April 20, 2015, 89–118.

States, but this same technology could be used on the battlefield. Using this method, the United States could develop more effective information operations (IO) themes and messages, pushing the United States' narrative more effectively toward a specific foreign audience, whether that be the enemy, local populace, or our partners, all while ensuring the United States dominates the IO realm.

Another area within the military that has the potential to benefit from algorithm-based decision-making is talent management—how the military, specifically the Army, recruits, hires, and places individuals into teams. Although the DoD has explored the implementation of other types of algorithm-based decision-making—mainly due to the successes highlighted in the private sector—very little focus on the use of these same algorithms to improve the way the Army forms teams has been explored. In the remainder of this chapter, we discuss the state of the current technology available that could assist with talent management and conclude by highlighting a frontrunner whose unique software, Base, could be applied to talent management systems within the military.

B. MATCHMAKING TECHNOLOGIES

Businesses in the private sector are constantly in search of ways to get the most out of their employees in order to maximize profits. With the emergence of AI, machine learning, and big data, more and more companies are focusing their efforts on ways to incorporate the benefits of these technologies to assist with a host of human resources issues.[53] In recent years, numerous consulting firms have emerged that have focused their efforts on providing organizations with personnel management solutions. Monster, Insperity, and Horizon Performance are examples of companies that assist organizations across a full range of human resources issues, including talent acquisition, training,

[53] Eva Winslow, "5 Ways to Use Artificial Intelligence (AI) in Human Resources," Big Data Made Simple, October 24, 2017, http://bigdata-madesimple.com/5-ways-to-use-artificial-intelligence-ai-in-human-resources/; Josh Bersin, "How Will AI in HR Be a Game-Changer?," SearchHRSoftware, December 2017, http://searchhrsoftware.techtarget.com/opinion/How-will-AI-in-HR-be-a-game-changer.

performance management, and retention.[54] While companies like Monster and Insperity cater their services to corporations, Horizon Performance specializes in assessment and selection services for athletic teams and for government and military organizations. Horizon's software, Gideonsoft, is a selection and development software service that enables organizations to capture behaviors and measure attitudes and beliefs through a proprietary mobile and web-based application. Using this data, Horizon Performance then assists their clients by helping them align operational objectives with performance, behavior, aptitude, and other vital information, which enables them to make informed decisions about candidates and focus coaching throughout the assessment process.[55]

However, while there are numerous solutions to assist companies with the hiring process by increasing the likelihood that the right individuals are brought into an organization, less effort has been directed toward the application of technology to build better teams within an organization once individuals have been hired. According to Macgregor and Tomberlin, the most successful attempt so far to solve this problem has come from Dr. Alistair Shepherd, whose London-based consulting firm Saberr uses matchmaking algorithms to assist in assembling teams in a corporate setting.[56] According Shepherd, "Historically, all of the psychology and psychometric profiling (e.g. Myers-Briggs) looks at who you are, but this can't predict what will make people work well together."[57] Moreover, Shepherd believes that the ability to make such predictions could contribute significantly to productivity in a wide range of sectors.[58]

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[54] Winslow, "5 Ways to Use Artificial Intelligence (AI) in Human Resources";, "Home Page," Monster.com, 2018, https://hiring.monster.com/?intcid=skr_btmCTA1_www_employer; "HR Outsourcing Services," Insperity, 2018, https://www.insperity.com/; "Home Page," Horizon Performance, 2016, http://horizonperformance.com/web_government.html.

[55] Horizon Performance.

[56] MacGregor and Tomberlin., "TeamHarmony."

[57] Sue Tabbitt, "Forget Myers-Briggs, Algorithms Can Better Predict Team Chemistry," *Guardian*, May 27, 2016, https://www.theguardian.com/small-business-network/2016/may/27/forget-myers-briggs-algorithms-predict-team-chemistry.

[58] Tabbitt.

C. THE SABERR SOLUTION

Although numerous matchmaking technologies exist, many are focused around romantic matchmaking and have no utility in a military setting. Some websites like eHarmony and PerfectMatch are designed to match people with long-term interpersonal chemistry, while others like AdultFriendFinder, Tinder, and Grinder are, as Tomberlin MacGregor put it, "based mostly on superficial physical qualities and proximity."[59] Likewise, companies like Monster, Insperity, and Horizon Performance assist in assessment and selection services but not in placement of individuals into teams with the intent of optimizing team performance. Since our research proposes the need to validate a proof-of-concept regarding whether or not matchmaking technologies, using algorithm-based decision-making, have the ability increase the performance of military teams, we have identified Saberr, a United Kingdom-based consulting firm that specializes not only in team hiring and assessment but in the management of those individuals using predictive analysis with the potential to form more cohesive and effective teams. Saberr has developed a unique system that employs software based on matchmaking algorithms derived from those used by online dating websites, which allows leaders within companies to assess the chemistry of their teams and make informed decisions when it comes to hiring and realigning team members in order to increase team cohesion. Saberr advertises that they have "customers across a variety of industries from Bank of Ireland to Unilever, Deloitte, Thomson Reuters, LVMH, NHS and Virgin, along with a number of fast growing tech companies pushing the boundaries in their own fields."[60] Saberr claims that it can perform a variety of team-improving services ranging from a team diagnostic to coaching and training programs for team management.[61] Team leaders and organizers are presented a values-based analysis of their team, which assesses performance as a function of

[59] Eli J. Finkel et al., "Online Dating: A Critical Analysis from the Perspective of Psychological Science," *Psychological Science in the Public Interest* 13, no. 1 (2012): 8; MacGregor and Tomberlin., "TeamHarmony," 24.

[60] Jennifer Dawson, "Who Else Is Using Saberr?," Saberr, February 1, 2018, http://help.saberr.com/overview/other-common-questions/who-else-is-using-saberr.

[61] "Home Page," Saberr, accessed February 11, 2018, https://www.saberr.com/.

cohesiveness and identifies areas where challenges might arise.[62] According to Saberr, they have "profiled more than 1,092 teams in 49 countries and have found [that] a strong values [-based] alignment can explain 20–30% of team performance, a significantly strong indicator when personality accounts for just 5–7% of performance variance."[63]

Based on Schwartz's Values Framework and the Big Five personality traits, Saberr's technology, called Base, utilizes a proprietary personality- and values-based algorithm that focuses not only on organizational fit and roles but interpersonal fit as well.[64] In other words, it focuses on the relationships between an individual team member's values and how their values relate to the values of the other team members. By identifying these relational values, Saberr is then able to organize optimally cohesive teams with the goal of increasing team performance. For these reasons, we believe that Saberr's algorithm, unlike other matchmaking algorithms, has a direct application to military settings.

D. APPLICATION OF MATCHMAKING TECHNOLOGY IN A MILITARY SETTING

In conjunction with the work that is already being pursued by the Army TMTF, the incorporation of service-wide matchmaking software similar to Saberr's Base could provide for a truly holistic process for assigning service members and filling open positions with the right person, at the right place, at the right time.[65] Since matchmaking tools require that individual users complete a web-based questionnaire in order to compile the data necessary for the algorithm to perform its analysis, MacGregor and Tomberlin identified the Army's AIM 2.0 website as an ideal location for the information storage and

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62 Saberr.

63 Robertson, "The Benefits of Assessing Team Fit First."

64 MacGregor and Tomberlin., "TeamHarmony," 27–28.

65 Kent MacGregor and Charles Montgomery, "Talent Management: Right Officer, Right Place, Right Time," U.S. Army, accessed August 27, 2018, https://www.army.mil/article/179947/talent_management_right_officer_right_place_right_time.

computation to be performed. This is specially the case given that the website is intended to be a collaborative tool for Soldiers and talent managers.[66]

> Within the AIM 2.0 is a page called "My Resume" that is specifically intended to contain all of a soldier's non-professional data which might be of interest to the unit. A soldier's inputs from a team-building questionnaire could be housed on this page. As needed, a talent manager would be able to access the data and build it into a team chemistry model composed of all other current or tentative team members. Having a model to predict chemistry would enable a talent manager to make stronger recommendations for personnel movements or reorganization.[67]

To build on the system that MacGregor and Tomberlin describe, utilizing a Base-like software to analyze the AIM 2.0 data profiles would reduce the number of talent managers required to access and analyze an individual's My Resume data. Furthermore, much like Watson, it could do so faster and more effectively, relying on algorithms to scour the millions of digital personnel files, analyze them, and make recommendations on which individuals to select for assignments and where each of those individuals would be most optimality utilized. As the previous chapters described in detail, in the current and increasingly fast-paced digital world, human judgment is often overly biased and therefore insufficient for making routine decisions, especially when there is sufficient data to automate the process. This principle not only holds true for logistics of equipment but will enviably be relevant regarding talent management.

Assuming that a service-wide system is put in place and all service members have completed the online questionnaires, matchmaking software could significantly improve the formation of teams like that of an infantry platoon or SFODAs. In fact, the process of organizing an entire special forces battalion into optimally cohesive teams would be straightforward and could have immediate positive impacts. Rather than conducting a full reorganization of all members of all teams in a special forces company or battalion, a baseline profile could be established for each team. The data that this baseline provides could then enable leaders within the organization to analyze trends and confirm or dismiss

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[66] MacGregor and Tomberlin., "TeamHarmony," 57.

[67] MacGregor and Tomberlin, 57.

intuitive judgments made about certain teams. Ideally, it would allow leaders to identify which traits help to make the best teams good and identify specific areas of friction that are holding back poorly performing teams. Additionally, due to this technology's ability to predict team performance, it would also allow leaders to test-fit personnel moves before they are made in order to predict the outcomes while seeking to optimize all teams across the organization. Once a baseline is established, utilizing a matchmaking tool like Saberr's Base would enable leaders to make informed decisions quickly about where a new special forces officer or non-commissioned officer would best fit among the pre-existing teams. In reality, rather than requiring leaders to spend their own time test-fitting incoming personnel to the teams with open positions, the matchmaking tool could perform this analysis automatically and provide recommendations immediately once an individual is assigned to the organization. Using these tools, leaders and individuals within the units would be granted access to valuable insights into potential sources of conflict that could arise between team members and promote professional development programs aimed at addressing these issues before the problems arise. This abundance of information would empower leaders and set the conditions for them to make the final decisions.

While the benefits of using matchmaking software to create optimally cohesive teams are readily apparent, another area that would benefit from its use would be the formation of joint staffs such as a Special Operations Command Forward (SOCFWD). As joint staffs are created to oversee smaller regions within the area of responsibility of a Theater Special Operations Command or combatant command, a leader is often identified, and the remainder of the personnel who make up the staff are assembled based on those who are available for assignment at the time. In the scenario previously described, where matchmaking software is in use broadly across the DoD, the formation of a cohesive staff would again be a straightforward process. However, this time, it would be tailored around the individual chosen to lead them. As the need arises to stand up a joint staff, a matchmaking tool could again assist in the manning process. In this scenario, all the staff principals would be identified and assembled around the leader or commander and optimally designed to have a staff core that works well together. The individual staff sections could then be formed using the same process that would be used for organizing

SFODAs. With a large pool of potential candidates to draw from, ad hoc SOCFWDs or joint staffs could be quickly be organized and optimized to work more effectively from the start, avoiding the internal frictions and inefficiencies that often plague these types of organizations due to personality conflicts. Should these SOCFWD or joint staffs become an enduring requirement, such that individuals move in and out of these positions, the matchmaking tool would automatically provide recommendations for replacements. Simultaneously, it would provide feedback that would empower individuals and leaders to address potential conflict issues before they become a reality.

In this chapter, we discussed how the Army is currently implementing technology that uses algorithm-based decision-making software and identifying an application gap using that same technology. We detailed how it could be used to assist the Army with its talent management issues, identifying solutions that are not only more effective but also faster and use far less human capital. In the next chapter we propose a two-part test which, if run correctly, could serve as a proof of concept, demonstrating this technology's predictive abilities and its utility in improving team performance in military applications.

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IV. HYPOTHETICAL PROOF-OF-CONCEPT TESTS

A. INTRODUCTION AND OVERVIEW

The previous chapters sought to offer a baseline understanding of human chemistry and make the case that human judgment can be improved upon using IT. Furthermore, in Chapter III, we examined existing software that utilizes algorithms and has the potential to improve the way the military conducts team building and talent management. In this chapter, we propose two hypothetical tests that would serve as proofs of concepts or pilot tests in order to determine the efficacy of a Saberr-like algorithm within a military team setting.

We start by detailing the preliminary procedures and groundwork that future researchers would be required to complete prior to commencing any proof-of-concept testing. This section includes a discussion of the military approvals and funding that would be necessary to conduct such testing, the services that Saberr can provide along with their associated costs, and the safeguard procedures that would be required by the Institutional Review Board to protect both the individuals being tested and the information being exchanged. Next, more substantively, we propose two different tests—one in a controlled, schoolhouse environment known as Sluss-Tiller and the other within any of the active-duty special forces groups, which would provide a real-world operational environment for testing. Both of these venues were chosen due to the extremely high value that each of the respective organizations places on effective team-building and, due to the small size of the groups they employ, the necessity of team cohesion to each in achieving mission success.

For the first test, which would allow researchers to examine the algorithm's ability to create optimized teams using Saberr's software, we selected Sluss-Tiller, the culminating exercise of the Civil Affairs Qualification Course (CAQC). This venue allows for testing within a preexisting and semi-controlled scenario, which has pre-established and measurable matrices along with a substantial amount of historical data. This historical data includes attrition and graduation rates, peer evaluation reports, and cadre observations for every student that has ever taken part in the Sluss-Tiller exercise. Access to this historical data will allow researchers to run more in-depth statistical analysis and to more accurately judge how well Saberr's software improves—or does not improve—team performance and cohesion.

For the second test, within a real-world operational environment, we propose testing within one or more of the U.S. Army's active-duty special forces groups. Here, we would test soldiers currently assigned to Special Forces Operational Detachments–Alpha (SFODA), nearly all of whom have operational experience. Testing in this manner provides researchers the opportunity to compare existing teams' performance rankings, assigned to them by their respective commands, with that of their corresponding values tolerance scores, assigned by Saberr's software.

The combination of the two proposed tests would give researchers the best opportunity to determine the extent to which matchmaking algorithms can be utilized to improve military team building and the existing Army talent management systems. The first test provides insight into the algorithm's ability to create teams that perform and work well together from a pool of individuals, while the second test allows researchers to examine the accuracy of the algorithm's values tolerance score—the measure for how effective a team *should* be—against the real-world assessment of how effective a team *is* based upon mission performance and the judgment of their superiors. Although each test alone provides valuable insight into the feasibility of implementing matchmaking algorithms within the military, combining the results from both tests would provide an overlap of complementary data that forms a strong foundation for further research into the efficacy and potential impacts of these algorithms within the military's talent management systems.

B. FOUNDATIONAL PROCEDURES

In this section, we discuss four procedures that would need to be completed prior to testing. Of these steps—sponsorship and approval, funding and contracting, coordination with Saberr, and the Naval Postgraduate School's Institutional Review Board (IRB)—sponsorship and approval is undoubtedly the most critical and should take precedence; however, all four steps would need to be conducted concurrently in order to maintain a timely sequencing of events.

1. Sponsorship and Approval

The first step in conducting this kind of study would be to secure reliable sponsorship. In 2017, Ian McGregor and Jared Tomberlin identified the U.S. Army Special Operations Command (USASOC) as being the ideal candidate for a sponsor, having both the appetite for the study and the means to support it.[68] Sponsorship by USASOC also has an added benefit in that it is the parent command of the desired testing venues—U.S. Army John F. Kennedy Special Warfare Center and School (USAJFKSWCS) and the 1st Special Forces Command (Airborne) (1st SFC(A))—and thus could streamline the approval process. Once sponsorship was obtained, the approval process could begin.

Conducting the two tests would require separate approvals from different military commands. Within these commands, each test would require at least two different approvals—one from the command being tested and the other from its higher or parent command. For instance, the schoolhouse environment test at the CAQC culminating exercise Sluss-Tiller would require approval from the commander, Special Warfare Training Group, the parent command of CAQC, and from the commander of the U.S. Army John F. Kennedy Special Warfare Center and School (USAJFKSWCS). Likewise, for the real-world operational environment test done at the special forces groups, approval must be obtained from both the commander of the special forces group being tested and their higher headquarters, the 1st Special Forces Command (Airborne) (1st SFC(A)). As stated previously, since USASOC is the parent command of both USAJFKSWCS and 1st SFC(A), gaining approval from each of these commands could occur much more quickly if sponsorship and/or pre-approval for the study has already been obtained through USASOC.

68 MacGregor and Tomberlin, “TeamHarmony,” 50, 54.

2. Funding and Contracting

With sponsorship and approval obtained, the next step is to find funding. In totality, approximately \$25,000–\$30,000 would be required to conduct both of these tests and should come from the sponsor—in this case, USASOC. Historically, USASOC has agreed to sponsorship, with the caveat that each of the individual commands, USAJFKSWCS and 1st SFC (A), provide funding specifically for the tests conducted within their command.[69] Due to the number of individuals being tested during Sluss-Tiller, the test at USAJFKSWCS, would cost approximately \$25,000, while testing at the active-duty special forces groups would cost approximately \$2,500-\$5,000 per group. Funding for these tests is required to compensate Saberr for access to their matchmaking software, Base, as well as their consulting fees, which we discuss in the next section. It is important to note here that since Saberr is providing a service, not just a product, and since the cost of this study exceeds the threshold for a single-purchase agreement, the DoD will require each command(s) to conduct a 4–6-month military contracting process.[70]

Finally, of particular importance to the student researcher is a ruling during a 2013 session of the House Arms Services Committee (HASC) that prohibits the use of Major Force Program 11 (MFP-11) funds, the usual source of finding within the special operations community, in support of student research in degree-producing programs. Instead, other lines of accounting such as grants, Major Force Program 2 (MFP-2) funds also known as Operations and Maintenance funds, or non-appropriated funds should be explored.

[69] In 2017, NPS students Ian McGregor and Jared Tomberlin received sponsorship from USASOC but were unable to secure a funding commitment. In 2018, NPS students David Schnaak and Robert Thompson were able to again receive sponsorship from USASOC and secured a funding commitment through USAJFKSWCS.

[70] Due to NPS's timeline placed on students, along with DoD's requirement of acquiring funds through the 4–6 month contracting process, conducting this study is nearly impossible for a single NPS cohort to complete. Due to these restrictions, we recommend that any future study be done outside of NPS or over multiple NPS cohorts facilitated though a single designated faculty member.

3. Saberr

Unlike the military's sponsorship, approval, and contracting processes, Saberr is capable of providing services on an extremely short timeline and will likely be the easiest of all the preliminary steps necessary to prepare for this study. In this section, we describe the services Saberr provides and their associated costs.

For one year of access to Saberr's Base platform, the capabilities of which were described in Chapter III, the current fee (as of May 2018) is $2,100.[71] This access fee, however, is simply the upfront cost, and many other associated fees are required to utilize the full capabilities of Saberr's software. The first associated cost is the requisite training to become familiar with Saberr Base. This half-day of training is done by a member of Saberr's .data science team and costs $1,100.[72] The training familiarizes the researchers with the data-science procedures necessary to implement the testing and how to manipulate, evaluate, and understand the outputs from Saberr Base. Researchers then use these outputs, the values tolerance scores, to help construct and evaluate the individual teams. Saberr does offer the option of providing their own data-scientist to execute these tasks mentioned. However, given that part of the study's intent is to assess whether military personnel can feasibly implement Base-like technology/software within a military setting and without external assistance, we believe that approach to be counterproductive.

The second and more costly fee associated with conducting the test is the fee for each individual that is being tested. These fees would operate on a sliding scale: the more people being tested, the lower the price per person. For these two studies, which aim to test 300+ individuals, the rate is $60 per person totaling approximately $15,000 for the 250 (+/-) individuals at Sluss-Tiller and approximately $7,200 for the 120 (+/-) individuals at each of the special forces groups.

Last is the fee for Saberr to utilize Amazon Web Services (AWS) to host its Base platform. Although Base is normally hosted within the United Kingdom and governed by the exceptionally strict European General Data Protection Regulation (GDPR), which

71 Alistair Shepherd, email correspondence, Monterey, CA, May 31, 2018.

72 Shepherd, email correspondence.

requires all data to be secured and encrypted, both at rest and in transit, USASOC and NPS require that all data remain in the United States.[73] Therefore, an added fee of $5,500 is required to set up an AWS within the United States in order to host the Base platform.

4. Institutional Review Board (IRB)

Because this study would involve human-subject research—specifically, the recruitment, voluntary consent, and data collection of individuals—it would need to be approved by the IRB. To see if our methodology of testing for the schoolhouse environment would pass the Naval Postgraduate School's IRB, we submitted and were approved for testing at Sluss-Tiller with an IRB Category 2 exemption (see Appendix A.). In this section, we highlight the major concern of NPS's IRB and how we mitigated those concerns.

Throughout the IRB process, many concerns were addressed, including the exact questions that would be asked to the participants of the study (see Appendix B), how their information was to be stored, and how they were going to be recruited to participate in the study. Consistently, however, the IRB's most significant concern with our methodology was access to personally identifiable information (PII)—information such as names, social security numbers, birthdates, or any other data that could be used to identify the individuals being tested. The primary means of mitigating this concern was ensuring that no actual PII would ever be accessed, recorded, or entered into any system. Instead of tracking the human subjects by their names or social security numbers, each participant would be tracked by a randomly assigned roster number that was assigned and strictly controlled by USAJFKSWCS. At no point would researchers or Saberr ever have access to any information that could be used to associate the roster number with any participant's actual identity. Additionally, when accessing historical class data, researchers would only require access to limited statics like the class sizes, graduation rates, peer evaluations, cadre observations, military occupation specialty (MOS), rank, age, and prior combat experience, none of which would contain any PII.

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[73] J.-P. De Clerck, "GDPR Encryption: What You Should Know and What You Do Not Know," I-SCOOP, accessed October 7, 2018, https://www.i-scoop.eu/gdpr-encryption/; IRB Chairman Lawrence Shattuck, personal communication, June 6, 2018.

Additionally, the design of the study, conducted in a triple-blind manner, would create an additional step that not only ensures a more accurate test but also has the added benefit of providing additional protection for the human subjects since it is conducted in such a manner neither the students nor the cadre at Sluss-Tiller would know whose performance was being evaluated by the researchers. Likewise, although the researchers would know who was and was not involved in the study, they would have no way to influence the cadre's evaluation reports or identify any of the individuals by way of PII.

C. CONTROLLED ENVIRONMENT TESTING: SLUSS-TILLER

As previously mentioned, for the first test in a controlled environment we selected the CAQC culminating exercise known as Sluss-Tiller. This exercise was chosen primarily due to the fact that it has a preexisting and semi-controlled scenario and cadre that grade each student against a pre-established and measurable grading standard. Additionally, the CAQC maintains a substantial amount of historical data that enables the researchers the ability to run more in-depth statistical analysis and accurately judge the ability of Saberr's software to improve team performance.

Having already set the foundation for this testing by receiving all the necessary approvals, funding, and trainings on Saberr's software, researchers would then begin setting up the test. The first step is for the CAQC cadre to provide the researchers with a list of the roster numbers for every student taking part in the exercise—not only those participating in the study, but the entire Sluss-Tiller class. Additionally, CAQC cadre should provide the general demographic information including class size, MOS, rank, age, and prior combat experience, again ensuring that no PII is exchanged. Once obtained, the research team would then create individual email addresses that are associated with each roster number (e.g., TeambuildingTest-Roster#1@yahoo.com). These email addresses would then be provided to Saberr, which would send each address a link where the user would be able to access Saberr's online survey. Researchers would then conduct an administrative briefing to all Sluss-Tiller students prior to proceeding with the study. Here, researchers would inform the students on the details of the study and provide each student with a consent form, email address, and corresponding login information along with instructions on how to complete Saberr's online questionnaire. At this point, and since according to the IRB the study must be voluntary, students would be able to decide whether or not to participate. Those willing to participate would log on with their email address and complete Saberr's online questionnaire, while those wishing not to participate would not.

Following the completion of the online survey, the research team would then use a randomizer function in Microsoft Excel to divide the participating students into two groups: a control group and an experimental group. The control group would be organized into teams in the traditional manner that the Civil Affairs cadre have used in the past, equally distributing the various MOSs, ranks, and prior combat experience across all teams. The experimental group of students would be organized by the research team who would form teams based on Saberr's analysis of the students' profiles, which were generated by their responses to their online questionnaire. Utilizing this software and their understanding of Base outputs, the research team's goal would be to form optimally cohesive teams. Here, it is important to note that since this study is designed as a triple-blind study, neither the students nor cadre would be informed as to which method of team building was used to form which team; only the researchers would have access to the manner in which each team was organized. This precaution not only helps to protect the human subjects but also reduces assessment bias on behalf of the cadre and increase the accuracy and objectivity of the outcomes.

Following the organization of all teams, the researchers would depart, and the cadre would oversee the execution of the training exercise, no differently than how it is typically conducted. Upon conclusion of the exercise, CAQC cadre would provide the researchers with the finalized class data, including the list of students that graduated or failed as well as all peer evaluations and cadre observations. Next the researchers would conduct statistical analysis on this data to see if the experimental group, the teams formed using Saberr's software, performed better than the control group and/or the teams represented by the historical data.

To understand the data gathered and to accurately make the claim that Saberr's algorithm-based decision-making software helped to improve team performance in a military setting, both descriptive and statistical analysis would have to be completed. Researchers would start by identifying the sample sizes of each class.

In this case, assuming the overall Sluss-Tiller class size was 300 students and split evenly between the experimental and control groups, the sample size would be 150. By contrast, since there were no experimental and control groups in the historical case studies to which the study group is being compared, this data's sample size would be the entire class population. The independent variable would be whether the students were on a Saberr Team or not, while the dependent variables would be students' graduation rates, peer evaluations, and the cadre's observations of team performance.

Ideally, descriptive statics would show an overall increase in the performance of the Saberr Team students for graduation rates, peer evaluation, and cadre observations over non–Saber Team students. However, descriptive analysis does not take the sample size into consideration; therefore, a two-proportion statistical analysis (Z-Test) would need to be conducted to demonstrate that there is a statistically significant difference in students' performance. Next, researchers would have to establish and test the hypothesis against a pre-established confidence interval. For the purposes of this study, the hypothesis would be that the Saberr Teams' graduation rates, peer evaluations, and cadre observations were higher than that of non–Saberr Teams at the 95% confidence interval.

Should the data analysis not support the hypothesis that Saberr helps to improve team performance in a military setting, these results should not be considered as evidence that the software is ineffective. Two things should then be considered—sample size and regression analysis. Considering that a larger sample size increases the fidelity of a test, arguably, one of the most important factors is the sample size. Since the sample size of the Saberr Teams will be significantly smaller than that of the non–Saber Teams, especially when combined with those of the historical case studies, another test with a larger Saberr Team sample size would have to be conducted.[74]

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[74] For further discussion regarding the selection of optimal sample sizes, see James E Bartlett, Joe W Kotrlik, and Chadwick C Higgins, "Organizational Research: Determining Appropriate Sample Size in Survey Research," *Information Technology, Learning, and Performance Journal* 19 (Spring 2001): 43–50.

The final step is a regression analysis. Using the same data and combining it with other independent variables like MOS, rank, age, and combat experience, researchers should attempt to find out which factors (independent variables) best explain an increase in team performance (dependent variable). Although Saberr's technology might not demonstrate a statically significant increase, it could account for the greatest increase when compared to the other independent variables. Should, however, that not be the case and Saberr's technology shows little to no increase or even a decrease in team performance, running these regression analyses has the potential to show which independent variables are the most significant and highlight areas that future research can attempt to more fully understand. Additionally, any display of negative results could demonstrate to Saberr which areas within their existing software could be more fully developed.

D. OPERATIONAL ENVIRONMENT TESTING: SPECIAL FORCES GROUPS

The second test proposed is the operational environment test, which should be conducted at one or more of the U.S. Army's special forces groups. This test is intended to assess whether Saberr Base can accurately predict the performance of a team compared to that same team's real-world performance as evaluated by their command. To conduct this test, again assuming all the foundations for testing discussed in Chapter 4 Section B have been set, the research team would first start with an interview of the special forces group's command teams at both the group and battalion levels. During these interviews, researchers would inquire about the process that each command team uses to evaluate the teams under their command, which teams they consider to be their top-rated or best-performing teams, and also receive a best-to-worst ranking list of each team with in their command. This determination of top-rated teams would be based on group and/or battalion command team's evaluations of real-world performance in previous missions, team reputation, and any personally assessed criteria each command deems pertinent. Concurrently, and in much the same fashion as the Sluss-Tiller study, researchers would once again conduct an administrative briefing to all SFODA members in which they would provide the same details of the study, consent forms, and email address/login information and instructions to Saberr's online questionnaire.

Upon completion of the command interviews, in which the team rankings having been received and the SFODA team members having taken Saberr's online questionnaire, the researchers would then compare the command team evaluations with the values-alignment composite scores provided by Saberr Base. Ideally, researchers would find a high correlation between Saberr's values alignment scores and that of the team's rankings by their commands. If a team's values alignment score was reflective of the command's rankings—a high-ranking team has a high-values tolerance score and low-ranking team has a low-values tolerance score—this would support Saberr's claim that they can help reliably predict team performance. If, however, they differ—a high-ranking team has a low-values tolerance score or a low-ranking team has a high-values tolerance score—this could challenge their claim.

It is important to note that, whether the results support Saberr's claims, due to the subjectivity of the individual command's rankings, such results would likely require further investigation. Factors such as how the command assesses the disparity of mission sets between the teams; the different structures of some teams within the special forces' groups; and in some cases, nepotism, would require additional insight to avoid undue influence on the study. For example, how do commanders account for teams that deploy multiple individuals on singleton assignments, as supposed to those that serve together as a 12-man team? Are the individuals' solo performances factored into the overall performance and reputation of a team even though that team is not necessary required to work together? This could result in a team having a high-performance ranking yet have a low-values tolerance score. The same could be said in the reverse. Additionally, there is also the question as to whether—given all subjectivity is correctly mitigated—a commander's intuition and assessments of teams are even correct. It could be argued that a commander's evaluations are wrong or flawed in the first place and that the algorithms, the computers, are more objectively correct.

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V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

Throughout this thesis, we endeavoured to build upon the work of Ian McGregor and Jared Tomberlin in their 2017 study on the same topic, which opened the door for our more in-depth exploration of employing algorithms to enhance the Army's talent management system. Our focus throughout this process has been on an area within the Army's talent management system that is vastly overdue for improvement: the creation and management of teams. We first examined the Army's talent management processes in their current form, then developed a baseline understanding of the concept of human chemistry and the various methods used to study it. We then examined the rapid technological advances in algorithms and predictive analysis that allowed us to argue that human judgment and intuition alone are no longer sufficient for decision-making, most notably with regard to talent management and team building. We then argue for the need to explore the use of technology, currently being employed in the private sector, to revolutionize the way the Army conducts its talent management processes. Proposing a two-part study, we describe the process and methodology one could use to conduct a proof-of-concept test to determine the extent to which algorithms could be employed to enhance talent management and team building in within the military.

The concepts and ideas that we have discussed throughout this thesis are not new, nor are they particularly ground-breaking within the corporate world. Companies in the private sector, particularly start-up technology companies, are eager to get the best performance out of their employees to maximize profits and become as efficient as possible with shareholders in mind. The military, particularly the special operations community, proudly proclaims the importance it places on individuals who serve within its ranks above all else. It is with this goal in mind that we urge decision-makers to examine the existing system for creating teams and conducting talent management and to take advantage of emerging technology to aid or make critical personnel decisions that could greatly enhance the overall warfighting capability of all services.

B. RECOMMENDATIONS

During our study, we found that numerous military organizations were interested in the concept of harnessing the power of algorithms to assist in team-building. Organizations like Special Operation Command's Preservation of the Force and Family, the Army's TMTF, and the Army Capabilities Integration Center all showed interest, but due to the restrictive thesis timeline imposed by the Naval Postgraduate School, they were unable to provide financial backing within the window required. The exception, however was USASOC, which was willing to both act as both a sponsor and assist with funding. In fact, working with USASOC and their subordinate commands, USAJFKSWCS and 1st SFC (A), we were able to plan and coordinate the entire testing process. Due to the HASC restriction placed on research funds mentioned in the previous chapter, however, USASOC was unable to provide funding that would meet our timeline. Having said that, wide interest in the study still exists, and all the foundational procedures to conduct the study remain in place. Therefore, our recommendation for this study is to continue to exploit the conditions previously set within the USASOC enterprise, obtain funding, and complete the study.

We contend that this research has potential to improve the military team-building concept, both within the SOF community and the Army as a whole. The future of AI and machine learning is full of great potential and a significant amount of uncertainty. Current practices utilize algorithms to help identify talent that meets certain subjective criteria that is developed by humans. How long will it be before AI not only identifies this talent for us but also determines the objective criteria as well, taking humans out of the decision-making process entirely? What will the implications be, what role will future commanders and military decision-makers have, and how do we solve the problem of objectively verifying whether or not the criteria that AI develops is "right" or not? These are all questions that will have to be answered in the not-too-distant future, and in order to be equipped to answer those questions there is a very real need to further explore this topic in the present. The only way to do that is to invest in research, and figure out how current technology can be used to optimize existing tasks and systems. It is far easier to make decisions about the future use of technology by keeping pace with it as it develops, rather than by trying to jump onto a moving train once it is up to speed. Doing so has the possibility to capitalize on untapped potential within the U.S. military and ensure that we optimize our forces on the battlefield, especially against near-peer adversaries like China and Russia.

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