

# The Devil is in the Concepts: Lessons Learned from World War II Planning Staffs for Transitioning from Conceptual to Detailed Planning

A Monograph

by

MAJ William M. Dixon  
Canadian Army



School of Advanced Military Studies  
United States Army Command and General Staff College  
Fort Leavenworth, Kansas

2017

Approved for public release; distribution is unlimited

<b>REPORT DOCUMENTATION PAGE</b>				<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this 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 Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. <b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b>					
<b>1. REPORT DATE (DD-MM-YYYY)</b> 28 Feb 2017		<b>2. REPORT TYPE</b> Master's Thesis		<b>3. DATES COVERED (From - To)</b> June 2016 – May 2017	
<b>4. TITLE AND SUBTITLE</b> The Devil is in the Details: Lessons Learned from WWII Planning Staffs for the Transition from Conceptual to Detailed Planning				<b>5a. CONTRACT NUMBER</b>	
				<b>5b. GRANT NUMBER</b>	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
<b>6. AUTHOR(S)</b> Major William M. Dixon				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
				<b>5f. WORK UNIT NUMBER</b>	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, KS 66027-2301				<b>8. PERFORMING ORG REPORT NUMBER</b>	
<b>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> Advanced Military Studies Program				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b>	
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>	
<b>12. DISTRIBUTION / AVAILABILITY STATEMENT</b> Approved for Public Release; Distribution is Unlimited					
<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b> <p>Transitioning from conceptual to detailed planning is one the most crucial stages in the planning process. Current US Army doctrine links conceptual planning to the Army Design Methodology and detailed planning to the Military Decision Making Process. By associating conceptual and detailed planning with doctrinal methodologies, it is easy to regard the transition as a set period in time, simply moving from one checklist to another. This analysis seeks to identify methods for effectively conducting this transition.</p> <p>Study of Allied planning processes during the conceptual and detailed planning for the Mulberry Harbors and the Persian Corridor identifies how each staff moved an idea to reality in terms of refining their understanding of the environment, communicating requirements, and eventually providing the specific direction to execute plans on the ground.</p> <p>As the case studies show, effective transition from conceptual to detailed planning happens through detailed understanding of the current and desired environments, continuous assessment with deliberate reframing, and designated and consistent responsibility and leadership. This happens from conception through to execution, and by utilizing these methods, planners evolve conceptual ideas and plans into detailed directives resulting in changes to the operational environment.</p>					
<b>15. SUBJECT TERMS</b> Design; Army Design Methodology; Conceptual Planning; Detailed Planning; Transition; Mulberry Harbor; Persian Corridor; World War II doctrine; Operation Overlord					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>	<b>18. NUMBER OF PAGES</b>	<b>19a. NAME OF RESPONSIBLE PERSON</b> Major William M. Dixon
<b>a. REPORT</b> (U)	<b>b. ABSTRACT</b> (U)	<b>c. THIS PAGE</b> (U)			<b>19b. PHONE NUMBER (include area code)</b>
			(U)	42	

## Monograph Approval Page

Name of Candidate: Major William M. Dixon

Monograph Title: The Devil is in the Concepts: Lessons Learned from World War II  
Planning Staffs for Transitioning from Conceptual to Detailed  
Planning

Approved by:

\_\_\_\_\_, Monograph Director  
Peter J. Schifferle, PhD

\_\_\_\_\_, Seminar Leader  
Robert L. Smith, COL

\_\_\_\_\_, Director, School of Advanced Military Studies  
James C. Markert, COL

Accepted this 25th day of May 2017 by:

\_\_\_\_\_, Director, Graduate Degree Programs  
Prisco R. Hernandez, PhD

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other government agency. (References to this study should include the foregoing statement.)

Fair use determination or copyright permission has been obtained for the inclusion of pictures, maps, graphics, and any other works incorporated into this manuscript. A work of the United States Government is not subject to copyright, however further publication or sale of copyrighted images is not permissible.

## Abstract

The Devil is in the Concepts: Lessons Learned from World War II Planning Staffs for Transitioning from Conceptual to Detailed Planning, by MAJ William M. Dixon, Canadian Army, 43 pages.

Transitioning from conceptual to detailed planning is one the most crucial stages in the planning process. Current US Army doctrine links conceptual planning to the Army Design Methodology and detailed planning to the Military Decision Making Process. By associating conceptual and detailed planning with doctrinal methodologies, it is easy to regard the transition as a set period in time, simply moving from one checklist to another. This analysis seeks to identify methods for effectively conducting this transition.

Study of Allied planning processes during the conceptual and detailed planning for the Mulberry Harbors and the Persian Corridor identifies how each staff moved an idea to reality in terms of refining their understanding of the environment, communicating requirements, and eventually providing the specific direction to execute plans on the ground.

As the case studies show, effective transition from conceptual to detailed planning happens through detailed understanding of the current and desired environments, continuous assessment with deliberate reframing, and designated and consistent responsibility and leadership. This happens from conception through to execution, and by utilizing these methods, planners evolve conceptual ideas and plans into detailed directives resulting in changes to the operational environment.

## Contents

Acknowledgement .....	v
Acronyms.....	vi
Introduction .....	1
The Doctrinal Guidance for Transitioning from Conceptual to Detailed Planning.....	5
The Mulberry Harbors .....	16
The Persian Corridor .....	29
Conclusion .....	39
Bibliography .....	44

## Acknowledgement

This monograph was a learning experience for me and the quality of the product is a direct result of the help and guidance of some very patient people. First, my monograph director, Dr. Peter Schifferle. Right from day one, his interest in my topic and his approachability have made the process enjoyable and incredibly educational. To the officers in Dr. Schifferle's monograph syndicate who endured numerous iterations and readings of this paper, I extend many thanks. The edits and suggestions they provided undoubtedly made me a better writer. Mr. Russell 'Rusty' Rafferty at the Combined Arms Research Library was instrumental and provided me with the bulk of my research documentation. Finally, to my wife Rebekah. Having patience and putting up with my constant talk about applying design to my chosen case studies provided a much-needed sounding board. I cannot adequately express my appreciation for her support throughout this year.

## Acronyms

ADM	Army Design Methodology
ADP	Army Doctrine Publication
ADRP	Army Doctrine Reference Publication
ANCXF	Allied Naval Commander in Chief Expeditionary Force
ATP	Army Techniques Publication
CACD	Commander's Appreciation and Campaign Design
CCS	Combined Chiefs of Staff
COA	Course of Action
ComNavEu	Commander Naval Forces Europe (US)
COSSAC	Chief of Staff to the Supreme Allied Commander
FM	Field Manual
FMI	Field Manual Interim
ISR	Iranian State Railway
JP	Joint Publication
MDMP	Military Decision Making Process
PAM	Pamphlet
RAF	Royal Air Force
RAM/P	Rear Admiral Commanding Mulberry and Pluto
RN	Royal Navy
SAMS	School of Advanced Military Studies
SOD	Systemic Operational Design
SOS	Services of Supply
TLP	Troop Leading Procedures
TRADOC	Training and Doctrine Command (US Army)
USN	United States Navy
WWII	World War II

## Introduction

How do planners transition from the realm of ideas and imagination in conceptual planning to the requirements and specifications of detailed planning? The current US Army Techniques Publication (ATP) 5-0.1, *Army Design Methodology* identifies the process as commencing when the commander and staff frame the environment and “agree on the problem or set of problems, they develop ways to address them. They do this by developing an operational approach – a description of the broad actions the force must take to transform current conditions into those desired at end state.”<sup>1</sup> Planners then use the understanding and objectives outlined in the operational approach to facilitate detailed planning using the Military Decision Making Process (MDMP).<sup>2</sup> It is important to note that this is an evolutionary process and does not simply happen with a document handover. For it to be effective, the School of Advanced Military Studies *Art of Design-Student Text 2.0* states that the planning process must ensure “an iterative common shared understanding of the context, the problem, and initial ideas for problem management or solution.”<sup>3</sup> The process of turning ideas into action, moving from the conceptual planning of Army Design Methodology (ADM) to the detailed planning of MDMP resulting in physical changes to the environment, is at the center of this inquiry.

In order to properly examine the transition period from conceptual to detailed planning it is essential to begin with an analysis of current and past doctrine focusing on ADM, MDMP, and

---

<sup>1</sup> Army Techniques Publication (ATP) 5-0.1, *Army Design Methodology* (Washington, DC: United States Government Printing Office, 2015), 5-1.

<sup>2</sup> ATP 5-0.1, *Army Design Methodology*, 5-8.

<sup>3</sup> Alex Ryan, Peter Schifferle, Michael Stewart, and Alice Butler-Smith, *Art of Design - Student Text, Version 2.0* (Fort Leavenworth, KS: School of Advanced Military Studies, US Army Command and General Staff College, 2010), 229.



the specifics of Operational Art. Section I establishes the terminology and definitions used in the case studies and facilitates the identification of lessons learned in terms of today's vernacular.

Section II is the first case study and focuses on Mulberry Harbor. Code-named the 'Mulberries,' the project actually consisted of two fabricated harbors the Allies emplaced on the Normandy shoreline to support Operation Overlord in World War II.<sup>4</sup> Facing a German-fortified Atlantic coast and assuming the enemy would defend and extensively damage existing ports, the Allies developed the plan for constructing two artificial harbors. Allocating one Mulberry each to the American and British sectors, the Allies intended to create sheltered water to facilitate the uninterrupted logistical support for the invasion.<sup>5</sup> The Mulberries were a critical component of Operation Overlord and offer analysis of the transition between conceptual and detailed planning for a situation in contact with the enemy.<sup>6</sup>

Section III, the second case study, examines the Persian Corridor, a logistical supply route through Iran to the Soviet Union in World War II. The Persian Corridor was one of five arteries over which the Soviets received more than 17 million tons of lend-lease supply and equipment from the West.<sup>7</sup> These supplies were crucial for the Soviet Union's efforts against Germany. This case study observes the transition from conceptual to detailed planning in an environment not influenced by the enemy.

Using the Army Design Methodology as a framework, the case studies first identify how planners for the Mulberries and Persian Corridor viewed and understood their current environment. Critical to understanding the movement from conceptual to detailed planning is the

---

<sup>4</sup> Alfred Stanford, *Force Mulberry: The Planning and Installation of the Artificial Harbor Off U.S. Normandy Beaches in World War II* (New York: William Morrow and Company, 1951), 7.

<sup>5</sup> Guy Hartcup, *Code Name Mulberry* (New York: Hippocrene Books, 1977), 14-15.

<sup>6</sup> Stanford, *Force Mulberry*, 7.

<sup>7</sup> T. H. Vail Motter, *U.S. Army in World War II The Middle East Theater: The Persian Corridor and Aid to Russia* (Washington, DC: United States Government Printing Office, 1952), 4.

examination of how the planners defined the desired end-state conditions and how they mitigated the effects of unknowns in the planning process. Once the start and desired end-state environments are clear, the case studies look at how the plans took form and evolved from the concepts of the planner to detailed orders and physical results.

The case studies offer two distinct illustrations of this process. The Mulberries were a solution to an operational logistics problem in support of the invasion of Europe. The planning and requirements were in direct response to the needs of Operation Overlord. The Persian Corridor was a political-military endeavor where plans evolved from diplomatic agreements. In this way, the case studies demonstrate differing examples of the process of bringing a concept to fruition to achieve a desired future state.

The case studies show that the transition from conceptual to detailed planning happened over a number of months and years in a continual progression. Both case studies show that the transition is more of an evolutionary process rather than a singular point in time. The success of the Mulberries and the Persian Corridor demonstrate that conducting this transition effectively requires detailed understanding of the current and desired environments, continuous assessment with deliberate reframing, and designated and consistent responsibility and leadership.

Understanding the environment is vital in the design process and facilitates the transition between ADM and MDMP.<sup>8</sup> By examining how the planners viewed and understood their current and desired end state environments it is possible to outline how they communicated the concept and translated it into detailed plans. The case studies prove that detailed understanding of the environments ensured the plan met all objectives even when changes in the situation necessitated adjustment.

---

<sup>8</sup> Ryan, *Art of Design*, 229-230.

Changes in the operational environment require iterative planning and as design is a continuous process, it is essential that staffs and organizations involved in implementing any project conduct deliberate assessment and reframing.<sup>9</sup> The case studies highlight changes to the plans throughout the process of planning, preparation, and execution. The planners conducted this assessment and reframing in reaction to changes in the environment. This action in turn resulted in amended directives or requirements that ensured achievement the overall aims of the project.

Designated persons of responsibility ensure planning staffs implement required changes while certifying the project meets the given objectives. This consistent command structure for the planning team ensures that the staff applies the corporate knowledge gained during the conceptual stage to the subsequent detailed planning. ATP 5-0.1 states, “Briefing the results of ADM and handing over associated products to another planning team is not an effective approach. Often the same planning team that led the design effort leads the staff through the MDMP.”<sup>10</sup> The case studies illustrate how planners involved from inception to completion of both projects contributed to effective transition.

The case studies selected are both from World War II and thus the limiting factor in the analysis of historical plan development is the attempt to draw insight in terms of today’s doctrine and terminology from situations that did not use the same processes and definitions. Attempting to understand what is doctrinally correct today requires an examination of how the Army brought the idea of design and the ADM into use. Section I steps through the process of integrating design into Army doctrine and shows how the evolution from the originating ideas of Systemic Operational Design were translated into simplified doctrinal publications. This analysis,

---

<sup>9</sup> Thoughts regarding changes to the operational environment driving iterative planning drawn from Bryan Lawson, *How Designers Think: The Design Process Demystified*, 4th ed. (Oxford: Elsevier/Architectural, 2005), 296. Periodic assessment and reframing drawn from Ryan, *Art of Design*, 244-245.

<sup>10</sup> ATP 5-0.1, *Army Design Methodology*, 5-8.

combined with an examination of the British and American planning doctrine of WWII, frames the case studies as it builds understanding, similar to how the initial steps of ADM help a commander “understand, visualize, and describe.”<sup>11</sup>

## The Doctrinal Guidance for Transitioning from Conceptual to Detailed Planning

How do planners transition to building a detailed plan in a situation of constant change? In his book *How Designers Think*, Professor Bryan Lawson from the Sheffield University School of Architecture poses the question, “How, then, do we find the end of a design problem? Is it not possible to go on getting involved in more and more detail?...There is no way of deciding beyond doubt when a design problem has been solved.”<sup>12</sup> The rapidity of action and change in the current operational environment means planners must move from concept to reality quickly and effectively. A planning staff must facilitate results; a great concept is useless if the staff does not transition to details so that units can execute the plan.

### Planning Overview

The planning process is comprised of two distinct but inseparable sub-processes of conceptual and detailed planning.<sup>13</sup> Army Doctrine Publication (ADP) 5-0, *The Operations Process* defines planning as “the art and science of understanding a situation, envisioning a desired future, and laying out effective ways of bringing that future about.”<sup>14</sup> In order to achieve this the staff must overcome one of the “more challenging aspects of design” by transferring

---

<sup>11</sup> Army Doctrine Reference Publication (ADRP) 5-0, *The Operations Process* (Washington, DC: United States Government Printing Office, 2012), 1-4.

<sup>12</sup> Lawson, *How Designers Think*, 55.

<sup>13</sup> Ryan, *Art of Design*, 120.

<sup>14</sup> Army Doctrine Publication (ADP) 5-0, *The Operations Process* (Washington, DC: United States Government Printing Office, 2012), 6.

knowledge and requirements from the conceptual to detailed planning teams.<sup>15</sup> ATP 5-0.1, *Army Design Methodology* currently only allocates two paragraphs to address this crucial period in the planning process.<sup>16</sup>

## Integration of Design

The discussion of implementing design into US Army doctrine began in 2004-2005 with Exercise Unified Quest. This exercise exposed the Army (outside of schools) to Systemic Operational Design (SOD). SOD formed the basis of current design doctrine, and centers on Israeli Brigadier General (Reserve) Shimon Naveh's theory. Although the concepts of SOD were being examined and were introduced at Exercise Unified Quest, even Naveh had "refused to put his theory into writing. He was reluctant to document a practice that was still evolving and defied proceduralization." The evolution of today's doctrine on the subject starts with SOD at the School of Advanced Military Studies (SAMS).<sup>17</sup>

SOD emphasized collective understanding, and founder and first director of SAMS, Brigadier General Huba Wass de Czege US Army (Retired), described operational design as a "journey of learning." The consistent change in the system, which necessitates continuous learning, typifies SOD and makes reframing of utmost importance. The dynamic changes in the environment drove Naveh to express "views on doctrine as antithetical to design."<sup>18</sup>

---

<sup>15</sup> Ryan, *Art of Design*, 229.

<sup>16</sup> ATP 5-0.1, *Army Design Methodology*, 5-8.

<sup>17</sup> Discussion on implementing design into US Army doctrine drawn from Alex Ryan, "A Personal Reflection on Introducing Design to the U.S. Army," *The Overlap*, November 4, 2016, accessed November 28, 2016, <https://medium.com/the-overlap/a-personal-reflection-on-introducing-design-to-the-u-s-army-3f8bd76adcb2#.wihw966te>. See page 4 for quote in mid paragraph.

<sup>18</sup> Journey of Learning quote from Huba Wass de Czege, "Systemic Operational Design: Learning and Adapting in Complex Missions," *Military Review* 89, no. 1 (January 2009), ProQuest, accessed November 23, 2016, <http://search.proquest.com/docview/225311325/fulltextPDF/E4C919BAEE264B4APQ/1?accountid=28992>, 9. Additional information regarding reframing drawn from Ryan, "A Personal Reflection," 9, and the Naveh quote regarding doctrine found on page 5.

The relationship and discourse between SAMS faculty and Naveh existed since the mid-1990s but it was not until 2005 that SOD was introduced into SAMS curriculum. This introduction led to SAMS students bringing SOD to Exercise Unified Quest and from there design quickly gained Army leadership interest. SAMS officially integrated design into the core curriculum in 2007 and in 2008 published the *Art of Design Student Text, Version 2.0*.<sup>19</sup>

That same year TRADOC published Pamphlet 525-5-500, *Commander's Appreciation and Campaign Design* (CACD). As a chronologically early publication in terms of American design doctrine, the CACD “intended to shape future joint and Army doctrine” and listed itself as an experimental process. In the same vein as SOD, the CACD centered on shared understanding of a complex problem as a pre-condition to constructing an approach to a solution as well as emphasizing the need for assessment and reframing. As a doctrine publication, the CACD built on the concept of SOD, translated and simplified aspects into doctrinal terms, and outlined the action of framing into a series of steps and sub-processes.<sup>20</sup>

The Army published the first official design doctrine in 2009 as Field Manual Interim (FMI) 5-2, *Design*. This manual was the foundation for Chapter 3 of Field Manual (FM) 5-0, *The Operations Process* in 2010. In 2012, the Army exchanged the term design with the Army Design Methodology when it replaced FM 5-0 with ADP 5-0, *The Operations Process*. The most recent doctrine is ATP 5-0.1, *Army Design Methodology* that the Army published in 2015.<sup>21</sup>

---

<sup>19</sup> Ryan, *Art of Design*, 1-2.

<sup>20</sup> All information regarding CACD drawn from TRADOC Pamphlet 525-5-500, *Commander's Appreciation and Campaign Design (CACD), Version 1.0* (Fort Monroe, VA: Headquarters, United States Army, Training and Doctrine Command, 2008). See page 1 for quote, page 4 for discussion on shared understanding, and pages 17-18 for framing and re-framing.

<sup>21</sup> Majority of paragraph drawn from Ryan, *Art of Design*, 3-4. Additional information from ATP 5-0.1, *Army Design Methodology*, v.

## Current Methodologies

To conduct planning, the United States Army utilizes three primary methodologies; the ADM, MDMP, and Troop Leading Procedures (TLP). The transition from conceptual to detailed planning happens when moving from the ADM to the MDMP.<sup>22</sup> Design as a process links to the conceptual component of planning as it incorporates critical and creative thinking in order to frame and solve complex problems.<sup>23</sup> Detailed planning then takes the concepts and builds them into complete and logical plans.<sup>24</sup> As the process evolves from concept to detail the overall outcome is a “plan or order – a directive for future action.”<sup>25</sup> The MDMP is the methodology used by the Army for detailed planning and results in an operations order for an executable plan.<sup>26</sup>

When defining the methodologies and processes used in planning it is logical to commence with operational art. Army Doctrine Reference Publication (ADRP) 5-0 describes operational art as an intellectual method associated with conceptual planning which helps to understand problems, and “guides conceptual and detailed planning” toward the overall goal of producing an order or plan.<sup>27</sup> Operational art allows commanders and staffs “supported by their skill, knowledge, experience, creativity, and judgement – to develop strategies, campaigns, and

---

<sup>22</sup> ADRP 5-0, *The Operations Process*, 2-4. See page 2-14 for information regarding TLP. TLP is “a dynamic process used by small-unit leaders to analyze a mission, develop a plan, and prepare for an operation....Leaders use TLP when working alone or with a small group to solve tactical problems.” In this way, TLP “extend the MDMP” and is a tool that leaders on the ground utilize to enact the detailed plan.

<sup>23</sup> Ryan, *Art of Design*, 10.

<sup>24</sup> Ryan, *Art of Design*, 120.

<sup>25</sup> ATP 5-0.1, *Army Design Methodology*, 1-2.

<sup>26</sup> ADRP 5-0, *The Operations Process*, 2-11.

<sup>27</sup> ADRP 5-0, *The Operations Process*, 2-4.

operations to organize and employ military forces by integrating ends, ways, and means.”<sup>28</sup>

Commanders utilize the elements of operational art to help describe their understanding and vision of the situation, a key component of facilitating further detailed planning. When faced with a new or complex problem, commanders can choose to initiate and follow the ADM as a “methodology for applying critical and creative thinking to understand, visualize, and describe unfamiliar problems and approaches to solving them.”<sup>29</sup>

For effective planning the commander and staff must have a clear understanding of the desired end state and the conditions required to conclude military action.<sup>30</sup> ADRP 3-0, *Operations* defines operational art as the “pursuit of strategic objectives, in whole or in part, through the arrangement of tactical actions in time, space, and purpose.”<sup>31</sup> Through its component activities of framing the operational environment both current and desired, problem, and solutions, ADM allows staffs to gain this critical understanding.<sup>32</sup> By conducting ADM, the commander and staff identify the operational approach as a guide to solving the problems faced. This approach then serves as the link between conceptual and detailed planning, as this is what the MDMP takes forward and develops into the plan.<sup>33</sup>

The MDMP, as detailed in ADP 5-0, is an “iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order.”<sup>34</sup>

---

<sup>28</sup> ADP 5-0, *The Operations Process*, 6.

<sup>29</sup> Majority of information for the examination of operational art in this paragraph comes from ADP 5-0, *The Operations Process*, 5-7.

<sup>30</sup> Joint Publication (JP) 5-0, *Joint Operation Planning* (Washington, DC: United States Government Printing Office, 2011), III-18 - III-19.

<sup>31</sup> Army Doctrine Reference Publication (ADRP) 3-0, *Operations* (Washington, DC: United States Government Printing Office, 2016), 2-1.

<sup>32</sup> ATP 5-0.1, *Army Design Methodology*, 1-3.

<sup>33</sup> ADP 5-0, *The Operations Process*, 7.

<sup>34</sup> ADP 5-0, *The Operations Process*, 8.



MDMP takes the information and knowledge gained during ADM and refines it to facilitate the development, comparison, and selection of a course of action (COA).<sup>35</sup> Throughout this process, the plan evolves and the staff adds details to produce an operations order that subordinates can execute to change the environment.<sup>36</sup>

## Transitioning from Conceptual to Detailed Planning

It would be wrong to consider the transition between conceptual and detailed planning as a singular point in time. This is not a ‘stop one process and start another’ event and the staff must consider and conduct both types of planning in concert. The outcomes of ADM such as the operational approach facilitate detailed planning, and the refinements and lessons learned in MDMP during COA development and war gaming are required for reframing and adjusting the operational approach. Although products of ADM drive the MDMP, the staff cannot simply hand them over or brief the highlights and transfer them to another staff section.

The ideal situation is a seamless transition with the same design team carrying the product through MDMP. This is normally difficult to attain and doctrine suggests maintaining key members of the design team to conduct detailed planning. The members that played a part in the design should occupy key roles during detailed planning due to the knowledge of outputs of the ADM they possess.<sup>37</sup> This is crucial, as the design team lead is the person “most familiar with the environment, the problem framing and the concepts of the operational approach.”<sup>38</sup> It is logical then to identify the requirement for designated and consistent team members and leaders

---

<sup>35</sup> ATP 5-0.1, *Army Design Methodology*, 2-2.

<sup>36</sup> ADP 5-0, *The Operations Process*, 8.

<sup>37</sup> ATP 5-0.1, *Army Design Methodology*, 5-8.

<sup>38</sup> Ryan, *Art of Design*, 235.

in order to maintain responsibility and knowledge base in the development of the plan.<sup>39</sup>

Planning teams should be diverse, and subject matter experts are a key component of the design team that should transition to the detailed planning team. These personnel offer insight and expertise aiding in framing the environment and developing solutions. If they are not present during detailed planning, the specifics regarding their area of expertise could be subject to misinterpretation or neglect from inclusion in the plan.<sup>40</sup>

The commander can choose to conduct ADM and MDMP in sequence or in parallel depending on personal preference or if time is available.<sup>41</sup> In either instance, sharing of information and knowledge between the conceptual and detailed planning teams is required to achieve “iterative common shared understanding of the context, the problem, and initial ideas for problem management or solution.”<sup>42</sup> In completing ADM and MDMP together or in parallel, the framing of the operational environment of ADM and the mission analysis of MDMP serve to complement each other. This leads to more detailed planning guidance, aiding the detailed planning team.<sup>43</sup>

One of the most emphasized methods in doctrine to ensure the transition from conceptual to detailed planning happens effectively is through assessment and reframing. Continuous assessment allows the staff to “determine progress toward accomplishing tasks, creating conditions, or achieving objectives.”<sup>44</sup> The design team ensures the plan meets the desired aims

---

<sup>39</sup> The majority of the concepts for this paragraph comes from ATP 5.0-1, *Army Design Methodology*, 5-8. The referenced page makes up the majority of the doctrinal answer for the transition from conceptual to detailed planning. Ryan, *Art of Design*, 232-235, outlines additional information regarding the use of subject matter experts, consistency of team members and responsibility.

<sup>40</sup> ATP 5-0.1, *Army Design Methodology*, 2-4.

<sup>41</sup> ADRP 5-0, *The Operations Process*, 2-13.

<sup>42</sup> Ryan, *Art of Design*, 229.

<sup>43</sup> ATP 5-0.1, *Army Design Methodology*, 2-1.

<sup>44</sup> Joint Publication (JP) 3-0, *Joint Operations* (Washington, DC: United States Government

of the ADM by clearly outlining the assessment criteria and required outcomes of friendly force action, giving the detailed planners the direction required to build the plan.<sup>45</sup> Reframing is “the activity of revisiting earlier hypotheses, conclusions, and decisions that underpin the current operational approach.”<sup>46</sup> Reframing is required after a change in the environment drives a reconsideration of the understanding gained during ADM. When reframing it is important that the design and detailed planning teams work together in order to fully understand what the staff needs to adjust in the operational approach or plan. Reframing is “a positive sign of increased understanding of the system.”<sup>47</sup> In order to draw parallels and lessons from historical case studies, the doctrine of the American and British Armies during World War II requires examination to highlight how today’s doctrinal terms apply.

## Historical Planning Doctrine

The United States’ doctrine of World War II was rooted in the Field Service Regulations (FSR) of 1939. FSR 1939 was the basis for the subsequent individual Field Manuals (FM) that covered large units, administration, and operations doctrine. The primary publication was FM 100-5 *Operations*.<sup>48</sup> This manual underwent two major iterations throughout the war including a 1941 and 1944 revision and “these were the critical doctrinal documents for division commanders and general staff officers.”<sup>49</sup> The FM 100-5 *Operations* 1944 was an update to the 1941

---

Printing Office, 2011), II-9. Additional information regarding the need for continuous assessment drawn from TRADOC Pamphlet 525-5-500, *CACD*, 18.

<sup>45</sup> Ryan, *Art of Design*, 232.

<sup>46</sup> ATP 5-0.1, *Army Design Methodology*, 6-2.

<sup>47</sup> Ryan, *Art of Design*, 245 gives supplemental information regarding reframing in terms of the importance of the design and detailed planning teams working together as well as the quote linking reframing to increased understanding.

<sup>48</sup> Walter E. Kretchik, *U.S. Army Doctrine: From the American Revolution to the War on Terror*, ed. Theodore A. Wilson (Lawrence, KS: University Press of Kansas, 2011), 147-148.

<sup>49</sup> Majority of discussion in this paragraph regarding evolution of U.S. Army doctrine from FSR to

publication and its impact on the overall conduct of the war is debatable due to the relatively minor changes and the timing.<sup>50</sup> For this reason, FM 100-5 1941 is the primary reference in examining American doctrine as the majority of planning the case studies investigate takes place prior to the release of the 1944 revision.

FM 100-5 1941 utilizes the term “estimate of the situation” to describe the process by which the commander and staff gain understanding of their environment and the options available. This draws an obvious parallel to the processes in ADM and MDMP today that facilitate decision-making.<sup>51</sup> FM 100-5 1941 has no terminology directly translatable to design but it does cover the use of staff to support the commander in developing the plan and helping supervise its execution, specifically ensuring that the outcome of planning is a complete order. FM 100-5 1941 also identifies the requirement to re-address decisions and plans depending on the outcomes observed, what today we would label as assessing then reframing.<sup>52</sup>

FM 101-5 *The Staff and Combat Orders* offers supplementary information and doctrine. Published in 1940, it outlines the responsibilities of the staff during planning. FM 101-5 1940

---

FM 100-5 drawn from Peter J. Schifferle, *America's School for War: Fort Leavenworth, Officer Education, and Victory in World War II* (Lawrence, KS: University Press of Kansas, 2010), 47, 48, 56. See page 48 for quote regarding FM 100-5 being the primary doctrine for staff officers.

<sup>50</sup> Kretchik, *U.S. Army Doctrine*, 154.

<sup>51</sup> Field Manual (FM) 100-5, *Field Service Regulations, Operations, 1941*, Obsolete Military Manuals (Fort Leavenworth, KS: Combined Arms Research Library, 2006), Combined Arms Research Library Digital Library, accessed November 20, 2016, <http://cgsc.contentdm.oclc.org/cdm/compoundobject/collection/p4013coll9/id/24/rec/1>, 25.

<sup>52</sup> FM 100-5, *Operations, 1941*, 30-33. Additional research conducted using Field Manual (FM) 100-15, *Field Service Regulations, Larger Units, 1942*, Obsolete Military Manuals (Fort Leavenworth, KS: Combined Arms Research Library, 2013), Combined Arms Research Library Digital Catalog, accessed November 20, 2016, <http://cgsc.contentdm.oclc.org/cdm/singleitem/collection/p4013coll9/id/912/rec/1>, 8-15. FM 100-15 outlines similar methods to FM 100-5 and does not stipulate the transition from conceptual to detailed planning. Also consulted was *A Manual for Commanders of Large Units (MCLU), Volume 1, Operations 1930*, Obsolete Military Manuals (Fort Leavenworth, KS: Combined Arms Research Library, 2011), Combined Arms Research Library Digital Catalog, accessed January 26, 2017, <http://cgsc.contentdm.oclc.org/cdm/singleitem/collection/p4013coll9/id/871/rec/2>, 1-6. The MCLU also covers the estimate of the situation and outlines how staff are required to translate a commander's decision into detailed plans and orders, however, there is no detail regarding the transition from conceptual to detailed planning.

designates the G3 (General Staff Operations) section as responsible for “tactical and strategic studies and estimates; plans and orders based thereon; supervision of combat operations; and future planning.”<sup>53</sup> The doctrine does not detail the transition between conceptual and detailed planning other than this reference to future operations and the requirement of the G3 to produce field orders as well as transmit them to the subordinate units. In addition, within the G3, doctrine did not designate a plans team and it fell to the individual staff to assign this responsibility.<sup>54</sup>

FM 101-5 1940 provides significant detail of the estimate of the situation, which is in line with FM 100-5 1941 as a consideration of all applicable variables for a given situation in order to arrive at a decision. FM 101-5 1940 outlines the planning process as a sequence of conducting the estimate, coming to a decision, detailed planning, and the production of orders. The estimate of the situation is comparable to today’s framing of the environment, and identifying problems and solutions. FM 101-5 1940 describes detailed planning as encompassing “elaborate tactical, intelligence, and administrative details pertaining to the operation.”<sup>55</sup>

Throughout the process, FM 101-5 1940 states that the G3 section conducts “continuous study of the tactical situation” to identify any changes resulting from variables such as the enemy, environmental considerations, and equipment serviceability. This is similar to the actions of assessment and reframing and offers the most obvious parallel to today’s doctrine. During the estimate process the commander and staff develop, analyze, and compare “Lines of Action” in order to come to a decision.<sup>56</sup> Lines of Action in this context are equivalent to the concept of

---

<sup>53</sup> Field Manual (FM) 101-5, *Staff Officers’ Field Manual: The Staff and Combat Orders* (Washington, DC: The War Department, 1940), 13.

<sup>54</sup> David W. Hogan, Jr., *A Command Post at War: First Army Headquarters in Europe, 1943-1945* (Honolulu, HI: University Press of the Pacific, 2006), 33.

<sup>55</sup> All references to FM 101-5 come from FM 101-5, *Staff Officers’ Field Manual*. See page 13-14 for discussion on responsibilities of the G3 section, and pages 36-38 for discussion on planning sequence and the estimate process. Quote regarding what detailed planning encompasses is located on page 38.

<sup>56</sup> FM 101-5, *Staff Officers’ Field Manual*, 90.

courses of action in current publications.

It is worthwhile noting that the doctrine of 1941 and 1944 found in FM 100-5 was not as prescriptive as today's design and planning manuals. The staff based their action on the "doctrines of combat" which laid out basic tenets for each section of the doctrine. In the "Exercise of Command" chapter, (Chapter 4 in FM 100-5 1941, and 5 in FM 100-5 1944) the doctrines of combat emphasized the importance of simple plans, unity of effort, surprise, and a commander choosing a course of action which meets the intentions of his higher commander. It was under these doctrines of combat that the planners for the Mulberries and the Persian Corridor based their actions.<sup>57</sup>

The British Field Service Pocket Book Part I – Pamphlet No.4 (PAM 4) outlines their doctrine of 1944. Similar to the US Army estimate of the situation, the British appreciation of the situation follows a comparable sequence in its consideration of purpose or mission, the variables, the courses of action, and the plan. The examination of the purpose and the variables, called the object and factors in PAM 4, are akin to framing the environment as well as intelligence preparation of the battlefield during MDMP. PAM 4 then outlines the development and comparison of courses of action in order to come to a decision, which facilitates detailed planning in that "it must be definite and clear, concisely stated in outline, but in sufficient detail to form a basis for orders."<sup>58</sup> Like FM 100-5 1941 and 101-5 1940, PAM 4 does not address the transition between conceptual and detailed planning.

---

<sup>57</sup> Discussion regarding Doctrines of Combat drawn from FM 100-5, *Operations, 1941*, 22-24. Supplementary information with respect to the Doctrines of Combat remaining unchanged from the FSR 1939 through FM 100-5 1941 to 1944 drawn from, Schifferle, *America's School for War*, 53-54.

<sup>58</sup> Discussion of British World War II doctrine comes from The War Office Command of the Army Council, *Field Service Pocket Book Part I-Pamphlet No. 4 APPRECIATIONS, ORDERS, MESSAGES, AND INTERCOMMUNICATION 1944* (London: His Majesty's Stationary Office, 1944). See page 6 for details regarding the appreciation of the situation and the topics covered in this paragraph.

## Analysis

Although American and British doctrines in WWII do not use the same terminology as current publications, it is evident that the overall process and logical sequence of moving from conceptual to detailed planning is comparable. The doctrine of both countries identified the necessity to consider the environment both current and future, a concept similar to framing the operational environment and mission analysis during MDMP. The product of both countries' planning process was an executable order, or planning guidance with sufficient detail to allow detailed planning and completion of these directives. Assessment and reframing, while not addressed in this terminology, is a consistent theme as well. The responsibility to conduct assessment and reframing fell to the staff and commanders in order to ensure plans ended in results that met the intended aim. Based on this understanding of the doctrine of 1944, Sections II and III examine case studies to identify how planners transitioned a concept into a detailed plan.

### The Mulberry Harbors

To develop detailed plans and executable orders from a concept born of imagination to build, tow, and emplace two complete artificial harbors is an amazing feat of military planning. Allan Beckett, who designed components and supervised portions of construction of the Mulberry Harbors, summarizes the concept of implementing a completely innovative solution when he stated,

Like the Trojan horse, Mulberry is an example of one of those completely original ideas in warfare that can only ever be used once in history. The enemy has not considered it even remotely possible that an invasion could be supported by an artificial harbor, assembled and working within a few days. Without the element of surprise it could not have been done. Once done, it can never be done again.<sup>59</sup>

---

<sup>59</sup> Jane Evans and Elizabeth Palmer, eds., *A Harbour Goes to War: The Story of Mulberry and the Men Who Made It Happen* (United Kingdom: South Machars Historical Society, 2000), ix.

A project such as the Mulberries offers a unique look into transitioning from conceptual to detailed planning. It moved from one man's idea to blueprints, fabricated components, and immense change to the physical environment to accomplish the goal of supplying the invasion of Europe. The Mulberries illustrate the iterative nature of moving from concept to details. Extensive understanding of the operational environment, and consistent involvement of leadership and subject matter experts throughout the process, facilitated this transition.

Allied staff designed and planned the Mulberry Harbors under the direction of Lt. Gen. Sir Frederick Morgan, Chief of Staff to the Supreme Allied Commander (COSSAC).<sup>60</sup> Morgan was responsible for the planning of Operation Overlord, which would gain the Allies lodgment on the continent and set the conditions for further offensive operations as part of the “grand design to defeat Germany by striking directly at the heart of Hitler's Reich.” Moving invasion forces from staging areas in the United Kingdom, to landing beaches somewhere on the Atlantic coast of continental Europe was an immense task, and Overlord constituted the largest amphibious operation not only of WWII but also in the history of warfare.<sup>61</sup>

The problem Morgan and his planning staff faced was gaining lodgment and selection of landing areas. The key consideration being subsequent build-up of forces and follow on equipment in order to facilitate continued allied offensive operations while ensuring a German counter attack could not negate the landings.<sup>62</sup> The Mulberry Harbors addressed the need for

---

<sup>60</sup> Ken Ford, *Operation Neptune, 1944: D-Day's Seaborne Armada* (United Kingdom: Osprey Publishing, 2014), 28.

<sup>61</sup> Discussion in this paragraph regarding gaining lodgment drawn from Chief of Staff to the Supreme Commander Allied Forces (COSSAC), *Digest of Operation "Overlord,"* dated 27 July, 1943, World War II Operational Documents (Fort Leavenworth, KS, 2007), Combined Arms Research Library Digital Library, accessed October 17, 2016, <http://cgsc.contentdm.oclc.org/cdm/ref/collection/p4013coll8/id/1246>, 1. Quote referencing “grand design” from Gordon A Harrison, *European Theater of Operations: Cross-Channel Attack* (Washington, DC: United States Government Printing Office, 1985), 1. Page 1 also provides discussion regarding the cross channel operation and scale of the amphibious operation included in this paragraph.

<sup>62</sup> Harrison, *Cross-Channel Attack*, 13.



sheltered water along the English Channel to offload equipment, vehicles, and men for the Allied advance. Without this ability, the Allied forces would have approached culmination due to lack of logistical support.<sup>63</sup> In order to identify how the planners moved from conceptual to detailed planning, it is necessary to first frame the operational environment as understood by the Allied planners of 1943-44.

## The Operational Environment

For execution of the Mulberries, the operational environment primarily centered on the English Channel and the Atlantic coast of France. Included in this environment are all factors that influenced and affected Allied operations, the most significant of which were the natural obstacles of terrain and weather. The channel is home to extraordinary tidal considerations resulting in a change of twenty-one feet between high and low tides meaning the beach itself expands and contracts in width by approximately a quarter of a mile. Landing at low tide would prolong the exposure of attacking troops to the guns of the established German defenses.<sup>64</sup> These drastic changes in tides cause the channel to exhibit exceptional currents that shift the sands, alter the coastline depths, and make control of landing craft and ships difficult.<sup>65</sup>

The flat sandy shoreline also presented a depth problem when landing ships. Utilizing outdated charts and limited depth sounding, the planners assumed that the depth tugboats required were a half of a mile from the shoreline at low tide, while the depth needed for larger ships was

---

<sup>63</sup> Hartcup, *Code Name Mulberry*, 14-15.

<sup>64</sup> Harrison, *Cross-Channel Attack*, 189.

<sup>65</sup> Discussion regarding tidal variations, currents, and shifting sands drawn from Edward Ellsberg, *The Far Shore* (United States: Createspace Independent Publishing Platform, 2016), 33.

approximately 28 feet, a distance from shore of 4,000 feet.<sup>66</sup> The coastline was an obstacle in itself due to exposure to the channel's consistent bad weather and rough seas for long stretches.<sup>67</sup>

Weather analysis and historical trends "showed that June was the most favorable month." However, as of May through to September, good weather was only likely for four-day periods separated by spells of rough seas that could significantly influence over-beach landings and logistics.<sup>68</sup> The unpredictable weather introduced an unknown element for the planners to account for, as the race to build up forces to secure the lodgment meant the inflow of equipment had to be "independent of weather interruption."<sup>69</sup>

Physical distance from Britain also played a role in the analysis of the natural environment, as the landings and establishment of the Mulberries had to be in a location that the Royal Air Force (RAF) could cover. Suppression of German positions as well as the German Air Force were required pre-conditions for Operation Overlord, and viewed as necessary supporting operations to the establishment of the lodgment area.<sup>70</sup>

These natural factors combined to present a significant set of variables and it is easy to see why planners sought to identify protected harbors or beaches for the landings. COSSAC staff worked under the assumption that retreating German forces would render any existing or established port unusable.<sup>71</sup> German action of sabotaging the ports would be combined with the effects of Allied air and naval fires in advance of any attempt at seizure and would result in the

---

<sup>66</sup> Stanford, *Force Mulberry*, 66.

<sup>67</sup> Ellsberg, *The Far Shore*, 33.

<sup>68</sup> See Hartcup, *Code Name Mulberry*, 13-14 for discussion regarding weather data. See page 13 for quote about June being the most favorable month.

<sup>69</sup> Stanford, *Force Mulberry*, 122.

<sup>70</sup> COSSAC, *Digest of Operation "Overlord,"* 2.

<sup>71</sup> COSSAC, *Digest of Operation "Overlord,"* 1.

requirement of weeks of salvage and repair work in order to begin accepting arriving equipment. By understanding this, COSSAC staff identified the requirement to inflow forces over the beaches in “the absence of a port in the initial stages by the provision of improvised sheltered waters,” while forces seized and repaired ports.<sup>72</sup> These considerations drove planners to select landing areas that included both suitable beaches and ports for follow on seizure.

Finding a landing area that met these criteria also had to take into consideration enemy action. The German building of the Atlantic Wall as part of the impregnable fortress of Europe was their defense against a cross channel attack. The Germans defended the coast, and understanding the Allied requirement to inflow forces onto the continent they concentrated around the ports. Hitler emphasized this with his direction to his staff, “Hold the ports and we will hold the continent of Europe.”<sup>73</sup>

German planners sought to exploit the natural obstacle and strong position afforded by the English Channel. Knowing that “the enemy’s weakest moment was at the time of landing,” they adopted a static defense mindset based on terrain. This defense served the purpose of identifying the Allied main attack in order to shift the counter attack force, defeat the lodgment, and push the Allies into the channel.<sup>74</sup> German forces in France also had control of the rail lines allowing quick reinforcement, which at the 1943 Casablanca conference, Allied planners assumed would allow the Germans “simultaneous movement of at least seven German divisions from the

---

<sup>72</sup> Majority of this paragraph regarding COSSAC assumptions of German action and the need for artificial port facilities drawn from COSSAC, *Digest of Operation “Overlord”*, 1-6. See page 6 for quote regarding “sheltered waters.” Additional information drawn from Stanford, *Force Mulberry*, 30-31.

<sup>73</sup> Information regarding German action to build the Atlantic Wall drawn from Stanford, *Force Mulberry*, 31-32. See page 37 for quote from Hitler’s direction to his staff.

<sup>74</sup> Information regarding the German anticipated movement to the coast to defeat an allied landing drawn from Harrison, *Cross-Channel Attack*. See page 41 for quote regarding seven German divisions, page 151-152 for discussion on German adoption of a static defense, page 152 for quote about the weakest point of a force being at landing, and page 176 for discussion on German intent to push the Allies back into the channel.

east to reinforce the Atlantic Wall.” In this context, Allied planners had to take concept to reality knowing that the Mulberries were “absolutely essential for the success of Operation Overlord.”<sup>75</sup>

Planners for the Mulberries faced a significant obstacle in terms of responsibility and chain of command. One of the primary doctrinal methods for effective transition from conceptual to detailed planning is the consistency of responsibility and staff throughout the process.<sup>76</sup> For a project so vital to the success of Allied operations, the Deputy US Task Force Commander, Alfred Stanford stated, “a more thoroughly scrambled chain of command has probably seldom confronted the commander of a naval operation in the whole history of warfare.”<sup>77</sup>

The British local economy and tradesmen constructed all components of the Mulberries, so the War Office and the Civilian Ministries of Labor and Supply handled all issues and direction with respect to actual production. The users for the components of the Mulberries were the staffs for Mulberry A, American, and Mulberry B, British. On the American side, planning and construction was a Navy responsibility “to suit the requirements of the U.S. Army.” For the British, planning responsibility fell to the Inland Transport Division of the War Office initially, then to the Royal Engineers as the Army element to plan and emplace while the Navy handled the transport.<sup>78</sup>

The Allied Naval Commander in Chief Expeditionary Force (ANCF) was Admiral Sir Bertram Ramsay. Subordinate to ANCF was an Eastern (British) and Western (American) Task Force commanded by Rear-Admiral Sir Phillip Vian RN and Rear Admiral A.G. Kirk USN

---

<sup>75</sup> Stanford, *Force Mulberry*, 7.

<sup>76</sup> ATP 5-0.1, *Army Design Methodology*, 5-8.

<sup>77</sup> Stanford, *Force Mulberry*, 60.

<sup>78</sup> Majority of discussion regarding the chain of command for the Mulberry planning drawn from Stanford, *Force Mulberry*. See page 60-62 for information regarding the War Office and Civil Ministries as well as the American designation of responsibility to the Navy. See page 48 for quote regarding the requirements of the Army, as well as discussion of British responsibility for Mulberry.

respectively.<sup>79</sup> For the United States, the senior Navy Commander was Admiral Stark. He held the positions of Commander Naval Forces Europe (ComNavEu) as well as Commander of XII Fleet, and was involved in the planning process since September of 1943. Additional confusion in the chain of command came when Admiral Ramsay appointed Rear Admiral W. Tennant RN as the commander for both Mulberry A and B as Rear Admiral Commanding Mulberry and Pluto (RAM/P).<sup>80</sup> Pluto was the codename for the follow up operation of emplacing fuel pipelines across the channel to supply the invasion.<sup>81</sup>

Stark appointed his Deputy Chief of Staff, Captain H. Flanigan as the primary person responsible for planning Mulberry.<sup>82</sup> This appointment of a one-person consistent presence significantly aided in the progress of planning for the Americans. Flanigan formed the ComNavEu logistics section, which was renamed Task Force Support Section in January 1944. The arrival of Rear Admiral Kirk in the winter of 1944 introduced the issues with the chain of command. Stark as ComNavEu supported the Western Task Force, but was Kirk's senior in the US Navy. Kirk as a task force commander worked directly for ANCXF. Compounding the muddled chain of command, Admiral Kirk "displayed little interest in Mulberry matters," so Stark kept the Task Force Support Section under command of XII Fleet in order to maintain consistent planning and knowledge. The American Navy then appointed Captain A. Dayton Clark USN as commander of Mulberry A in January of 1944; his character and drive gave the Mulberry staff an "identity and clear sense of mission."<sup>83</sup> Captain Clark stayed intimately involved in the

---

<sup>79</sup> Ford, *Operation Neptune, 1944*, 21-24.

<sup>80</sup> Stanford, *Force Mulberry*, 58.

<sup>81</sup> Ford, *Operation Neptune, 1944*, 19.

<sup>82</sup> Information regarding U.S. leadership drawn from Stanford, *Force Mulberry* 48-50. Stark appointed Flanigan as lead for planning Mulberry as he was already heavily involved in logistical planning.

<sup>83</sup> Discussion of American positions primarily drawn from, Stanford, *Force Mulberry*, 52-58. See page 53 for quote about Admiral Kirk not being interested in the Mulberries. See page 57-58 for discussion on arrival of Captain Clark, and page 58 for the quote about his provision of identity to the planning team.

planning process through to execution in Normandy, and his consistent presence directly contributed to the success of Mulberry A.

As of 1942, the Allies recognized the need for unity of command, and defined the term combined as “the participation of forces of two or more of the United Nations.”<sup>84</sup> A commander in charge of elements from different nations would be assisted by a composite staff and “each nation involved and each of the several component arms or services of the force will be represented on the staff in order to ensure an understanding of the capabilities, requirements, and limitations of each component.”<sup>85</sup> The staff also brought in subject matter experts throughout the process, the most notable being the inclusion of Rear Admiral Edward Ellsberg. Ellsberg was a salvage expert and vital in adjusting the plan late in the process in order to ensure the components were ready for D-Day.<sup>86</sup> Acknowledging obstacles with respect to personnel and the current environment, the staff then had to define the desired end-state or future environment prior to adding the details to their plan.

## Desired Future Environment

The most critical factor weighing on the future environment was the question of quantity of force flow onto continental Europe. Planners initially based their work on an assumption of a three-division assault force, followed by a build-up to ten divisions by D+5. General Montgomery increased these requirements by two divisions when he assumed the role of tactical commander

---

<sup>84</sup> Office U.S. Secretary of the Combined Chiefs of Staff, “Papers and Minutes of Meeting,” *Casablanca Conference January 1943*, World War II Inter-Allied Conferences (Washington, DC: Joint History Office, 2003), 2.

<sup>85</sup> Office US Secretary of the Combined Chiefs of Staff, *Casablanca Conference January 1943*, 2.

<sup>86</sup> General information regarding the use of subject matter experts found in John J. Marr, “Designing the Victory in Europe,” *Military Review* 91 (4) (July 2011), accessed October 12, 2016, <http://search.proquest.com/docview/874970601?pq-origsite=summon>, 2-3. See Ellsberg, *The Far Shore*, 10-21 for additional information regarding the inclusion of Rear Admiral Ellsberg as a salvage expert.

making the initial landing number five divisions. Knowing the Germans would deny existing ports, Allied planners assumed that upon capture the port facilities would take weeks to repair to a capacity that would still be “unable to maintain the invasion forces,” planners moved forward with the Mulberry idea.<sup>87</sup>

The requirement was that the artificial harbors must then support eighteen divisions in the first month, and twelve in the second month of operation, in all weather and tidal conditions. The original plan called for the Mulberries to be operational for three months, giving time to secure and repair existing ports and closing the artificial ports prior to winter. The timeline for emplacement was that the Mulberries would provide sheltered water by D+4, and by D+14 would start receiving shipments of expected quantity of “12,000 tons of stores and 2,500 un-waterproofed vehicles per day when working at full capacity.”<sup>88</sup> Initial planning figures indicated further increase to 18,000 tons by D+18.<sup>89</sup>

The breakwaters had to provide sheltered water “large enough to accommodate up to ten Liberty ships anchored within their shelter.”<sup>90</sup> These quantities even by today’s standards are immense, and considering that Cherbourg at full capacity could only inflow approximately 3,750 tons per day, the necessity and absolute no-fail importance for the Mulberries is evident.<sup>91</sup>

---

<sup>87</sup> All information in this paragraph regarding the planning figures and desired build-up rates drawn from Hartcup, *Code Name Mulberry*, 13. Quote regarding the suitability of the ports and not being able maintain the invasion forces found on page 13 as well.

<sup>88</sup> Discussion of originally planned timelines of three months found in Ford, *Operation Neptune*, 1994, 34. Quote regarding the expected required quantities at full capacity found on page 47.

<sup>89</sup> Information regarding totals of divisions by month which opens this paragraph drawn from, Hartcup, *Code Name Mulberry*, 13. Additional information about increasing tonnage to 18,000 per day by D+18 found on the same page.

<sup>90</sup> Hartcup, *Code Name Mulberry*, 22.

<sup>91</sup> Hartcup, *Code Name Mulberry*, 13.

Knowing now the desired future state, it is important to consider how the process evolved and how details were refined with the provided direction.

## Directives and Finding a Solution

Following Conference Rattle in Scotland in June 1943, the British moved ahead with planning and considering methods for an artificial harbor. The Artificial Harbors Committee formed and “was responsible for the preliminary design of the fixed breakwaters,” yet was unable to progress significantly due to lack of information on Operation Overlord as a plan.<sup>92</sup>

On 15 July 1943 Lieutenant-General Morgan provided a back brief on planning for Operation Overlord in memorandum COSSAC (43) 28. His task was to provide a “plan for a full scale assault against the Continent in 1944 as early as possible.” Based on the staff analysis conducted in examining the feasibility of this action, Morgan identified that a major consideration was the need to land forces over the beaches for up to three months while forces seize and repair the existing ports. Morgan then outlined the need for sheltered water and that his staff was examining new methods to address this need.<sup>93</sup>

COSSAC (43) 32 memorandum entitled “Digest of Operation Overlord” is dated 27 July 1943 and is numbered Combined Chiefs of Staff (CCS) 304. It provided the outline situation and framing of the problem facing the Allies.

There is no port of any capacity within the sector although there are a number of small ports of limited value. Maintenance will, therefore, of necessity be largely over the beaches until it is possible to capture and open up the port of CHERBOURG. In view of

---

<sup>92</sup> Discussion of the progress of planning for the Mulberries following Conference Rattle drawn from, Hartcup, *Code Name Mulberry*, 58. See page 66 for discussion of difficulty in progression due to lack of information on Operation Overlord as well as the quote in this paragraph.

<sup>93</sup> All information in this paragraph regarding COSSAC (43) 28 drawn from, Office US Secretary of the Combined Chiefs of Staff, ed., “Papers and Minutes of Meeting,” *Quadrant Conference August 1943*, World War II Inter-Allied Conferences (Washington, DC: Joint History Office, 2003), 95. Quote regarding the plan for a full scale assault is found on the same page.



the possibilities of interruption by bad weather it will be essential to provide early some form of improvised sheltered waters.<sup>94</sup>

Although this document does not provide details into how the transition from conceptual to detailed planning occurred, it does show the evolution of the understanding of the environment as it selects a lodgment area and details the necessity for improvised harbors to provide sheltered water on the French coast.

It is important to consider the transition from conceptual to detailed planning which commenced once the COSSAC staff understood the current and future environments. A successful framing of the environment facilitated the proposal of constructing sheltered water. TRADOC Pam 525-5-500 states that in situations such as this “understanding the problem and conceiving a solution are identical and simultaneous cognitive processes.”<sup>95</sup> In this light, planners considered a solution of constructing the Mulberries and commenced component engineering.

Chronologically, the next significant document is CCS 307 “Artificial Harbors for Combined Operations” dated 14 August 1943. CCS 307 outlines basic requirements for both breakwater and unloading capability, as well as the developments and projects for new pieces of equipment. It specifically highlights development of a 500-foot pier ship “which could be sunk in position and which could be connected to the shore by some form of pontoon equipment or two way pier....These and other suggestions are being examined.”<sup>96</sup> As with CCS 304, CCS 307 illustrates the evolution of the plan, moving from concept to reality as the requirements are refined and possibilities explored.

---

<sup>94</sup> Office US Secretary of the Combined Chiefs of Staff, *Quadrant Conference*, 98-106. Quote outlining the specific problem facing the Allies from Paragraph 19, page 4.

<sup>95</sup> TRADOC Pam 525-5-500, *CACD*, 10.

<sup>96</sup> All discussion provided with respect to CCS 307 drawn from Office US Secretary of the Combined Chiefs of Staff, *Quadrant Conference*, 118-120. Quote referencing the 500-foot pier ship is found on page 120.

Documents presented during the Quadrant conference at Quebec in August of 1943 regarding the invasion of France (Operation Overlord) pushed the Mulberry project into full swing. Following Quadrant, the Artificial Harbors Committee then established two civilian committees made up of subject matter experts. COSSAC tasked the Caisson Design Committee and the Production, or Contractors' Committee, with designing the fixed breakwaters, eluded to in CCS 307 by reference to the 500-foot pier ship.<sup>97</sup>

Based on the understanding of the current environment and the conditions and considerations given in CCS 304, the following requirements guided the design process:

- (1) They must be strong enough to withstand 8ft high waves about 120ft in length
- (2) Their height should allow sinking in 50ft of water and they should have at least 6ft of freeboard at high tide.
- (3) They had to be capable of being sunk by opening valves while the water inside must not be allowed to upset their position.
- (4) They must be capable of being towed across the Channel at 4 ½ knots.
- (5) They must be simple to build and not require labour and materials beyond the capacity of the Ministries of Labour and Supply.<sup>98</sup>

With these detailed specifications, the idea of Mulberry Harbor had shifted from the realm of conceptual to detailed planning. The understanding of the current and desired future environments drove the requirements that the harbors had to achieve. This was no longer a broad concept and approach. The engineer and detailed planning teams now had to design, test, and build the components that would bring the Mulberries from paper to reality.

## Analysis

The idea of an artificial harbor originated with Winston Churchill some twenty-six years earlier when planning “to capture the Frisian Islands.” Although his idea of building a breakwater using floating concrete caissons towed into location and sunk never came to fruition, it formed

---

<sup>97</sup> Information regarding the Artificial Harbor Committee as well as the Cassion Design Committee drawn from Hartcup, *Code Name Mulberry*, 67.

<sup>98</sup> Hartcup, *Code Name Mulberry*, 67-68.

the basis of the Mulberries concept. The planners for the Mulberries had to take that idea and turn it into executable plans; turn concept into reality.<sup>99</sup> General Morgan offered a fitting perspective in 1943, when addressing his staff officers for the first time he stated, “The term, ‘Planning staff’ has come to have a most sinister meaning – it implies the production of nothing but paper. What we must contrive to do somehow is to produce not only paper; but action.”<sup>100</sup> While the idea of an artificial harbor was somewhat obvious and necessary given the circumstances, it was also one of the most creative and bold concepts in the history of military operations.<sup>101</sup>

The planners based their specifications on detailed understanding of the current and desired future environments. The specific natural obstacles that the project had to overcome were key drivers in the design of the Mulberries. Communication impediments imposed by the need for secrecy at all levels, and a convoluted chain of command made up of offices of responsibility from different services and nations posed significant obstacles to effective transition from conceptual to detailed planning.<sup>102</sup> The planning staff overcame these obstacles through employment of subject matter experts and planners who were involved from inception to execution to provide a consistent presence and maintenance of corporate knowledge.

British and American staffs accomplished an amazing feat in planning and executing the emplacement of these artificial harbors. The Mulberries provided sheltered water, berths for ships, and piers that adjusted with the tide. This emplaced infrastructure allowed the build-up of forces and supported the invasion of Europe. Analysis of this project highlights the continuous nature of moving from conceptual to detailed planning. The planners for the Mulberries

---

<sup>99</sup> Discussion of the idea behind Mulberry originating with Churchill from Hartcup, *Code Name Mulberry*, 66. Quote regarding the Frisian Islands found on the same page.

<sup>100</sup> Harrison, *Cross-Channel Attack*, 51.

<sup>101</sup> Roland Ruppenthal, *U.S. Army in World War II European Theatre of Operations: Logistical Support of the Armies Volume I* (Washington, DC: United States Government Printing Office, 2000), 271.

<sup>102</sup> Stanford, *Force Mulberry*, 46-47.

transitioned effectively by utilizing extensive understanding of the operational environment, as well as consistent leadership and inclusion of subject matter experts throughout the process.

## The Persian Corridor

In anticipation of German invasion, the Soviet Union ordered the dismantling and relocation of the majority of its industrial infrastructure in 1941. Movement of the country's manufacturing capability from the western parts of the Soviet Union to locations further east and out of reach of German advances significantly affected Soviet logistics. The compressed timeline created disorder in the shipments eastward and the labor force to move the equipment was comprised of the factory workers, which further exacerbated the shortages in supply. Relocation and re-establishment of the factories took time, and the need to transition these factories to wartime equipment production further extended this delay.<sup>103</sup>

The Soviet Union's scorched earth policy to deny resources to the Germans combined with the industrial re-location to produce drastically low supply levels. This placed ever-increasing demand on an already strained logistical system. To offset reduced Soviet production and keep pressure on Germany from the East, the Allies opened multiple supply routes to the Soviet Union to ship large quantities of lend-lease aid between 1941 and 1945.<sup>104</sup> The Persian Corridor was the link through Iran that connected the Soviet Union with ports on the Persian Gulf over which the US Army transported enough supply to "maintain sixty combat divisions."<sup>105</sup>

---

<sup>103</sup> Discussion regarding the movement of the Soviet industrial base and subsequent impact on the logistical system drawn from David M. Glantz and Johnathan M. House, *When Titans Clashed: How the Red Army Stopped Hitler* (Lawrence, KS: University Press of Kansas, 1995), 71-72.

<sup>104</sup> Information regarding the Soviet scorched earth policy and strained logistical system drawn from Glantz, *When Titans Clashed*, 72. Information on supply routes for lend lease aid found on page 150.

<sup>105</sup> Discussion specific to the Persian Corridor ending this paragraph regarding the link to warm water ports drawn from Motter, *The Persian Corridor*, 3-5. The quote referencing sixty divisions is on page 6 and the quantity is by US Army standards (sixty US Army divisions).

The operations through the Persian Corridor brought into direct contact the interests of the United States, the Soviet Union, Great Britain, and Iran. The importance of supplying the Soviet Union was extraordinary, as her ability to pressure Germany was directly dependent on this aid.<sup>106</sup> At the December 1941 Joint Chiefs of Staff Conference in Washington, the emphasis on supporting the Soviets was clear, “it will be essential to afford the Russians material assistance to enable them to maintain their hold on Leningrad, Moscow and the oilfields of the Caucasus, and to continue their war effort.”<sup>107</sup>

In a situation where national interest and international relations play such a crucial facilitating role, it is obvious the planners had to understand the current and desired future environment in order to ensure actions did not compromise continued cooperation.<sup>108</sup> The Persian Corridor illustrates the requirement for extensive understanding of the operational environment and the need to continuously assess and reframe in order to ensure effective transition from conceptual to detailed planning.

## The Operational Environment

The Persian Corridor resulted from the need to protect vital resources and lines of communication following the German invasion of the Soviet Union in late June 1941. The rapid German advance early in the war left Axis units positioned to threaten the Caucasus. This region provided the Soviet Union petroleum resources, and if seized by Hitler, provided a step-off point

---

<sup>106</sup> James Pritchard, “The Beaver and the Bear: Canadian Mutual Aid, Ship Repairing and the Soviet Far Eastern Merchant Fleet 1941-1945,” *The Northern Mariner / le marin du nord* XX, no. 2 (April 2010), 129.

<sup>107</sup> Office US Secretary of the Combined Chiefs of Staff, ed., “Proceedings of the American-British Joint Chiefs of Staff Conferences,” *Joint Chiefs of Staff Conferences Held in Washington, D.C. on Twelve Occasions between December 24, 1941 and January 14, 1942*, World War II Inter-Allied Conferences (Washington, DC: Joint History Office, 2003), JCCSs-1 Annex I page 2.

<sup>108</sup> Motter, *The Persian Corridor*, 6.

to Iran and Iraq. The threat to British oil interests and the link from the Soviet Union to the Persian Gulf was sufficient for the British and Soviets to invade Iran.<sup>109</sup>

The British-Soviet forces entered Iran on 25 August 1941, and by September, they imposed terms on Iran to “secure the control by them of an area vital to their survival in the war against Germany.” A crucial factor in these terms was that Iran remained neutral and the occupiers would depart by the six-month mark post hostilities. This occupation forced the British to focus on the supply of the Soviet Union, and therefore looked to the United States for aid in providing the required commodities.<sup>110</sup>

The United States in 1941 was a neutral party and the President signed the Middle East Directive in September, which outlined initial direction for the provision of supplies to the Soviet Union. The solution to the neutrality issue was prescriptive detail of the need for the United States to maintain status as an auxiliary, and that aid to the British would be through commercial means only. A major reason why the United States supplied commodities requested by the Soviets to the British during the initial stages was that the Soviet Union “had not yet been declared eligible for lend-lease aid.” This was due mainly to the non-aggression agreements between the Soviet Union and Germany preceding June 1941.<sup>111</sup>

---

<sup>109</sup> All information in this paragraph drawn from, Motter, *The Persian Corridor*, 10.

<sup>110</sup> Discussion of the British-Soviet forces entering Iran and looking to the United States for help in supplying the Soviets drawn from Motter, *The Persian Corridor*, 11-15. Quote mid paragraph outlining terms imposed on Iran with regard to protecting Britain and the Soviets from Germany found on page 11.

<sup>111</sup> Majority of this paragraph drawn from Motter, *The Persian Corridor*, 16-19. See page 16 for discussion on the Middle East Directive of 1941 and the need for the United States to remain an auxiliary. Quote regarding the Soviet ineligibility for lend-lease aid found on page 19. See Glantz, *When Titans Clashed*, 150 for discussion of Soviet ineligibility for lend-lease due to non-aggression agreements with Germany.

The American Congress passed the lend-lease law in March 1941 and outlined the provision of wartime equipment and supplies to countries for efforts against Germany.<sup>112</sup> The German attack into the Soviet Union in June 1941 spurred American planning for lend-lease aid and provided the urgency needed by the US Government to gain public support for supply of goods to the Soviet Union. With the President eager to send substantial aid to the Soviets, the US Department of State proposed, “recommendations for reconsideration of restrictive anti-Soviet export control regulations.”<sup>113</sup>

Planning proceeded throughout the summer of 1941 at the diplomatic level with the US Government approving increased quantities of support. This led to the United States, United Kingdom, and the Soviet Union signing the first of four formal agreements in Moscow in October 1941. Signed on 01 October, the Moscow Protocol committed approximately one and a half million tons of American supplies during the period from October 1941 until 30 June 1942. An important aspect of this situation happened on 07 November 1941 when the United States designated the Soviet Union as eligible for lend-lease aid.<sup>114</sup>

The President signed an updated Middle East Directive in September 1942. This update effectively moved the United States from an auxiliary to the primary responsibility for movement of equipment along the Persian Corridor and was fully in effect by 01 May 1943. The same three signatories of the First Protocol signed the Second Protocol in Washington in October 1942,

---

<sup>112</sup> V. F. Vorsin, “Motor Vehicle Transport Deliveries Through ‘Lend-Lease,’” *The Journal of Slavic Military Studies* 10, no. 2 (June 1997), accessed July 21, 2016, doi:10.1080/13518049708430296, <http://dx.doi.org/10.1080/13518049708430296>.

<sup>113</sup> See Motter, *The Persian Corridor*, 20-21 for discussion on gaining American public support for provision of lend-lease aid to the Soviets due to German attack. Quote regarding the US Department of State recommendations found on page 21.

<sup>114</sup> All information covered in this paragraph regarding provision of aid by the United States to the Soviet Union drawn from Motter, *The Persian Corridor*, 22-24.

which accounted for supplies through northern Russian ports as well as just over one million tons of equipment through the Persian Corridor.<sup>115</sup>

On 19 October 1943, the United States, United Kingdom, Soviet Union, and Canada signed the Third Protocol in London. This outlined tonnages for the Pacific route as well as almost two and half million tons between the northern Russian and Persian Corridor routes between July 1943 and end of June 1944. The same signatories of the Third Protocol signed the Fourth in Ottawa on 17 April 1945, agreeing to shipments through the Pacific routes as well as three million tons through the Persian Corridor and Black Sea from July 1944 until June 1945.<sup>116</sup>

These protocols were the guidance given to the planners, each a very specific end-state criterion in terms of tonnage the Allies would supply.<sup>117</sup> The totals that the diplomats agreed upon increased the shipping and transport but did not correspond to increased priority in men and equipment to build the rail and road networks and then move the supplies.<sup>118</sup> As each protocol designated specifics for the different routes and increased tonnages for the year, it is evident that assessment and reframing was required in order to ensure the infrastructure and procedures continued to meet the demand and inflow rates.<sup>119</sup>

The Persian Corridor gained importance following the time-period covered by the First Protocol due to backlogs in shipping caused by German action against merchant ships attempting

---

<sup>115</sup> See Motter, *The Persian Corridor*, 23 for discussion on the Second Protocol. All information regarding the Middle East Directive signed in 1942 drawn from the same book, page 28-29.

<sup>116</sup> Majority of information in this paragraph covering the Third and fourth Protocols drawn from, Motter, *The Persian Corridor*, 23. See, Vorsin, "Motor Vehicle Transport Deliveries Through 'Lend-Lease,'" 154 for discussion of the four signatories of the Third Protocol.

<sup>117</sup> Kent Roberts Greenfield, ed., *Command Decisions* (Washington, DC: United States Government Printing Office, 2006), 227.

<sup>118</sup> Motter, *The Persian Corridor*, 37.

<sup>119</sup> Richard M. Leighton and Robert W. Coakley, *U.S. Army in World War II The War Department: Global Logistics and Strategy 1940-1943* (Washington, DC: United States Government Printing Office, 1955), 102.



to sail to the northern Russian ports. This necessitated an alternate route, but the Persian ports were not of a standard to be able to unload the capacities outlined in the Protocols. When British and Soviet forces entered Iran in late summer 1941, the only major port able to support a war effort was Basra in Iraq, which the British utilized to maximum capacity for their own supply.<sup>120</sup>

The existing line of communication infrastructure revolved around the Iranian State Railway (ISR), which connected Bandar Shahpur to the Caspian Sea. It featured a limited capacity rail line and a road network that was in poor condition and unable to handle the heavy traffic requirements to meet the prescribed tonnages. The Middle East Directive of September 1942 stated, “the US Army should assume responsibility for development of port and transportation facilities” for the Persian Corridor. The United States then commenced improvements of the port of Umm Qasr in Iraq, and the Iranian ports of Bandar Shahpur and Khorramshahr as well as the connecting road and rail networks.<sup>121</sup>

As previously mentioned, the Persian Corridor centered on the ISR, which as late as October 1941 had an assessed monthly handling capacity of 6,000 tons, “hardly the equivalent of a single shipload.” When the Americans assumed responsibility for the Persian Corridor in April 1942, the initial desired future environment envisioned an increase in ISR capacity “at least tenfold.”<sup>122</sup> A communication sent from Winston Churchill to the President of the United States in August based on the in-situ assessments by railway experts stated, “The traffic on the Tans-Persian Railway is expected to reach three thousand tons a day for all purposes by (the) end of the

---

<sup>120</sup> See, Leighton, *Global Logistics and Strategy 1940-1943*, 556-560 for discussion regarding Persian ports being unable to handle the capacity laid out in the Protocols. See page 566 for discussion of Basra being occupied for use by the British.

<sup>121</sup> All information covered in this paragraph drawn from Leighton, *Global Logistics and Strategy 1940-1943*, 566-567. See page 566 for information about the ISR as well as the quote regarding the US Army taking responsibility for development of the infrastructure. See page 567 for locations of where the American forces commenced improvements.

<sup>122</sup> See Greenfield, *Command Decisions*, 229 for quote regarding ISR handling capacity not meeting the equivalent of a shipload, and page 235 for quote regarding a tenfold increase in ISR capacity.

year. We are all convinced that it ought to be raised to six thousand tons.”<sup>123</sup> The American development moved at a rapid pace. By October of 1943, over 200,000 long tons of supplies per month was moving via the Persian Corridor, an incredible increase in a two-year period.<sup>124</sup>

A large portion of this success in infrastructure improvement resulted from contracted labor. Due to shifting priorities and inabilities of the project to keep pace with the incoming shipments, a key factor in the American construction task was the work completed by Folspen, a civilian construction contractor. Folspen worked on the construction program for the Persian Corridor from 1941 until the end of 1942 during which time they completed five wharves at Khorramshahr, 20 bridges, preparation of a temporary highway for surfacing, building construction, and completion of half of the preparation work needed for the permanent highway. At the end of 1942, the contract ended, and the work shifted to the US Army.<sup>125</sup>

## Assessment / Reframing and Finding a Solution

The Persian Corridor faced numerous obstacles during the execution phases of the plan. The Soviet Union was initially resistant to focusing on the Persian route, as supply delivery to the northern Russian ports were of closer proximity to the front lines, thus facilitating quicker delivery. The Soviets were also hesitant to accept the Persian Corridor as it required the build-up of British and American forces in Iran, which could pose a threat following the war knowing that the current agreements were only under the auspice of a common enemy. For these reasons the shipments during the October 1941 to June 1942 period, covered by the First Protocol, mainly continued through the northern routes to Murmansk and Archangel. German action against this

---

<sup>123</sup> Motter, *The Persian Corridor*, 190.

<sup>124</sup> Joseph Bykofsky and Harold H. Larson, *The Technical Services: Transportation Corps, Operations Overseas* (Washington, DC: United States Government Printing Office, 1973), 378.

<sup>125</sup> Information regarding Folspen drawn from Motter, *The Persian Corridor*, 100, 118-123. See page 123 for statistics regarding work completed prior to handover to US Army service troops.

route, as well as Japanese threats to the Pacific route were changes in the operational environment that forced planners to shift focus to the Persian Corridor out of necessity in order to meet the prescribed tonnages set out in the protocols.<sup>126</sup>

During the summer of 1942, the operational environment affecting the Persian Corridor changed and caused a significant period of assessment and reframing. German action influenced the overall military situation in the Middle East, and Axis advances threatened to cut off the Soviet supply routes in the region. Allied planners considered this in concert with the German action significantly limiting the northern supply routes through Murmansk. With the Soviet Union requiring the materiel support provided by these routes to maintain pressure on Germany the decision was made for the United States to assume the task from the British of transporting supplies along the Persian Corridor as a primary responsibility. The US President and British Prime Minister made this decision in hopes of relieving the logistic backlog already piled up along the Persian Corridor.<sup>127</sup>

American and British governments conducted this reframe deliberately and it resulted in the Services of Supply (SOS) Plan; an attempt to supply the Soviet Union by increasing the capacity of the Persian Corridor in light of the pressing German actions. It called for a capacity of 180,000 long tons monthly via rail of all cargos, a handling capacity for four American operated ports of Khorramshahr, Bandar Shahpur, Bushire, and Tanuma of 261,000 tons per day, and a road network capable of handling 172,000 long tons per month via truck. The plan also accounted for increases in labor, units, and equipment to enable these increases. The SOS Plan was the

---

<sup>126</sup> Information in this paragraph on supply routes drawn from Greenfield, *Command Decisions*. See page 229 for discussion on Soviet preference for northern routes as well as their hesitancies for US and British build up in Iran. See page 228-232 for discussion of northern routes, particularly during the First Protocol and Japanese threat to the Pacific Route. See pages 233, 238-240 for discussion on the planners shifting focus to the Persian corridor due to prescribed tonnages and enemy action limiting other routes.

<sup>127</sup> All information in this paragraph drawn from Motter, *The Persian Corridor*, 175-180.

recommendation for the directive regarding the Persian Corridor and was operationalized and authorized by the issuing of CCS 109/1 on 22 September 1942.<sup>128</sup>

The Combined Chiefs of Staff accepted the majority of the recommendations outlined in the SOS Plan. The significant changes in terms of logistic capability in CCS 109/1 were the addition of responsibility of another Persian port, Ahwaz, to the US Army for operation, and the decrease in sailing of shipments to ensure the backlog at the Persian ports would not continue. As the Persian Corridor was a combined effort between British and American forces, CCS 109/1 emphasized command relationships, as well as the responsibilities of each nation's leadership.<sup>129</sup>

CCS 109/1 stipulated, "the primary objective of the U.S. forces in this area will be to insure the uninterrupted and increased flow of all supplies into Soviet Russia." CCS 109/1 assigned the task of security in the region to the British, a decision the Allies made to ensure American resources were available for an eventual cross-channel invasion of Europe. The Americans assumed the tasks of improving and operating the five Persian ports as well as the rail networks connecting them to Tehran. In terms of meeting the goals of the Persian Corridor, CCS 109/1 outlined the expectations of the Commanding General, U.S. Persian Gulf Service Command:

the primary objective of the U.S. participation in the operation of lines of communications from the Persian Gulf area to Tehran is to increase and insure the uninterrupted flow of supplies to Russia, it is definitely understood that the British control of priorities and allocations must not be permitted to militate against the attainment of such objective, subject always to the military requirements for preparing to meet a threat to the vital Persian Gulf oil areas. Should the British Commander in Chief make any decision which in the opinion of the Commanding General, U.S. Persian Gulf Service Command, would unnecessarily prejudice the flow of supplies to Russia, the

---

<sup>128</sup> Information regarding the SOS Plan drawn from Motter, *The Persian Corridor*. See page 192 and 198 for discussion on date of issue of CCS 109/1. See page 192-195 for discussion on recommendations set out in the SOS Plan.

<sup>129</sup> Majority of information regarding CCS 109/1 drawn from Motter, *The Persian Corridor*, 198-200. Supplemental discussion on the transition from the SOS Plan to CCS 109/1 found in Leighton, *Global Logistics and Strategy 1940-1943*, 576-577.

latter will immediately report the circumstances through the Joint U.S. Chiefs of Staff to the Combined Chiefs of Staff in Washington.<sup>130</sup>

This excerpt was the commander's guidance and is the basis for continuous assessment of the Persian Corridor by the planning staff. The protocols laid out the directed amounts of supplies, and CCS 109/1 clearly stated the expectation that the delivery was to be uninterrupted. The staff ensured the Persian Corridor met these aims through continually assessing and analyzing its performance. This assessment would drive further detailed planning.

## Analysis

CCS 109/1 set in motion large-scale American participation along the Persian Corridor. The Allies initiated the Persian Corridor efforts based on the requirement to supply the Soviet Union. This route along with the northern and Pacific routes were essential in the Allied war effort and contributed to the overall end-state of the defeat of Germany.<sup>131</sup> Soviet demands for materiel and German advances drove the forecasting and direction of tonnages that the Allied forces needed to supply. The Allies assigned these tonnage requirements in the official Protocols that were essentially the desired end state criteria. The concept of a logistic link via the Persian Corridor with desired tonnages then moved to detailed planning. The planners had to ensure the environment's infrastructure and processes could meet these criteria.

The resulting supply through Iran is a direct result of assessment and reframing and the SOS Plan and subsequent CCS 109/1 are prime examples. The planners required detailed understanding of the operational environment in order to facilitate the ability to adapt to changing requirements and directives. The definition of the desired future environment was an evolutionary

---

<sup>130</sup> Majority of information for this paragraph drawn from Motter, *The Persian Corridor*. See page 199 for information and both quotes regarding stipulations and direction outlined in CCS 109/1. See Leighton, *Global Logistics and Strategy 1940-1943*, 577 for discussion on British keeping the security task of the Persian Corridor in an attempt to ensure availability of American resources for invasion of Europe.

<sup>131</sup> Leighton, *Global Logistics and Strategy 1940-1943*, 551.

process. Continuous assessment of the infrastructure in terms of being able to meet the changing stipulated goals allowed detailed planning to occur. As the environment changed, planners had to adjust their priorities, which in many cases resulted in changes on the ground to requirements, staffing, and responsibilities.

## Conclusion

Commanders and staffs seek original ideas and concepts in military planning to achieve surprise, gain an advantage, or keep the enemy off balance. The challenge is taking a completely innovative and imaginative concept and bringing it to action; realized with physical changes in the environment. How can today's planners effectively conduct the transition from the conceptual idea to detailed planning? Examination of two historical examples of immense scale, which were both born of necessity and imagination offer insight for contemporary planners.

The planning staff for the Mulberries took an original idea and turned it into plans for two artificial ports. American and British forces emplacing the Mulberries caught the enemy by surprise, negated German efforts to deny existing ports, and allowed the invasion of Europe. Analysis of the Mulberries indicates an extensive understanding of the environment, both current and desired was essential.

Understanding natural conditions facilitated the engineering design of the harbor components, which had to handle the equipment quantities, schedule, and timelines laid out in the desired future environment. Planners had to comprehend the natural obstacles the environment imposed as part of the problem frame in order to effectively plan the Mulberries. In an environment as unforgiving as the English Channel combined with the German fortifications of the coast, it is important to emphasize the criticality of understanding the operational environment. By accounting for the physical environmental factors combined with enemy action, the planners could then develop an approach.

The subject matter experts within the British and American Navies and Armies then translated this approach into blueprints, experimental components, final products, and construction sequence. Supervision of this process was through consistent leadership involved from inception to execution. The inclusion of subject matter experts and consistent leadership is a valuable lesson learned from the Mulberries and offers a vivid illustration of the benefit of these factors in the planning process. The convoluted chain of command and ever-changing leadership appointee list offered significant impediment to planning, but these personnel provided the corporate knowledge necessary to emplace and adjust a project of such scale in adverse circumstances in contact with the enemy.

The concept behind the Persian Corridor was simple but immense in scope and intricacy. In order to supply the Soviet Union with the war materiel required to maintain pressure on Germany from the East, the Allies established multiple logistic supply routes. The Persian Corridor became the focus due to enemy action changing the operational environment. In this way, the Persian Corridor as a whole was the result of assessment and reframing by the Allied powers. The overall concept did not change in terms of supplying the Soviets, but continuous assessment caused Persia to increase in priority.

Changes in the operational environment caused evaluation of the Soviet requirements based on successes of either Axis or Allied forces. As a result, Allied Protocols stipulated tonnages for the year based on Soviet need, and therefore served as a continual update to the desired future state. The planners used these protocols as the foundation of their assessment as to whether or not the Persian Corridor could meet the intended aims.

Assessment of the infrastructure, staffing, and construction priorities drove modifications in order to meet these goals. Subject matter experts on the ground executed these changes based on a detailed understanding of the environment in terms of what existed and what needed to exist to move the politically designated amounts of supplies. Through understanding of the

environment, and continuous assessment and reframing, planners for the Persian Corridor successfully transitioned from conceptual to detailed planning.

Current doctrine emphasizes the importance of this transition, but ATP 5-0.1, *Army Design Methodology* allocates only two paragraphs to address it. The focus is on the products developed during ADM facilitating the development of an order or plan using the MDMP. Para 5-44 highlights the need for shared understanding, transfer of knowledge, and suggests design team members be involved with the project through the detailed planning process; avoiding a simple document handover.<sup>132</sup>

The difficulty in moving from conceptual to detailed planning is a product of the two processes being associated with doctrinal methodologies. Conceptual planning is linked to ADM while detailed is linked to MDMP. The result is that today's planner sees them as being sequential rather than complimentary and simultaneous. If viewed in this manner it is easy to see how a planner could approach the transition as a set period in time, once the ADM is complete.

The planners of the American and British Armies and Navies of WWII did not utilize the terminology or processes that current doctrine associates with design. However, the extensive use of the American 'estimate of the situation' and British 'appreciation of the situation' offer parallels to today's understanding of the operational environment in ADM, as well as intelligence preparation of the battlefield during MDMP. The American doctrine of WWII outlined the duties of the staff in a less prescriptive way when one compares it to today's doctrine. Doctrines of combat guided the planners as overarching principles, which steered the way yet did not reduce the process into a rigid checklist.

WWII doctrine for both countries outlined the role of the staffs and highlighted the requirement to monitor operations and update plans and orders accordingly based on changes in

---

<sup>132</sup> Doctrinal discussion on transitioning from conceptual to detailed planning drawn from ATP 5-0.1, *Army Design Methodology*, 5-8. Paragraphs 5-44 and 5-45 form the doctrinal answer to this transition.



the environment. This is akin to assessment and reframing in today's doctrine, a method that current publications emphasize to ensure the detailed planning and execution meet the aims of the concept. Although the publications of the American and British Armies leading into WWII did not utilize the vernacular of current doctrine, the logical sequence of solving a problem is remarkably similar.

The planners for the Mulberries and the Persian Corridor built understanding of the operational environment they were facing. Overlaid on this knowledge were the requirements and commander's intents, which built the desired future environment. From this understanding, the planners developed solutions to extremely difficult and unfamiliar problem sets. In amazing examples of the planning process, the staffs for both case studies then translated their solutions into detailed orders and complicated engineering construction requirements. In all aspects, the Mulberries and the Persian Corridor demonstrate the execution of what today's doctrine would label design, followed by a transition to detailed planning.

Analysis of the Mulberries and Persian Corridor demonstrate the transition from concept to reality is a more fluid and continuous process than a simple completion of one methodology and movement to a second. So how then can the modern planner ensure this transition happens effectively? Current day planners can mitigate the difficulties of moving from concept to reality by ensuring a detailed understanding of the current environment and precise definition of the desired future environment. A thorough understanding of the environment facilitates the development of a solution that is more robust and can adapt to unknown variables in the environment. The planners for the Mulberries understood the unpredictability of the English Channel, which allowed the detailed planners to fabricate components that could reconfigure and adjust in a rapidly changing environment. The ability to transition from conceptual to detailed planning centers on a thorough knowledge of the environment in its current and desired states.

This knowledge is essential throughout the process and both design and detailed planning teams must incorporate it. The case studies show that the best method in transferring this knowledge is having members of the team involved from inception to execution. This includes leadership, planners, and subject matter experts. These personnel provide the consistency of knowledge and understanding that is required by projects or operations to move from imagination to reality while still meeting the aims envisioned in the concept. Planners throughout the process must strive to improve the understanding of the environment by conducting deliberate assessment and reframing. The continuous nature of planning aided by assessment and reframing highlight that it is not so much a 'transition from' conceptual to detailed planning, as much as it is a concept 'evolving into' a detailed plan.

## Bibliography

### Primary Sources

#### Doctrine Publications

Army Doctrine Publication (ADP) 1. *The Army*. Washington, DC: United States Government Printing Office, 2012.

Army Doctrine Publication (ADP) 3-0. *Unified Land Operations*. Washington, DC: United States Government Printing Office, 2011.

Army Doctrine Publication (ADP) 5-0. *The Operations Process*. Washington, DC: United States Government Printing Office, 2012.

Army Doctrine Reference Publication (ADRP) 3-0. *Operations*. Washington, DC: United States Government Printing Office, 2016.

Army Doctrine Reference Publication (ADRP) 5-0. *The Operations Process*. Washington, DC: United States Government Printing Office, 2012.

Army Techniques Publication (ATP) 5-0. 1. *Army Design Methodology*. Washington, DC: United States Government Printing Office, 2015.

Field Manual (FM) 100-15. *Field Service Regulations, Larger Units, 1942*. Obsolete Military Manuals. Fort Leavenworth, KS: Combined Arms Research Library, 2013. Combined Arms Research Library Digital Catalog. Accessed November 20, 2016.  
<http://cgsc.contentdm.oclc.org/cdm/singleitem/collection/p4013coll9/id/912/rec/1>.

Field Manual (FM) 100-5. *Field Service Regulations, Operations, 1941*. Obsolete Military Manuals. Fort Leavenworth, KS: Combined Arms Research Library, 2006. Combined Arms Research Library Digital Catalog. Accessed November 20, 2016.  
<http://cgsc.contentdm.oclc.org/cdm/compoundobject/collection/p4013coll9/id/24/rec/1>.

Field Manual (FM) 101-5. *Staff Officers' Field Manual: The Staff and Combat Orders*. Washington, DC: The War Department, 1940.

Field Manual (FM) 6-0, Change No. 2. *Commander and Staff Organization and Operations*. Washington, DC: Headquarters, Department of the Army, United States Government Printing Office, 2016.

Joint Publication 5-0. *Joint Operation Planning*. Washington, DC: United States Government Printing Office, 2011.

Joint Publication (JP) 3-0. *Joint Operations*. Washington, DC: United States Government Printing Office, 2011.

*A Manual for Commanders of Large Units, Volume 1, Operations 1930*. Obsolete Military Manuals. Fort Leavenworth, KS: Combined Arms Research Library, 2011. Combined

Arms Research Library Digital Catalog. Accessed January 26, 2017.  
<http://cgsc.contentdm.oclc.org/cdm/singleitem/collection/p4013coll9/id/871/rec/2>.

Ryan, Alex, Peter Schifferle, Michael Stewart, and Alice Butler-Smith. *Art of Design - Student Text, Version 2.0*. Fort Leavenworth, KS: School of Advanced Military Studies, US Army Command and General Staff College, 2010.

TRADOC Pamphlet 525-5-500. *Commander's Appreciation and Campaign Design, Version 1.0*. Fort Monroe, VA: Headquarters, United States Army, Training and Doctrine Command, 2008.

The War Office Command of the Army Council. *Field Service Pocket Book Part I-Pamphlet No. 4 APPRECIATIONS, ORDERS, MESSAGES, AND INTERCOMMUNICATION 1944*. London: His Majesty's Stationary Office, 1944.

## Memoirs

Eisenhower, Dwight D. *Crusade in Europe*. Baltimore: Johns Hopkins University Press, 1997.

Ellsberg, Edward. *The Far Shore*. United States: Createspace Independent Publishing Platform, 2016.

Stanford, Alfred. *Force Mulberry: The Planning and Installation of the Artificial Harbor Off U.S. Normandy Beaches in World War II*. New York: William Morrow and Company, 1951.

## Official Documents

Chief of Staff to the Supreme Commander Allied Forces (COSSAC). *Digest of Operation "Overlord."* World War II Operational Documents. Fort Leavenworth, KS, 2007. Combined Arms Research Library Digital Library. Accessed October 17, 2016.  
<http://cgsc.contentdm.oclc.org/cdm/ref/collection/p4013coll8/id/1246>.

Office, US Secretary of the Combined Chiefs of Staff, ed. "Papers and Minutes of Meeting Argonaut Conference." *Argonaut Conference January-February 1945*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

———, ed. "Papers and Minutes of Meeting." *Casablanca Conference January 1943*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

———, ed. "Papers and Minutes of Meeting." *Quadrant Conference August 1943*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

———, ed. "Papers and Minutes of Meetings Octagon Conference and Minutes of Combined Chiefs of Staff Meetings in London, June 1944." *Octagon Conference September 1944*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

———, ed. "Papers and Minutes of Meetings Sextant and Eureka Conferences." *Sextant Conference November-December 1943*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

———, ed. “Proceedings of the American-British Joint Chiefs of Staff Conferences.” *Joint Chiefs of Staff Conferences Held in Washington, D.C. on Twelve Occasions between December 24, 1941 and January 14, 1942*, World War II Inter-Allied Conferences. Washington, DC: Joint History Office, 2003.

## Secondary Sources

### Books

Axelrod, Robert M. and Michael D. Cohen. *Harnessing Complexity: Organizational Implications of a Scientific Frontier*. New York: Basic Books, 2001.

Benamou, Jean-Pierre. *10 Million Tons for Victory: The Arsenal of Democracy During the Battle of France in 1944*. France: OREP, 2003.

Bykofsky, Joseph and Harold H. Larson. *The Technical Services: Transportation Corps, Operations Overseas*. Washington, DC: United States Government Printing Office, 1973.

Dolman, Everett C. *Pure Strategy: Power and Principle in the Space and Information Age*. London: Frank Cass, 2005.

Evans, Jane and Elizabeth Palmer, eds. *A Harbour Goes to War: The Story of Mulberry and the Men Who Made It Happen*. United Kingdom: South Machars Historical Society, 2000.

Ford, Ken. *Operation Neptune, 1944: D-Day's Seaborne Armada*. United Kingdom: Osprey Publishing, 2014.

Glantz, David M. and Johnathan M. House. *When Titans Clashed: How the Red Army Stopped Hitler*. Lawrence, KS: University Press of Kansas, 1995.

Greenfield, Kent Roberts, ed. *Command Decisions*. Washington, DC: United States Government Printing Office, 2006.

Harrison, Gordon A. *European Theater of Operations: Cross-Channel Attack*. Washington, DC: United States Government Printing Office, 1985.

Hartcup, Guy. *Code Name Mulberry*. New York, NY: Hippocrene Books, 1977.

Hogan, Jr., David W. *A Command Post at War: First Army Headquarters in Europe, 1943-1945*. Honolulu, HI: University Press of the Pacific, 2006.

Hughes, Mark. *Conwy Mulberry Harbour*. Wales, United Kingdom: Gwasg Carreg Gwalch, 2001.

Jordan, William. *The Normandy Mulberry Harbours - English*. Edited by Gill Knappett. London, UK: Pitkin Unichrome, 2001.

Kennedy, Paul. *Engineers of Victory: The Problem Solvers Who Turned the Tide in the Second World War*. New York, NY: Random House Trade, 2013.

- Kretchik, Walter E. *U.S. Army Doctrine: From the American Revolution to the War on Terror*. Edited by Theodore A. Wilson. Lawrence, KS: University Press of Kansas, 2011.
- Lawson, Bryan. *How Designers Think: The Design Process Demystified*. 4th ed. Oxford: Elsevier/Architectural, 2005.
- Leighton, Richard M. and Robert W. Coakley. *U.S. Army in World War II The War Department: Global Logistics and Strategy 1940-1943*. Washington, DC: United States Government Printing Office, 1955.
- Motter, T. H. Vail. *U.S. Army in World War II The Middle East Theater: The Persian Corridor and Aid to Russia*. Washington, DC: United States Government Printing Office, 2000.
- Ruppenthal, Roland. *U.S. Army in World War II European Theatre of Operations: Logistical Support of the Armies Volume I*. Washington, DC: United States Government Printing Office, 2000.
- . *U.S. Army in World War II European Theatre of Operations: Logistical Support of the Armies Volume II*. Washington, DC: United States Government Printing Office, 1959.
- Schifferle, Peter J. *America's School for War: Fort Leavenworth, Officer Education, and Victory in World War II*. Lawrence, KS: University Press of Kansas, 2010.
- Schön, Donald A. *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions (higher Education Series)*. San Francisco: Jossey-Bass Inc., 1990.

## Monographs

- Larkins, John G. "Entering a Continent: An Historical Analysis of Port and Beach Operations in the European Theatre of Operations, WWII." Carlisle Barracks, PA: US Army War College, 1983.
- Peters, Brett. "Mulberry-American: The Artificial Harbor at Omaha." Fort Leavenworth, KS: MMAS, US Army Command and General Staff College, 2011.
- Wehner, Randolph B. "Sustainment Improvisation - Expanding the Realm of the Possible." Fort Leavenworth, KS: SAMS Monograph, US Army Command and General Staff College, 1987.

## Journal Articles

- Cojocar, William J. "Adaptive Leadership in the Military Decision Making Process." *Military Review* Nov-Dec 2011 (2011): 23–28.
- Marr, John J. "Designing the Victory in Europe." *Military Review* 91 (4) (July 2011): 62–68. Accessed October 12, 2016. <http://search.proquest.com/docview/874970601?pq-origsite=summon>.

Pritchard, James. "The Beaver and the Bear: Canadian Mutual Aid, Ship Repairing and the Soviet Far Eastern Merchant Fleet 1941-1945." *The Northern Mariner / le marin du nord* XX, no. 2 (April 2010): 129–47.

Ryan, Alex. "A Personal Reflection on Introducing Design to the U.S. Army." *The Overlap*. November 4, 2016. Accessed November 28, 2016. <https://medium.com/the-overlap/a-personal-reflection-on-introducing-design-to-the-u-s-army-3f8bd76adcb2#.wihw966te>.

Vorsin, V. F. "Motor Vehicle Transport Deliveries Through 'Lend-Lease.'" *The Journal of Slavic Military Studies* 10, no. 2 (June 1997): 153–75. Accessed July 21, 2016. doi:10.1080/13518049708430296. <http://dx.doi.org/10.1080/13518049708430296>.

Wass de Czege, Huba. "Systemic Operational Design: Learning and Adapting in Complex Missions." *Military Review* 89, no. 1 (January 2009): 2–12. ProQuest. Accessed November 23, 2016. <http://search.proquest.com/docview/225311325/fulltextPDF/E4C919BAEE264B4APQ/1?accountid=28992>.

## Websites

"MULBERRY HARBOURS." Accessed August 11, 2016. <http://www.combinedops.com/Mulberry%20Harbours.htm>.

"School of Architecture - Professor Bryan Lawson." August 13, 2014. Accessed November 23, 2016. <https://www.sheffield.ac.uk/architecture/people/visiting-emeritus/bryanlawson>.